APMG Lean IT Foundation

Increasing the Value of IT

Version 1.0 Owner – APMG

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Scope and Purpose

The purpose of this document is support the Lean IT Foundation qualification. The exam questions can all be answered based on information in this document.

Target audience

The target audience of this document is:

- Candidates for the Lean IT Foundation Exam
- Accredited Training Organizations

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Acknowledgements

The authors would like to thank the people who have put their time and effort into creating this and earlier versions of this document.

Special thanks go out to the following people whose critical reviews have improved both content and readability of the content:

- Troy DuMoulin, Pink Elephant
- Frederik Schukken, Quint Wellington Redwood
- Eline Zweers, Quint Wellington Redwood
- Rita Pilon, EXIN
- Arjan Woertman, ITpreneurs
- Tammy Butler, Pink Elephant

Foreword

When writing Lean IT – Enabling and Sustaining Your Lean Transformation back in 2010, I dreamed that perhaps someday, there would be a professional certification recognizing proficiency in the practical application of Lean IT.

Lean IT represents what I believe is the most impactful application of Lean thinking, methods, and tools for any organization because of our interdependence on information, communication, and technology. Lean IT is the fulcrum with which we can accelerate Lean transformation across the enterprise, because the quality and timeliness of products and services we produce is a direct reflection of the quality and capability of our people, information, and technology. Transformations build upon the value that we provide customers and reflect the abilities of our people to skillfully exploit capable processes and quality information enabled by great technology.

The Lean IT Foundation Certification is a significant step toward identifying standard work of the core terminology, methods, capabilities, processes, and tools of Lean as they specifically apply to Information and Technology. In the pages that follow, a wide-ranging discussion of the core ideas of Lean IT is succinctly presented.

My hope is that your pursuit of Lean IT training and certification is not your final destination, but inspires the continuation of a lifetime of learning, experimentation, and discovery.

Best Wishes Towards Your Pursuit of Lean IT and Enterprise Excellence,

Mike Orzen
Oregon City, Oregon, USA

Oct 2, 2015

1. Introduction

In compiling the Lean IT Foundation publication, our goal was to provide a broad and practical basis for people wishing to gain knowledge about Lean, and how it can be applied to IT. This publication provides the content on which the Lean IT Foundation exam is based. It also serves as a reference guide to ensure the knowledge required for this certification is accessible to all who wish to acquire it. At the end of this document, we also provide references to other publications for further reading, and understanding of Lean IT.

The call for applying Lean principles to IT organizations had been growing since the early 1990's and, after decades of application and development of the Lean philosophy within production industries, the principles were transferred to service organizations. The key driver behind this development was the continued inability of IT to deliver the required value to its customers. Despite the industry's IT-initiated attempts at improvement through maturity or process models, IT has continued to underperform in the eyes of its customers.

The problem is that year-over-year, these same customers have become more dependent on their IT departments and the services they provide. As a result, in organizations where Lean principles have been applied to the primary business, it was thought Lean must also be able work within IT department.. As you will see, the thought is correct but the application of Lean to IT has specific challenges. Altogether, Lean principles are readily adaptable within IT, however the first issue we found was there is no clear definition of what Lean IT is.

The Lean IT is defined as:

"Lean IT is the extension of lean manufacturing and lean services principles to the development and management of information technology products and services. Its goal is to continuously improve the value delivered by IT organizations to their customers and the professionalism of people working in IT"

Lean IT focuses on improving people working within IT, IT processes and information technology in order to deliver more value to its customers.

2. Lean

Lean traces its roots back to people's desire to create products. It consists of continuously evolving concepts and deeper thinking on business performance. Since Lean principles are applied in many contexts, tools and methods have multiple sources. However, many of the iconic elements of Lean come from the Toyota Production System.

2.1 History

Lean history starts at a time when most production was a matter of craftsmanship. Towards the end of the 19th century, Frederick Taylor investigated workplace efficiencies. His ideas included dividing work and specifying tasks to be performed for workers, training workers so they could perform these tasks, and installing supervisors to ensure that tasks were performed as specified. A supporter of Taylor, Henry Ford introduced interchangeable parts with standard work and moving conveyance to create what he called flow production. This type of production thrived on the division of labor and specification of tasks.

As the people 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 innovations might make it more possible to provide both continuity in process flow and a wide variety in product offerings. It was vital for Toyota to catch up with the rest of the world, particularly America. Due to scarcity in a general sense, Toyota focused on minimizing the amount of raw materials required to produce cars and on minimizing the time between purchasing raw materials

and sending an invoice to the customer. Their ideas became known as the **Toyota Production System (TPS).** This system shifted the focus of the manufacturing engineer from individual machines and their utilization, to the flow of the product through the total process, which was strongly tied to customer demand. Toyota soon discovered that factory workers had far more to contribute than just muscle power.

The Toyota Production System was based on two basic principles: Just-in-time production and Jidoka. As Toyota improved, TPS became part of the encompassing **"The Toyota Way"**, that was published in 2001. Today, the Jidoka and Just-in-Time principles remain, however the Toyota Way philosophy within which they now reside has included two higher principles: Respect for People and Continual Improvement.

J. Edwards Deming is regarded as having a huge impact upon Japanese manufacturing and business. He showed that organizations could increase quality and reduce costs by reducing waste, rework, staff attrition and litigation while increasing customer loyalty. The key was to practice continual improvement and think of manufacturing as a system, not as a series of parts to be optimized.

Although Deming is credited with the **Plan- Do-Check-Act (PDCA),** he always referred to it as the Shewhart cycle. The PDCA has a built-in improvement cycle; an iterative four- step management method used in business for the control and continuous improvement of processes and products.

The Deming (or Shewhart) cycle is an integral part of the Lean philosophy and embodies the goal for continual improvement:

- **Plan**: Design or revise business process components to improve results
- **Do**: Implement the plan and measure its performance
- **Check**: Assess the measurements and report the results to decision makers
- **Act**: Decide on changes needed to improve the process

The Deming cycle creates a feedback loop for management to ensure that improvements are identified and implemented.

2.2 Six Sigma and the relationship with Lean

Originating at Motorola in the 1980's, Six Sigma today is widely adopted in many industries and sectors.. Six Sigma is a disciplined, data-driven approach for eliminating variability, defects and waste that undermines customer value and loyalty. Six Sigma improvement projects help to increase performance and decrease process variation, leading to defect reduction and vast improvements in profits, employee morale and the quality of a product.

One of the methodologies, inspired by the PDCA cycle is **DMAIC (Define, Measure, Analyze, Improve and Control).** Six Sigma is often mentioned in combination with the Lean methodology. The two concepts have a large overlap; however there are differences in the approach on various aspects. Six Sigma is the disciplined, data-driven approach for eliminating variation. Lean IT primarily focuses on establishing flow of value, particularly in conjunction with the behavior and attitude of the people involved. However, Lean IT also makes use of some elements of

Six Sigma, for example the problem-solving cycle DMAIC.

Lean has continued to develop into a concept in its own right even though it is still largely associated with manufacturing. Although originally developed in the manufacturing industry, the concept has proven itself relevant and applicable in other businesses, industries and functional roles such as Finance, Human Resources or Insurance, Banking, Healthcare and IT Technology.

2.3 Scarcity

Lean thrives in environments with scarcity of resources such as time, money, talent or materials. Toyota's pioneering ideas come from a time where they could not afford to produce inventory simply because there wasn't enough material, which, among other things, led to the continuous focus of reducing set up times for their machinery. A scarcity of resources is a reason for the development of Lean and a reason to apply Lean principles and use Lean tools.

The key perceived scarce resource within IT is time. Since IT is 'knowledge work', the productivity of knowledge workers becomes critical to understand. And time is an important factor in calculating productivity. In IT, it seems we "are too busy with solving incidents to document properly", "have no time to complete changes and projects properly", "have no time to improve" or we "have to test less to meet the delivery date". Scarcity of time is an important factor that drives opportunities for improvement. Lean helps to make the best of scarce resources, also within IT.

2.4 Aspects of Lean

Lean is, in essence, a way of thinking and behaving. It revolves around the following key concepts:

- Improving customer value
- Continual improvement in small steps
- Decreasing peaks and troughs in production
- Reducing waste
- Involving everybody
- Developing people
- Focusing on long-term goals

Once companies start transforming themselves with Lean principles, concepts and techniques, they need to involve people across the company and address desired behavior.

An effective Lean Transformation consists of aligning attitudes towards the work we do and desired behavior, supported by Lean tools.

2.5 Being Lean

There are a variety of reasons for organizations to be Lean. They revolve around three major categories: **Customer Satisfaction, Strategic Value** and **Financial Value**.

First, Lean helps to focus on **Customer Value**. By doing so, organizations add more value to their products and services while reducing sources of waste and increasing their agility and ability to adapt. An improved dialogue and connection with customers and end-users enables an IT organization to drastically increase the loyalty of satisfied customers.

Secondly, the Lean organization continuously improves process performance which offers them great **Strategic Value**. Their services are of better quality, their delivery times are shorter and their efficiency of development and deployment keeps increasing. The most important asset for a 'knowledge worker' organization is its people. Lean promises higher involvement and motivation of employees.

Thirdly, there is **Financial Value** to be expected from reducing process waste, optimizing value-adding work that frees up time to add even more value. Also, the reduction of the duration between order intake and delivery will improve cash flow. It must be stressed, however, that increasing profit margins is not the primary goal of Lean, although it can be expected to be a secondary effect of improving and thereby reducing effort spent on non-value adding activities.

In addition to these reasons for being Lean, current business performance may also offer a compelling reason for an organization to embrace Lean thinking.

Poor Quality can also be a driver for the adoption of Lean. Poor quality has its effects both within and outside the organization. Aspects such as reputation damage and loss of customer trust may cause the organization to incur large costs or penalties. Also, waste of talent or an unexpected number of defects causes stress within the organization. Again costs will increase due to inspections, rework or demotivation.

2.6 Paradigm Shift

A outcome of applying Lean principles is a paradigm shift in the way we think. It challenges our assumptions of how work is supposed to be done and how responsibilities are supposed to be executed.

A traditional paradigm is that knowledge is power. An organization may find itself depending on a few critical resources that

have the knowledge of how processes operate. Lean organizations understand that it is more powerful to work on the continuous involvement of all employees and to maximize the transparency of information by use of, for example, visual management techniques.

In a traditional context, management decides what needs to be done and how to operate, while workers just need to follow orders. This division of labor and specification of tasks originates from the interpretation of the studies of Taylor. In Lean organizations, managers facilitate the workers at the shop floor level. They lead as a coach and teacher, and allow their teams take on the responsibility to figure out how processes are best optimized to deliver results for the customer.

In order to effectively facilitate a team, managers need to have a presence on the shop floor, the place where the work is done. This kind of managerial behavior is in sharp contrast with the more traditional style of management, where managers are found in their offices or in meetings mainly with other managers. This causes them to lose touch with what is actually happening on the shop floor.

Traditional organizations aim to maximize the utilization of resources. In the case of IT, this means ensuring that 'expensive' people like programmers must be given as much work as possible so that no time is "wasted". This kind of thinking derives from the scarcity and cost of resources, so we should make the best use of them. However, it often leads to inefficiencies because people produce more than is actually needed, and filling up people with work reduces their flexibility. Lean organizations focus first on maximizing the efficiency of flow, i.e. ensuring that work is moved through the process so as

to deliver value to the customer as quickly as possible.

Another aspect of the paradigm shift is how people regard defects or mistakes and how to deal with problems. In traditional organizations, the focus is on avoiding problems, even though they occur. Problems are seen as 'not good'. At the same time, there is acceptance of a certain, undefined, rate of defects. Lean organizations welcome problems and learn from mistakes. They make it a collaborative exercise and share what they have learned across the organization. It is up to management to ensure that the mistakes are embraced and used to continually improve the capabilities of the people and the organization as a whole. This openness to seeing, accepting and solving problems is strongly related to an on-going pursuit of perfection.

2.7 Lean IT and IT Frameworks

Since the advent of the IT organization, there have been many efforts to standardize and ensure that high-quality services are delivered. Frameworks and standards, particularly in the area of IT Service Management, aim to ensure quality. Most frameworks have some element of continuous improvement however their focus is on how or what to do rather than methods and approaches to improve and to ensure long-term relevance and evolution. In summary, these frameworks present the principles and the need for continual improvement but fall short in delivering the practical methods and tools to achieve it.

To understand the difference and complementary nature of Lean principles in relationship to process frameworks, one needs to understand the difference between a quality system and a process framework.

A **Quality System** drives improvement based on the understanding that to improve anything the following logic tree must be understood and executed:

- What is not "Defined" cannot be stabilized or controlled (Lean Standard Work)
- What is not "Controlled" cannot be measured effectively
- What is not "Measured" cannot be improved.

From this perspective, different quality systems all begin and end with the same goal of establishing a rhythm and cycle of continual improvement. There are many different Quality Systems available such as the PDCA cycle, Total Quality Management, or Lean and Six Sigma. Each of these quality system has similar characteristics. However, they are dependent on Process Frameworks to provide a reference model for what and how an IT Management process is best defined or measured.

It is important to note the various quality systems and process frameworks are co-dependent and complementary. Without the application of a Quality System, a process framework is at risk of not being applied with the controls necessary to sustain and keep it relevant. Likewise without the use of an IT management framework, the Quality System is less effective due to the lack of external best practice reference models which support the goal of establishing best and common practices.

IT best practice frameworks deliver content on how topics like architecture, service management or security should be approached. They present an ideal end-state picture of the way the world of IT should look and operate. Unfortunately, most IT organizations struggle to achieve this end-state, leaving them with a feeling that they are not making progress.

Lean IT is an improvement approach uniquely focused on pursuing the delivering of value to customers with the least amount of effort. Or, in other words, Lean IT while similar in nature to other quality systems balances both the concept of effectiveness with efficiency with a goal to establish a **"Fit For Purpose" approach** to continuous improvement. This gives the people involved the feeling they are making steps towards delivering more value in the most efficient way possible. In this quest for improvement, the best practice frameworks and standards can serve to feed the long-term vision.

The second benefit of combining Lean IT with an IT best practice framework is that Lean IT brings a strong focus on behavior and attitude within IT environments. Lean IT is applied on the entire IT domain, from requirements to maintenance. Applying Lean IT involves the entire management and all the employees. Attitude and behavior elements of change are often not explicitly covered in these frameworks, and if they are the tools to improve are not provided. This, consequently, makes the combination of Lean IT and IT best practices very powerful.

Lean tools are used to optimize processes and reduce waste. The IT best practices guide us on how the process should be structured.

Frameworks, models, standards and quality systems offer guidelines for demonstrating compliance, good practices, a common language and measurements for improvement. But, as Taiichi Ohno, considered to be the father of the Toyota Production System, said…"If you think of the standard as the best you can do, it's all over. The standard is only a baseline for doing further Kaizen."

IT Service Management is constructed around the need for standardized IT processes. However, from a Lean perspective not all of the processes are actually value streams, a Lean principle we will discuss in the next chapter. By using Lean IT, we can focus on the right processes to deliver the maximum value to customers.

Even though Lean IT practices evolved independently, IT Service Management is highly supportive of them as there are many shared objectives. IT Service Management best practices may serve as a 'future state' for process improvement while Lean IT keeps the IT processes fresh and continually relevant.

The Lean IT objective is to continuously improve the delivery of value to the customer. For this, we apply Lean principles and techniques to the work of IT. This means continually taking small steps in the right direction rather than attempting to implement an entire ideal situation.

2.8 Lean IT, Agile and DevOps

The last ten years has seen an explosion of interest in methods such as Agile and DevOps. These methods are strongly related to the Lean principles. Agile has its roots in the application of Lean principles to the area of Software Development. We see that a focus on customer value ('working software') is at the heart of Agile. As with Lean, Agile aims to ensure that the processes ('value streams') work in such a way that software is delivered quickly ('flow') and that teams deliver the software that is required at that moment ('pull'). There is also a clear continuous improvement mindset within Agile, based on the delivery and improvement of a 'minimum viable product' that delivers the value that customers are seeking.

As with Agile, DevOps is also about the application of Lean principles to the delivery of IT products and services. In fact, one could go so far as to say that DevOps is actually all about achieving the flow of value to customers of IT. Every possible method for achieving flow is used within DevOps. We reorganize, combining previously separate departments, to improve flow. We optimize and automate the processes, to improve flow. We focus behavior and mindset on achieving flow. In fact, every choice made in a DevOps environment is about delivering value as quickly as possible to a customer.

Clearly, the developments of the past decade have been focused, intentionally or not, on integrating Lean principles into the fabric of the IT industry.

2.9 Lean Community

Hundreds of books and thousands of articles have been published on Lean IT related topics over the last decade. An abundance of associations, consultancy firms, and educational organizations are also well established in the world of Lean. Many of them provide websites filled with insights, tools, discussion platforms, training propositions and certifications. There is an increasing number of communities coming together on a regular basis to discuss Lean topics and new insights in the application of principles and tools, most often referred to as Lean Summits.

In the world of Lean, the Shingo Institute with its Shingo Model is one of the foremost Lean standards. The world of Lean is also constantly evolving, but here to stay and still growing in popularity. Since all work is a process, and all value is delivered as a result of a process, the application of Lean is relevant to all industries and businesses.

Lean IT was brought to prominence by the 2011 Lean IT book written by Steven Bell and Michael Orzen. This came after a number of years of growing interest in using Lean within IT, and many practitioners applying Lean principles within IT organizations.

3. Key Principles of Lean

As covered earlier, the Lean framework originates from the manufacturing industry; the Toyota Production System (TPS) , a system of delivering high quality products that meet customers' requirements. The three basic elements of TPS are **Just-In-Time** production, focus on **Quality** and **Continual Improvement**. The essence of Lean is delivering value to customers and continuously improving the ability to do this, by removing waste from the entire system that produces the value. In the landmark publication on the philosophy of Lean, *Lean Thinking* (Womack and Jones, 1996), the author provides details on the key principles of Lean:

Value is defined by the customer ("Voice of the Customer") and represents the requirements that a customer has regarding a specific product or service delivered. We can consider the value of a product or service as its ability to help the user of the product or service to deliver value to his or her customers. We, therefore, need to continuously focus on the value for the customer and the value they perceive from a product or service. If that value is insufficient, customers will seek out another organization to provide it.

Value is delivered through a **Value Stream**. This is an end-to-end process triggered by the customer that ensures the delivery of the required value is received as quickly as possible. A value stream is comprised of

all tasks and activities used to bring a product or service from concept to customer, and includes all information, work and material flows.

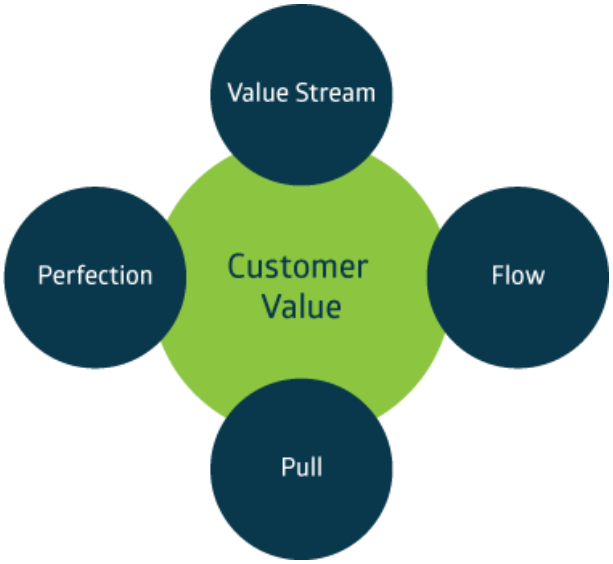


Figure 1. Lean Principles as defined by Womack and Jones

In order for a value stream to deliver value, it must have **Flow**. This means that the activities must follow each other with minimal interruptions and minimal intermediate stockpiles. This means designing the flow so each unit that enters the flow is carried out to its conclusion without interruption. Flow means working with a so-called 'single-piece flow', (i.e. each unit of work goes through the process on its own). This is the opposite of working in batches where multiple units of work are processed through a particular step together.

Flow is interrupted mostly by the following types of waste: Handoffs, inspections, and waiting times. Work In Progress (WIP) is an obstacle to achieving flow, generated by differences in work tempo. A surplus of inventory can result from a work tempo that is faster than customer demand. Flow is about getting the right materials and the right information to the right people, with the right skills, in the right place, at the right time, every time, in short: Just In Time. One word of caution: Even if a process has flow, it is vital to manage

the demand to ensure that the work can be carried out, as a change in customer demand can alter the current flow in the process.

It is also vital to understand that the customer can trigger the value stream when the value is required. This is the essence of **Pull**. A Pull Production System is one that explicitly limits the amount of work in process that can be introduced into the system. Nothing is to be produced until the next process really requires it. For service industries like IT, this is less problematic than for production industries, since a service is consumed as it is produced and is generally started when requested by the customer.

Last but not least, Lean aims for **Perfection**. This does not mean that multiple quality controls need to be in place, causing delays. It means that each resource in the value stream must know his/her task and the associated quality requirements. The essence of perfection is doing things right the first time. This aspect also ensures that there is a focus on continuously improving the ability to deliver value. Transparency supports the goal for perfection because transparency ensures useful feedback is obtained to understand where delivery does not meet expectations. We need to create an environment where learning from mistakes can become a powerful element of continuous improvement and initiatives are not discarded immediately. There is no end to the process of reducing effort, time, space, cost and mistakes to offer a product that is aligned with what the customer wants and values.

3.1 Waste

As Lean can be applied to other areas in an organization, Lean IT is not only concerned with delivering as much value as possible for customers, it is also focused on ensuring

that the waste that often masks much of the customer value is removed. Therefore,, the value to customers is increased in two ways: By reducing the proportion of wasteful activities to value-adding activities and increasing the amount of value-related activities.

Waste within IT includes the traditional categories: Transportation, Inventory, Motion, Waiting Time, Over-processing, Over-production and Defects & Rework **(TIMWOOD).** There is an important additional type of waste in IT: Talent. This is when the skills and abilities of the resources in the IT organization are lacking or not used to their full extent.

- **Transportation**: Movement of work product, information, materials
- **Inventory**: Work in progress, having more than strategic levels of products
- **Motion:** Unnecessary physical movement
- **Waiting:** Stopping or slowing down for work to arrive
- **Overproduction:** Producing more or sooner than is needed
- **Over Processing:** Excessive or unnecessary work
- **Defects:** Reworking to correct mistakes, inspection and scrap
- **Talent:** Unused human creativity and potential

In addition to traditional definitions of waste (**or Muda**), there are two other categories of waste: **Variability (Mura**) and **Overburden (Muri).**

Mura (variability) occurs when incoming work is not matched by the right number of people with the appropriate skills, thus leading to a wide range of possible outcomes in quality. Variability is about fluctuation, in cost, quality or throughput times. Variability is directly related to the fact that customer demand can

vary significantly and unpredictably, e.g. an IT organization can rarely predict when and how many units of work (e.g. incidents, changes, service requests) will be received.

Muri (overburden) is caused by fixed service timeframes, release windows and other such time constraints. The ability to scale a team up or down to match workload also plays a role in being flexible. Large inventories and a batch processing system cause overburden and inflexibility, reducing the ability of processes to have flow. Muri is largely policy-based waste. It is caused by constraints that the organization chooses to use, (eg. team composition or size, organizational structure and the aforementioned release windows).

To remove waste from an IT organization, it is vital for management to initiate a review of Muri before tackling Mura, followed by Muda. Attempting to remove, for example, an excess of changes (inventory waste) may be frustrated by policy-based choices. The decision to have a Change Advisory Board meeting once a week will tend to cause inventory waste and waiting times. The fact that the IT Service Management system is used as a place where customer wishes are recorded without any indication as to whether the wish will ever be actually be pulled into the process by the customer may also be considered waste.

3.2 Improving using the Principles

There are five key principles that can be used as a guideline for driving improvements within an organization. The sequence always starts with **Customer Value**. This is the anchor for all improvements; Customer Value is the starting point for Lean thinking. Every improvement must in some way be related to the creation of more value for customers.

The next step is to **understand the Value Stream that creates the value**. Based on this knowledge, improvements can be made to the Value Stream through the identification and removal of waste in the Value Stream. With a clearly defined Value Stream, the aim is to **create Flow in the process.**

Flow will be achieved as a result of removing the waiting time and inventory waste between the steps in the Value Stream.

Integrating Pull into the Value Stream is generally the next step, particularly in a manufacturing setting. This is, however, different within IT. Being a service industry, much of IT's 'production' is pull-based; IT does not generally solve incidents before they happen, and mostly changes are carried out based on a customer's request. The fact that IT is largely pull-based means that customers are instantly confronted with any inefficiency in the IT process.

The last of the principles is **Perfection**. This principle holds a special position in that it is not the final step, rather something that must be applied to every action taken.

3.3 Types of activities

Customers put a demand for value on your organization. In this way, they define three types of activities:

- Activities that add value from a customer perspective **(Value-Add Activities, VA),**
- Activities that do not add value from a customer perspective **(Non-Value Add Activities, NVA)**
- Activities that do not add value but need to be done nevertheless, often according to an organization's policy **(Necessary Non-Value-Add Activities, NNVA).**

Necessary Non-Value Add activities are necessary steps or changes made to the product for future or subsequent steps, for compliance to policies, but which is not noticed by the final customer.

Our goal is to optimize value adding activities, minimize necessary non-value-add activities and remove non-value adding activities. The expenditure of resources for any goal other than the creation of value is considered to be wasteful. Value adding activity is any action or process that a customer would be willing to pay for, and is performed right the first time.

Examples of Value-Add activities are:

- Application Development: delivers new functionality for the customer
- Operational Activities: ensure the service keeps working
- Delivery of a laptop: means a new employee can start working
- Advice: Providing understanding and insight into the use of IT so that decisions can be made

Examples of Necessary Non-Value Add activities are:

- Recruiting Staff: recruiting and selecting new people ultimately helps the organization to deliver value.
- Finance & Accounting: these activities mean we can finance the delivery of value to customers.
- Application Testing: ensuring that the product works before it is delivered to the customer.
- Conducting Problem and Root Cause Analysis to resolve the root cause incidents to avoid re-occurrence

Examples of Non-Value Add activities are:

- Inventory: Managing large backlogs of incidents.
- Doing more than Required: Providing functionality that is not necessary.
- Rework: Bugs in software and subsequent solving IT incidents.
- Waiting: Delay between programming and testing.
- General Non-Value add: Sick leave.

Understanding the nature of a particular activity helps resources within IT to focus on activities that add value to the customer. Lean aims to remove Non-Value-Adding activities. Necessary Non-Value-Add work must be optimized and reduced, where possible.

4. Characteristics of Lean IT

Why has Lean been so successful in manufacturing industries? Manufacturing mainly deals with machines that create products. Increasingly the human factor is removed from the production equation; robots, automated processes, machinery are all aimed at removing the variability of humans and ensuring consistent quality. Machines are designed for efficiency, i.e. they create large amounts of products at a speed that humans cannot match. Unfortunately, in the process, they tend to produce more waste than humans (who adapt quickly to re-use or reduce waste). The machines are subsequently tuned to ensure that they work better, producing more products per hour or less waste per product. This is (in general) a rational, scientific process, which deals with tangible products that are produced in a predictable, structured manner. It is also relatively easy to measure how the products are made. After many improvement iterations, the goal is to obtain a 1% or 2% increase in improvement each time. These characteristics explain why the Six Sigma methodology has developed within the manufacturing industry.

Compare this with an IT organization and we find different challenges. First, an IT service is an intangible entity. Even at the core of the service, software is not something you can pick up and look at. It is only by installing it and using it that the value can be understood. To a large extent, IT is unpredictable; we do not know when it will fail; we do not know how it needs to be improved. Within IT, we are also not used to measuring the service as a whole. We measure the performance of machines but that is only part of the service. The "people" part remains largely unmeasured. This is precisely where IT differs from manufacturing: the most critical component is still the people delivering the service. The software industry continues to make inroads into reducing the people effect, but people still make up a substantial part of the where the IT service can fail.

Applying Lean to IT is thus a different proposition. It is about applying the Lean approach to people, not machines. Aiming for perfection means raising the level of professionalism of the people involved. This means improving their ability to solve problems, to deliver and provision services in a predictable time frame and quality, to work autonomously and in a team, and to improve their mastery of the subject matter. Aside of skills training, this means taking on a new mind-set focused on value, value streams, flow, pull and perfection.

5. Structuring Lean IT

The Lean principles have far-reaching consequences for all organizations that wish to integrate the principles into their daily work. In order to make the analysis and improvement of an IT organization a more manageable prospect, we have chosen to define dimensions which a variety of considerations and tools are positioned.

The dimensions of Lean IT are Customer, Process, Performance, Organization and Behavior & Attitude. Aligned with the dimensions, we need a method for carrying out continuous improvement or Kaizen. For this, we use the Define, Measure, Analyze, Improve and Control (DMAIC) problem-solving method.

5.1 Lean IT Dimensions

There is no business without a customer. The purpose of any business is to find and keep customers. For any business improvement to be effective we therefore need to start by looking at it from a customer point of view. The **Customer** dimension deals with all aspects of understanding the customer and the value they are seeking and includes tools such as Voice of the Customer and **Critical to Quality** (CTQ).

Once we have found a customer, the IT organization will need to perform a sequence of activities that result in products and services for which the customer is willing to pay for. **Process** looks at how value is delivered through Value Streams, integrating the principles of flow, pull and perfection. Tools used are **Supplier, Input, Process, Output and Customer (SIPOC)** and **Value Stream Mapping (VSM)** to ensure that a process is correctly scoped (SIPOC) and detailed with the addition of quantitative data (VSM). The VSM is subsequently used to identify where there is waste in the process.

To make a process flow it requires resources of any kind, like time, money, people and their talents, and materials. Aligning these resources around the process output requires organization.. The **Organization** dimension investigates the aspects needed to ensure that we can steer the resources. This includes Visual Management techniques supplemented with the Performance Dialogue. Also, we need to decide how to organize people for maximum value delivery to customers. This means understanding the effect of siloed organizations versus organizing for customer-orientation.

Performance is a key aspect of Lean. From our understanding of the customer value and process, we can determine the performance measures needed to understand, manage and steer the performance of the organization. Key aspects are defining **Key Performance Indicators (KPIs)** to understand at the very least the output of processes, understanding and measuring the use of time within an IT organization and, lastly, identifying the availability and requirements for the skills and knowledge of the workforce.

Behavior and Attitude has been found to be one of the most important success factors for Lean (and Lean IT) implementations. There are many tools available in the literature to help steer behavior. The first step is understanding the key characteristics of Lean behavior for everybody within the organization, in particular for those in leadership positions. Leaders must also understand how behavior and attitude may change during a transformation.

These five dimensions have ongoing importance in our improvement activities. The rest of this publication is structured around these five dimensions.

When discussing the Customer dimension we will find answers to the questions: Who are our customers? What do they want? And how do they value our IT services?

When discussing the Process dimension we will answer: Which types of activities are considered to be of value and which are not? We will also identify opportunities to increase the flow of value also by means of using a pull-mechanism in our processes. A powerful technique to continuously improve the way we work is called 'value stream mapping' which we will also address in the process dimension.

Questions to be answered in the Organization dimension are: Is our organization shaped to deliver maximum value? How do we ensure rapid communication across the board? How do we create and discuss transparency of performance?

In the Performance dimension we will discuss what results we should measure and how to influence them. To really increase performance we need to answer the question how to obtain the right capabilities and how to navigate, using key metrics.

Since people are the most important asset in the IT organization, their attitude towards work and how they behave is of key interest. For this, we will answer what people's mindsets are and how to reshape them? We will discuss how we can collaborate more effectively and how to transform our culture to create a high performance, Lean thinking organization.

5.2 Continuous Improvement with Kaizen

Continuous improvement begins by clearly defining value in the eyes of customers, both internal and external. Expectations must be clearly and unambiguously communicated so that processes can be designed to meet customer need.

Continuous improvement focused on how the flow of value requires both scientific thinking and the capacity to identify and eliminate waste. The most essential precondition for improvement is the pursuit of clear and agreed goals: make things better, faster, cheaper, create more meaning in our work and leave a healthier environmental footprint.

Kaizen forms the basis of incremental continuous improvement in organizations and contains an approach for solving problems. Kai means change, Zen means for the better. Kaizen is about continuously improving: everyday, everyone, everywhere. Many small improvements implemented with Kaizen result in faster innovation and more competitive advantage for the business with less risks.

Problem-solving consists of five phases starting with a problem statement towards embedded improvement implementation. These steps are: Define, Measure, Analyze, Improve and Control, also known as DMAIC. This method originates from Six Sigma and has proven to be suited to investigating and solving problems within IT organizations.

- In the **Define** step, we define the problem statement, describe the goal statements, analyze the cost of poor quality, define the scope with a SIPOC diagram, establish the Kaizen project team, create the project charter and planning, get stakeholders' support and start the project.

- In the **Measure** step, we build understanding of current KPIs and performance, develop the Critical to Quality (CTQ) flow down, write a data collection plan, we try to understand process behavior and variation, and relate current performance to the Voice of the Customer.
- In the **Analyze** step, we collect data and verify the measurement system, study the process with Value Stream Mapping, identify the types of waste, develop hypotheses about the root cause, analyze and identify the data distribution and study correlation
- In the **Improve** step, we generate potential solutions by brain-storming, design assessment criteria for impact and feasibility, decide the improvement to implement, implement or pilot the improvement and measure the impact on the CTQs.
- In the **Control** step, we implement ongoing measurement, we anchor the change in the organization, we quantify the improvement, capture the learning, and replicate it across the board. We write the project report and close the actions for our project.

Our main objective is to improve the delivery of value to the customer. For this we apply Lean principles and techniques to the work of IT. We use five dimensions to support the effectiveness of our improvement activities. We use the DMAIC steps in a disciplined way to solve problems and learn from them. This is how we implement and adapt Lean IT. This is how we continuously improve business performance.

6. Customer

6.1 Value

John Bicheno (2008) sums up the various definitions of value in his book *The Lean Toolbox for Service Systems* from an economic definition of value to qualitative definitions. This shows how illusive the concept of value can be. In order to make value more concrete and usable, it is useful to understand what types of customer value there are. Value tends to be described by adjectives that indicate the importance of particular attributes of a product or service. In some cases, these are measurable, and even if they are measurable, the customer takes a relative view of what the suitable level is in order to perceive value.

As an example, let us look at the value requirement "cheap". This word alone begs a whole host of questions: What is the product or service? What does the product or service mean to the customer? Does it help the customer to generate more business? What is the market price for similar products or services? What is the customer's perception of cheap'? And so on.

In the previous example, "cheap" could be replaced by any number of characteristics for products and services. Examples for products are performance, timeliness, reliability, serviceability, durability and aesthetics. These come on top of the requirement for specific features. Similarly for services, a customer might define the following types of value: Competence, accuracy, responsiveness, access, communication and credibility. Some of the types of value of services and products may be the same but there are also differences. The key message is that understanding and defining the value required by the customer is not as easy as it may seem, especially when it comes to working out exactly what the customer is looking for when they say (for example): "it's got to be responsive". Below is a table containing examples of values that customers attribute to products and services.

Product	Service
• Performance	• Competence
• Features	• Reliability
• Conformance	• Accuracy
• Timeliness	• Timeliness
• Reliability	• Responsiveness
• Serviceability	• Access
• Durability	• Courtesy
• Aesthetics	• Communication
• Reputation	• Credibility
• Completeness	• Understanding
• Pricing	• Pricing
• ...	• ...

Figure 2: Examples of customer attributes of products and services

The customer may define any number of characteristics for the product or service. It is up to the organization delivering the value to determine, through interaction with the customer, which of the characteristics are requirements, i.e. the customer will not buy the product or service without these characteristics, and which are wishes, the characteristics that have the potential to delight the customer. The aim is to create a product or service that meets the expectations of the customer. The goal is this will lead to a higher customer satisfaction with the products and services delivered by the IT organization.

6.2 The Customer

We have referred and focused on the customer at length within this document, but who is the customer?

In a generic sense, we can identify two types of customers:

- The customer who uses the product or service
- The person next-in-line in the process.

The second type of customer is relatively easy to identify since we generally know who receives work from whom. The first type of customer can be quite confusing. In the case of IT, who is the customer? Is it a person who uses the IT service or the person who buys a product or service from the organization that IT is serving? Both of these may be within or outside of your own organization.

For example, the employee of an insurance company uses an IT service in order to record a sales order and start an insurance policy for a customer. In this case, the employee can be seen as a customer of IT. It is also possible that the person buying the insurance policy accessed a website and committed to the insurance through web-based application without the intervention of an employee of the insurance company. In this case, the person buying the insurance is the customer. In the case of our example, we have two distinct customers for essentially the same service: the employee and the insurance buyer, since they both use the service.

In Lean, it is only the customer who can define the value. But always remember, appreciation is subjective per customer and consists of collection of requirements and wishes. These requirements and wishes change over time with new insights and expectations.

Let us take a look at the generic value provided by IT. We have seen that there are two groups of customers: employees and people who buy the organization's products and services through web-based services. Focusing on the employees, we see that they want three basic pieces of value:

1. Ensure that any existing service I use work and when it stops working, please restore it as quickly as possible
2. I regularly need new functionality to match the way my business is evolving, please give me new functionality as quickly as possible so that I can meet the needs of MY customers
3. Assuming that everything else is going well enough, I may require advice about how I can use IT to improve my business

These are the three generic pieces of value IT must deliver, at reasonable cost.

Customers who buy through web-based services have needs that particularly focus on the first two pieces of value. Their needs may however diverge from those of the employee in

the area of ease of use or level of functionality, as a result of a lower level of sophistication with the product or service they are buying.

6.3 Critical to Quality

Customer value is made up of requirements and wishes. A **requirement** is a specific property that the product must have; otherwise the customer will not buy it. A **wish** is a property that excites the customer if the product has this property.

Together, the requirements and wishes represent the **Voice of the Customer (VoC).** From the VoC, the organization delivering the value must distil and prioritize the requirements and wishes that are most important for the customer, the aspects that are **Critical-to-Quality (CTQ).** Having defined the CTQs, the organization must define their key internal attributes. The attributes must be measureable. In this way, customer expectations are translated into measurable internal objectives and activities. The CTQs and Attributes related to the Voice of the Customer are referred to as the CTQ Tree.

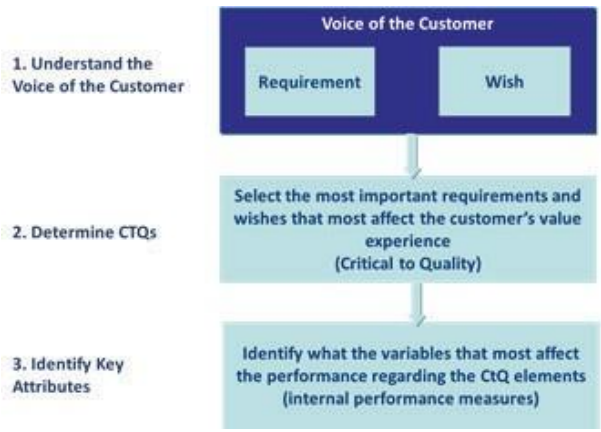


Figure 3: Steps for carrying out a Critical to Quality analysis

The objective of investigating and understanding the Voice of the Customer and using the CTQ structure is to examine and understand the end-to-end customer experience, in relation to the value that the customer expects to receive.

Let us briefly look at a classic IT situation. Customers indicate that the delivery time of changes needs to be shorter.

From discussions with the customer, it has become clear that there are two important drivers for achieving this requirement: reliability and timeliness. It is important to clearly define what is meant by these two terms. Reliability could be explained as the ability to deliver on time. In this case, it concerns the reliability of the software, that it is as "bug-free" as much as possible.

The attributes show the most important measures that can be used to determine whether the IT organization is meeting its goal.

In terms of timeliness, we see that there are two key attributes: the availability of development capacity and the fact that the development process always takes 20 weeks (due to release arrangements). The reliability depends on the number of defects. These attributes are generally process performance indicators (or metrics), where the Voice of the Customer tends to be related to economic indicators.

The first question we need to ask is: Are we meeting the requirement from the Voice of the Customer?

- If we are, then we need to investigate the Voice of the Customer further to see whether there are other requirements or wishes that are not being fulfilled.
- If we are not meeting the requirement, then we have a problem that needs to be solved.
- If we are not sure, then we must measure the attributes and ask the customer whether the performance is good enough.

A final step in getting the CTQ to provide insights is to link the Voice of the Customer requirements to a strategic goal. In this way, operational improvements within IT can be directly associated with a clear business benefit.

6.4 Investigating VoC

Before we wrap up this section, we need to look at how we can investigate the Voice of the Customer.

First, we need to look at which customers we have. As we stated earlier, an IT service may have two different customers: an internal employee and an external customer depending on how the service has been deployed. **Segmentation of customers** is therefore important because each segment may have different needs and spending capability (e.g. high-intensity users, users who use their IT services infrequently, specialist users)

Second, there are a number of ways to collect information regarding the Voice of the Customer:

- **Observation**, when the customers use your product or service at their location or the point where they interact with your company. See what it is like to be a customer (user) of your product or service
- **Interviews**, using e.g. focus groups, face to face or telephone interviews. Get feedback, identify product requirements or get feedback on existing products
- **Surveys**, collect qualitative and quantitative data from a larger sample of the customer base
- **Social media**, i.e. Twitter, Facebook, LinkedIn and many other social media representing specific user groups give brutally honest feedback about how the organization is doing

6.5 Voices

The Voice of the Customer represents the requirements and wishes, both spoken and unspoken, of the IT organization's customers, whether internal or external. It is all about understanding where we are and are not meeting the requirements of our customers. As such, it is a source of (continuous) improvement initiatives.

There are three other sources of improvement initiatives:

- **Voice of the Business:** Identifies improvements to help the IT organization achieve its goals and objectives
- **Voice of the Process:** Identifies improvements based on the performance of processes
- **Voice of the Regulator**: Identifies improvements based on changing legal requirements.

7. Process

Value Streams are the 'vehicle' for delivering value to customers. A Value Stream consists of steps that add value to the unit of work being processed. Each of these steps is executed in a certain way. Lean aims to continuously improve the way each of the steps is carried out, both individually and particularly as a chain of steps to be optimized. When work is not carried out correctly, or when the required value is not delivered, the first place we look to find the cause is in the value stream. The assumption is that the way the process was designed or carried out is the cause of the issue, and often is, especially in service industries like IT. The beauty of investigating the process is that it is the central entity that will almost inevitably lead us to the cause, even if we find that the design or execution of process is not at fault.

At any given moment in time, there is a best practice way to carry out the step or process as a whole. This process should be documented to ensure standardization which leads to a consistent level of quality of the output. The document describing this standardized way of working is known as a **Standard Operating Procedure (SOP)**. In this way, Lean aims to improve the value delivered to customers through standardization.

Within IT, we have a number of Value Streams such as delivering new functionality or ensuring that an IT service works. We also resolve incidents. This activity is based on failure demand rather than value demand. We therefore refer to the process for resolving incidents as a Failure Stream.

As we saw in the Lean principles, Value Stream was the second principle after Customer Value. This underscores the importance of Value Streams, or processes, in the world of Lean. IT has been concerned with processes since the advent of ITIL® in the 1980's. As we saw in the Introduction, Lean IT takes a different approach to processes than the standard IT process frameworks.

Within Lean, processes are vital. They are the vehicles we use to deliver value to customers. For this reason, we refer to processes as Value Streams. The concepts are synonyms, only the use of the word Value indicates clearly what the intent is of the process. A Value Stream is a chain of specific and identifiable actions that lead to the creation of a product or service that has value for the recipient of the product or service.

The actions must be performed correctly in the right sequence at the correct time for value to be created and delivered. The actions must also be executed in succession so that delays between steps are minimal. In this case, the value stream has the characteristic of Flow, the third Lean principle. Our aim is also to start the value stream when a customer provides the trigger, also known as the fourth Lean principle of Pull.

Lean challenges us to look at processes from customer triggers to deliver the value. However, it is simply impractical to consider the entire chain of actions. We therefore need to be aware of the links between processes. This is done by being aware of the output of one process or action, which is then the input of the next process or action. A key skill here is to be able to define products or intermediate products rather than focus on the activities. Experience has shown that within IT, people

tend to talk about what needs to be done, rather than what needs to be created.

Before we dive into the details of Lean process analysis, let us acquaint ourselves with the most important elements of a process.

7.1 Process

Fundamentally, a process consists of input that is transformed to output through a series of actions. Input can be information, machinery, materials and labor or a combination of these inputs. Work is then done to create the desired output, being a product, service or information.

The output is always created for a clearly definable customer. If we cannot identify the customer, it is questionable as to whether we should carry out the process at all.

Every process has a goal and a predefined result. In order to ensure the process works correctly, we need to have people taking care of the activities. These people have roles and responsibilities. One of the responsibilities is to ensure the process works correctly. This is done by having process measures and controls to check how units of work are progressing through the process.

Let us quickly look at an example. Taking the IT process Request Fulfillment, we can define:

- **The Goal**: To answer requests for service, not being the resolution of disruptions, from customers regarding IT services
- **The Result**: Customers promptly receive the service they require
- **The Input**: A submitted request for service
- **The Output** is a fulfilled service request
- **The Transformation** will differ depending on the type of service request submitted. Resetting a password requires a different set of actions than providing access to a new application.
- **Roles** may include a "password re-setter" as a role for a service desk agent, who has the responsibility of ensuring that passwords are reset as quickly as possible
- **Measures** may include a measurement of how many password resets are carried out per day and what the average time is that customers have to wait for their password reset.

It is important to understand each of these aspects of a process to ensure that when we aim to improve it, we do the right things. There will be more about that when we look at the tools for analyzing value streams.

7.2 Basic processes

At an abstract level, each organization has three processes: Design, Delivery and Support.

- **The Design Process** takes an idea from concept to the launch of a product or service
- This product or service must then be delivered to customers. **The Delivery Process** covers the activities from order intake to the delivery of the product to the customer
- During the lifecycle of the product or service use by the customer, the **Support Process** ensures that the customer continues to benefit from the value of the product or service

IT organizations obviously also have three similar processes: Product & Service Development, Production & Delivery and Service & Support:

- The **Product and Service Development Process** is concerned with the design of an IT service
- The **Production and Delivery Process** is all about ensuring the IT service is created and deployed

- **The Service and Support Process** is concerned with operating and supporting the deployed IT service

It is important to understand these different processes because within IT they can become intertwined. If we look at the process of delivering a change, often the production and delivery actions follow the development steps seamlessly, leading to a deployed service for which support may be required the moment it is in production. This is where understanding the links between processes is vital.

7.3 Push and Pull

We already mentioned that value streams should have the characteristic of pull, so what is the difference between a Push and a Pull system?

A **Push System** produces a product or service before the customer has actually ordered the product or service. The product is so-called "pushed" through the process. The key effect is that we produce to stock: Push processes always have inventory. In general, this pertains mostly final product but also work-in-progress. Push systems use a mechanism called Batch and Queue. We produce a certain number of products in one go and then store them in stock until the next step in the process takes place. Push production systems tend to work with forecast demand schedules rather than actual demand. This type of production always accentuates the bottlenecks in the system since each process step produces at maximum capacity. The process step with the lowest capacity will become the step with the greatest inventory preceding it.

A **Pull System** work differently. The value stream starts when the customer places an order. In effect, we let the customer pull the product or service through production. The ultimate version of a pull system is Just-In-Time production in which inventory is brought into the process at the moment that it is needed in a value-adding step. In reality, most pull systems have small inventories to support the levelling of production. The ideal situation is that a single product is pulled through the process as and when the customer needs it. This is known as Single Piece Flow. In this situation, there will be no bottlenecks since each step in the process is capable of processing a single unit of work at a time.

We have covered the definitions and elements of processes and value streams, the various types of processes and the characteristics of value streams. The question now is: how can we analyze value streams? Within Lean IT, we use Value Stream Mapping. This is an instrument that consists of two tools: the SIPOC and the VSM.

7.4 SIPOC

Achieving the improvement of a value stream is done in two phases. In the first phase, we define the scope of the value stream we are aiming to improve. The second phase is all about detailing the value stream with the goal of implementing improvements.

Scoping a value stream starts with the elements we saw in the Customer module. Based on the Voice of the Customer and the related Critical to Quality tree, we can identify an area where the organization is not delivering the value required and the value stream most affected, and the stakeholders associated with this area.

In preparation for improving a value stream, we need to know who the customer is, what value

they are currently receiving and what the CTQ tree is associated to this particular customer value. We need to know what the customer thinks of its current performance. This is important because the perception may be good or even excellent, which would mean that we can better spend our time on improving a different value stream.

The next step is to define the boundaries of the value stream. We do this with the SIPOC tool, which is a method for scoping a value stream to be improved. Based on the input from key stakeholders, we assemble a team of people to investigate the value stream.

Using the **Supplier, Input, Process, Output and Customer (SIPOC) tool**, we can record the information related to this investigation. SIPOC stands for Supplier, Input, Process, Output, Customer. SIPOC is a method for scoping a value stream that needs to be improved. Assuming the CTQ and Voice of the Customer require us to improve the value stream, we can first identify the Output of the process and the Customer who receives the output.

We must then discuss the scope of the value stream with stakeholders since process boundaries are not always obvious. What will form part of the analysis, and what is explicitly not part of the analysis, should be confirmed with the stakeholders. A good place to start is to identify the goal and results of the process to be improved. Make sure this is clearly linked to the output of the process.

Based on the process, output and the customer, we should be able to identify the input and the supplier of the input. Each of the SIPOC entities may be adjusted as the value stream is analyzed. For example, the request fulfillment process that starts with a request will be different from one that starts with an authorized request especially if, in both cases, the request needs to be authorized before it can be fulfilled.

Ensure all stakeholders directly related in the value stream are in some way involved in the Value Stream Mapping exercise. This is a precondition to ensure support for implementing the suggested improvements later on. Assuming the team aiming to improve the process has been able to identify the SIPOC components, the process steps can then be described. Generally, the aim is to describe the process in 3 to 5 high level steps. A guide for defining the steps is to identify handover moments; when does the process pass from one role to another?

The process of creating the SIPOC for the problem you wish to solve may take a number of iterations.

7.5 Value Stream Mapping

Value Stream Mapping (VSM) is an exercise to understand waste and improvement potential in a value stream. We use it to visualize the current and future states of a particular value stream. This visualization is used to facilitate the communication within the team improving the value stream and the stakeholders, such as other resources in the process or managers responsible for the process. The most important output of the Value Stream Map is to determine which improvement actions need to be implemented to achieve the desired future state.

The aim of the VSM analysis is to understand where the process fails to provide the value that the customer requires. Understanding these issues, gives us input for continuously

improving the value stream and the value it provides. The Value stream map shows the input, the steps and the output of the value stream. It helps us to understand how the value stream currently operates.

In the Value stream map, we calculate the waiting and cycle time of each step as well as perform a Value/ Non Value Analysis on each step. In this way, we can identify where there are issues of flow and waste in the process. This contributes to achieving flow. The Value stream map clearly shows where inventory exists in process, and therefore helps to identify where we apply push or pull. The Value stream map is instrumental in identifying waste in the process and thus helps us to achieve perfection. As such Value Stream Mapping is an analytical exercise that supports the achievement of all of the Lean principles.

7.6 Developing a Value Stream Map

We know which process we need to improve to meet the customer's CTQ requirements and wishes. We can now move to the second phase where we improve the process. To do this, we will produce a Value Stream Map. This is a detailed diagram of the process flow of the current process where, we will record key data and identify where waste can be found in the process.

We start with creating the Value Stream Map of the current way of working. Let the team reflect on their current processes. Stimulate them to identify bottlenecks and other impediments. The next step is to determine improvements together with the team. We create an improvement plan with a maximum timeframe of 3 months, during which selected improvements will be carried out.

We then show the future state of the value stream and communicate with all stakeholders on which improvements will be made. The team will be able to differentiate between high and low impact improvements.

These three steps are iterative, since the future state becomes the current state as, particularly high impact, improvements are embedded into the organization. As the effects of improvements become visible to the customer, it becomes important to investigate the Voice of the Customer and the CTQ to see whether the organization is now meeting the requirements and wishes of the customer.

The goal of Value Stream Mapping is to visualize a process in such a way that the process can be analyzed. We build the Value Stream Map by taking the SIPOC and detailing the flow of the process steps. We start by adding basic information so that the Value Stream Map is easily understood by anyone who wishes to review it. This means giving insight into the input and output of the process. The key activity is to draw in the process steps. The SIPOC has given us a broad insight into the activities. In the VSM, we need to be more specific. The key reason for being specific is that we will be trying to quantify as much of the process as possible. This means creating logical and measurable process steps. Also, our ability to define clear steps makes it easier to identify waste.

Next, we need to be clear on what units of work are being processed by this Value Stream. It is important to understand where the work for this process comes from.

7.7 Takt Time

The next key information we need to add to the VSM is the **Takt Time**. Takt time is the

"heartbeat" of the process. Takt time is defined as the pace the process much keep in order to keep up with the pace of incoming customer demand. If the Takt time is too slow inventory will build in front of the process. If the Takt time is too fast the resources remain idle. Takt time is calculated by dividing the net working time available by the number of incoming customer requests during that time.

Takt time determines the correct pace of the process to ensure that it delivers products to match customer demand. If the average time between two outputs of the process is higher that the takt time, then customers will have to wait longer than the expected cycle time. Takt time is vital for managing the flow of a process and understanding how long can be spent on the steps in the process.

7.8 Lead Time

The next piece of information we need to add to the VSM is **Lead Time**, the time between the moment a customer requests something and the moment that it was delivered. To calculate Lead time, we subtract the time the request was submitted from the time the customer received the requested performance.

The lead time depends on work-in-progress and how many products are delivered on average in a given time. Shortening lead time often goes hand-in-hand with the reduction of the work-in-progress.

7.9 Standard Time

Next, we will start adding information to the process flow. The first piece of information is the **Standard Time**. This is the time that a particular step should take to carry out by design. We record the standard time in the block in the right bottom corner of the step. The standard time for the whole process is the sum total of all the standard times of the steps.

Standard time is not necessarily the same as the actual time spent. It has more to do with our expectations. For example, in an order entry step, we may determine that it should take 10 minutes to accept and record an order from a customer.

The Standard Time help us to design processes that are capable of delivering value at the Takt rate required. We can then measure how much time it takes us in reality. The difference shows us where the process can be improved. In practice, differences between the standard times and measured times reveal waste in the process step.

7.10 Time Metrics

Time metrics are added to the VSM, and must be based on measurements. Most measurements can be derived from tooling, however, it may be necessary to go the workplace to measure how the work gets done.

The four most important measures are:

1. **Cycle Time** is the time we actually spend on creating the product or service. This is value-add time.
2. **Waiting Time** is time spent on waiting for the next activity.

Together, cycle time and waiting time make up the time spent in a process.

These are recorded on the serrated line, the time line, underneath the process steps. The drawing convention states that the waiting time after a step is part of the step.

A key measure of the flow of the process is **Process Cycle Efficiency (PCE).** This is the percentage of total lead time spent on value-adding activities and is stated at the end of the timeline.

Two other useful time measures are machine time and changeover time.

3. **Machine Time** is the time the product is worked on by a machine. In the case of IT, we see machine time when database reorganization needs to take place or when a Business Intelligence system needs to load data.

4. **Changeover Time** is the time needed to reconfigure a device between two units of work. Within IT, we find this kind of time when we need to adjust a development environment between different program changes. Within IT, changeover time also occurs when we go from processing a change to resolving an incident, back to processing the change.

Machine time and changeover time are really specific forms of waiting time.

7.11 Process Metrics

For each step in the process, we can also add process metrics.

Four possible process metrics are:

1. **Parallel Lines**. This is the number of simultaneously operating lines of work. Having insight into the number of parallel lines can help us to understand whether there are bottlenecks that may be remedied by adding extra processing capacity. This could mean both people and machines are added to increase the capacity of the process step

2. The **Capacity** is the calculated maximum production volume of a process or process step

3. The **Throughput** is the actual production volume of a process or process step, taking all constraints into consideration

4. **Work-in-Progress** is the average volume of work that is in progress at any point in time

Each of these metrics gives us a richer understanding of the process, and helps us to analyze the process.

7.12 Symbols in the VSM

The final step is to add symbols to the Value Stream Map. These symbols come in two categories: Waste and Other Symbols.

The first type of symbol is **Waste**. Here we aim to define where types of waste are present. It is reasonable to assume that where there are waiting times, there is probably inventory. We do not necessarily need to put the inventory symbol at each location. It is about identifying and recording the wastes with the most influence on the process.

On top of the waste symbols, there are a few **Other Symbols** that help us create a readable Value Stream Map. We can distinguish between **Physical Flows** and **Information Flows**. In IT processes, the most important flows are Information Flows. The core IT process of developing software to making it available to customers is an example of an information flow. When we investigate, for example, the delivery of hardware, we must take the physical flow into account.

One very useful symbol is called the **Kaizen** 'burst'. This symbol illustrates the areas where more investigation is required; we know

something is wrong but we have not been able to identify it sufficiently. We need to define a problem statement and work towards a solution. It may be necessary to produce a new SIPOC and more detailed VSM for that part of the process.

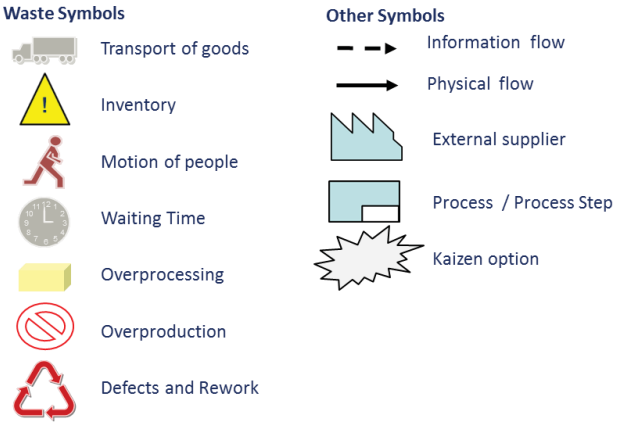


Figure 4: Common symbols used in a Value Stream Map

Once we have produced a Value Stream Map, we need to analyze it. Areas to investigate include:

- **Muri:** what policy-based waste is associated with the process?
- **Mura:** where do we find variability and what is it based on?
- **Muda**: what kind of waste is in the process?
- How can we understand and improve the **flow of the process?**
- Do we need a **push or pull mechanism** for this process? How could pull help us to unburden the process?

Lastly, but certainly one of the more important aspects, how can we ensure that each step is carried out **"first time right"?**

7.13 5S

There are two standard Lean concepts that we can use to actually improve a process. The first is **5S.** 5S provides us with a set of hygiene rules that help to, for lack of a better word, clean up our processes: **Sort, Simplify or Set, Shine, Standardize and Sustain.(5S)**

Sort is about eliminating all unnecessary tools, parts, and instructions. We aim to keep only essential items and eliminate what is not required, prioritizing things per requirements and keeping them in easily-accessible places.

Simplify or Set in Order ensures that everything is in the right place. There should be a place for everything and everything should be in its place. Also the place for each item should be clearly indicated. For IT, this may mean having a standard repository for documentation. Standard use of the Configuration Management Database (CMDB) is a "set in order" activity.

Shine is simply about keeping the workspace and all equipment clean, tidy and organized. At the end of each shift or working day, the work area must be cleaned and everything must be put back in its place.

Standardizing is a very important activity within Lean. Work practices should be consistent and standardized. All employees doing the same job should be able to work in any station with the same tools that are in the same location in every station, with the same standard procedures. Standardizing makes doing work easier, particularly routine work, and it makes it easier for resources to take over work if necessary.

Lastly, we must **Sustain** what we have installed. This means maintaining and reviewing standards. Once the previous 4 S's have been established, they become the new way to operate. While thinking about the new way, also be thinking about better ways. It

should be made as a habit and be continually improved.

Investigating each of these aspects in relation to each process step can help to ensure that processes become more efficient through simple improvements.

7.14 Heijunka

One of the goals of improving processes through Value Stream Mapping is to reduce Mura, or variability. **Production levelling or Heijunka** is a Lean technique for this purpose.

Heijunka is vital for achieving flow. It means ensuring that each process step can process the same number of units of work per unit of time. The aim is to produce intermediate products and services at a constant rate so that further processing may also be carried out at a constant and predictable rate. One of the ways to achieve Heijunka is through reducing bottlenecks. We can do this by adding parallel lines or other capacity.

So, we have built and analyzed the current state of the Value Stream Map. We have identified the places where we need to improve and we have thought up a number of improvements that we can carry out.

7.15 Improvement Plan

Next, we must plan the way we intend to implement the improvement actions. The plan must cover no more than 12 weeks. If the plan is longer then you need to focus on smaller improvements that can be carried out more quickly. Obviously, there may be improvements that may take longer, for example, increasing server or network capacity. Even these improvements can be broken down into smaller steps. Discuss the proposed actions with the stakeholders. Ask for their commitment and ensure that where decisions are required, they are made.

It is important to involve the people who work in the process in the improvement actions for that process. The people in the process must feel ownership and so we allocate actions to the people themselves. This has been shown to help in the acceptance of changes among other workers in the process.

In summary, Value Stream Mapping helps us to effectively understand, analyze and identify improvements to processes. In small steps, we take a process from its current state to a future state which, through the implementation and sustaining of improvements becomes the new, improved current state of the process.

8. Performance

Performance is a critical component of Lean. It is about ensuring that decisions are based on facts and figures rather than opinion and conjecture.

Every Lean publication mandates the need for performance and its measurement. Performance, like all other dimensions of Lean, starts with the customer. The first step is to go back to the Voice of the Customer, and more specifically the Critical to Quality. The CTQ tree gives us a direct link to the things we should be measuring. But even the CTQ can contain too many "things to manage". We need to choose the right indicators.

We have already seen how important numbers are in the process dimension. Value Stream maps must be accompanied by performance data. In the Problem-Solving module, you will also see how important measuring performance is.

Taking a brief look at the three main concepts we will be discussing in this section, we find that within Lean, IT needs performance indicators, time and capabilities described as skills and knowledge to ensure that the value, the desired result of the performance, is achieved.

Performance indicators must be related to agreed objectives and/or critical success factors. They must be consistent throughout the IT organization and must reflect the IT organization's strategy and its customers' needs. Performance indicators can cover many different topics.

One topic that sticks out in particular is time. Time represents the most important production factor within IT. As we saw earlier, one aim is to understand how much time we spend on value-add work versus non value-add work, so that we can steer this time usage.

Lastly, time on its own is not particularly valuable to the Lean IT organization. It is particularly what we do with the time that makes it valuable. What we do with our time depends on the results of a skills and knowledge assessment and plan to support the alignment of customer demand and IT supply. It is therefore vital that we know what skills and knowledge we have available so that we can ensure the right people are assigned with the right units of work.

8.1 Defining Performance

So what do we mean by Performance? It is the completion of a chosen objective or obligation. The performance includes both the result and the way the result is achieved, whereby the result is the outcome of a process.

Measuring performance enables us to achieve objectives. In the case of Lean IT, we always aim to relate these objectives to customer value. In relation to the Plan-Do-Check-Act cycle, we find that in the Check step we need to form an opinion of how we did in comparison to the plan. The only way to do this objectively is to ensure that when we planned our activities, we included in the plan how we would check whether we achieved the plan. This means that while we are doing the work, measurements were being carried out that form the basis for an evaluation.

Within the Lean IT organization, we aim to make performance information available to everyone involved:

- Primarily, the team producing the performance must get regular and frequent information feedback so that the team members are able to understand whether the performance meets the requirements.
- Team managers must also be aware of the numbers so that they can identify whether there is a reason to investigate possible shortcomings with the team.
- Lastly, the team must be prepared to share performance information with customers. Based on these insights, the customer can help to define what level of performance represents value for the customer.

Let's take a brief look at a common example. Customers generally indicate that they would like to have an incident resolved the moment they report it to the service desk. The IT organization cannot deliver on this requirement each time. In Voice of the Customer discussions, the customer indicates that the level of performance is good.

By measuring the performance, the IT organization can put a concrete number to the general feeling of the customer. We may find, for example, based on the measurement of the average time to resolve incidents, that 90% of calls are resolved within 1 day. This measure can be equated to a 'good' level of performance. Sharing this information with the customer can help the customer put their own thoughts into perspective.

In later VoC discussions, the customer may indicate that the expectation has changed and now he expects a better level of performance. Not that calls must be solved more quickly but that a higher percentage must be solved within 1 day. Obviously, there are more aspects to the service than the speed of resolution of the incident. Aspects such as friendliness of the service desk agent and how quickly the telephone is answered are also part of the total performance. Through the CTQ we dealt with in the Customer module, we can understand which of these aspects is most important.

8.2 Performance Indicators

We now come to a concept that is central to the measurement of performance: The **Performance Indicator**. Clearly defined performance measures (or indicators) are vital in order to understand whether the organization is achieving its goals. Performance indicators can and must be used at all levels of the organization.

Measuring performance is in fact relatively straightforward. The key questions are:

1. Are we measuring the right things, and
2. Are we using the measurement to help the organization to continuously improve?

If we do not take action based on the results of the measurement, then there is no point to measuring.

Here, we need to distinguish between general metrics and **Key Performance Indicators (KPIs).** A KPI is a central performance measure that supports the execution of the strategy. KPIs cascade from the strategic level to the operational level and are consistent across the organization. There must be a clearly defined measurement procedure so that everyone knows how the KPI is measured and most importantly how it can be influenced. Ideally, a KPI should be long lasting. This is to ensure that we can follow the trend of the KPI over a longer period of time,

especially since the achievement of a strategy is a longer term objective.

Lastly, it is important that the KPI can be controlled by the team, in this case the IT Management Team. All performance indicators should be: **Specific, Measurable, Achievable, Realistic and Time-bound (SMART).**

KPIs are derived from the strategic intent of the IT organization and measure the performance of a key organizational objective. Performance measures always derive from the strategy of the organization. This means that the KPIs of the IT organization should be related to the goals of the overall organization for which the IT organization works, even if this is an external customer.

At the same time, a performance indicator should be controllable by the team that is being measured according to the indicator. A measurement procedure is available to ensure that everyone measures the KPI in the same way. As with the organizational goals that should focus on longer term performance indicators, especially KPIs, should also be long lasting. In this way, performance can be consistently tracked over a longer period of time allowing the organization to see whether improvement measures have a sustained impact.

The idea is that teams within the IT organization have freedom to choose the performance indicators that they can directly influence. The requirement is that the team can explain how these performance indicators are related to the KPIs. An example here is a team that is responsible for delivering development, test and acceptance environments. Their principal performance indicator may be the ability to deliver a new environment within 1 day. This contributes to the ability of the IT organization to meet the time-to-market goals of its customers.

Once we have performance indicators, we need to make them work for us. What tools can we use to visualize performance so that we are constantly aware of its importance and prompted to do the right things? This is about giving all levels of the organization the tools to be in control of their own performance. This means ensuring that measurements become part of the organizational or team Plan-Do-Check-Act cycle. We also need to ensure that measurements become one of the aspects of Visual Management, which we will deal with later in this document.

KPIs are vital for monitoring performance in relation to the delivery of customer value. Having said this contributing to customer value is more important than achieving the specific goal or target of a KPI. This also means that managing the long term development of the trend of a particular KPI measurement is more important than meeting a particular target.

Managing with KPIs is a balancing act. Within IT, a common occurrence is that the number of incidents has a tendency to increase as a result of an increased number of changes. The IT organization will only truly be successful if the number of incidents does NOT increase in line with the number of changes. On the contrary, we should be aiming to reduce the number of incidents with an increased number of changes since at least some of these changes will be related to problems that have been solved, and our aim is to implement changes that do not introduce new errors into the IT infrastructure.

KPIs only work if the complete set of KPIs represents the aforementioned balancing act.

It is inevitable that there will be some tension between the KPIs as described above. At the organizational level, KPIs should have a certain tension. If all of the KPIs display their intended trend, we know that one area is not improving at the expense of another.

So we have seen how to determine performance indicators and their position within Lean IT. The key consideration with performance indicators is that we must always be aware of the impact that performance indicators have and must have on behavior. Often achieving a particular performance level with a KPI becomes a goal in itself. This must not be the case. Contributing to customer value is always more important than achieving a KPI. Performance indicators must be used to direct behavior across value streams. In the case of IT, we see that processes often go from the customer through an internal IT organization to an external service provider. Lean IT encourages organizations to look across the organizational boundaries to measure the value for the customer end-to-end.

8.3 Defining a KPI

The next step is to actually define the KPIs related to the strategic intent of the IT organization.

Defining a KPI is not as straightforward as it may seem. The minimum aspects to be defined are:

1. The goal of the KPI. What will this KPI help us to measure? An example is: the time-to-market of changes will help us to understand whether we are meeting our part of the customer's goal to innovate quickly.
2. The definition of the KPI tells what the KPI is about. The time-to-market KPI is defined as the ability to meet an agreed implementation date. Alternatively, we may choose to define it as the ability to continually shorten the time between the request and the delivery of the functionality.
3. The definition obviously impacts strongly on the formula. The two definitions described in step 2 will lead to different formulae for determining the performance.
4. A KPI must have a unit of measurement. Do we want an absolute number, an index or a percentage? This choice can influence the way a KPI is read. Is it, for example, interesting how many incidents are open, or does the percentage of incidents still open from this month tell us more?
5. How regularly is the KPI reported? Within Lean, we need KPIs that are refreshed on a frequent basis. Only KPIs that are refreshed at least once a week can be used to actually steer performance. Preferably KPIs must be measurable on a continuous basis. As we will see in the Organization module, the daily and weekly cycles within Lean IT require KPIs that are useable in these cycles.
6. The KPI must have an owner. This is the person who is responsible for the quality of the KPI and preferably also someone who takes overall responsibility for the performance regarding the KPI across the organization. This almost inevitably means that a member of the Management Team will be the owner.
7. In order to ensure that KPIs are balanced, it is advisable to consider multiple perspectives, for example in the Balanced Scorecard from Kaplan and Norton, which looks at Finance, Customer, Internal and Innovation categories. The categories may be taken directly from the strategy. In the example in the previous section, we could categorize KPIs at the level of standardization, predictability, costs and productivity.

8. This KPI card can be used to define other performance indicators, not just KPIs. In this case, it is important to know at which level in the organization the performance indicator is in use. For KPIs, we know that the Management Team is the main user. However, KPIs may also be used at other levels in the organization. The number of open incidents is interesting from the strategic level all the way through to the work floor. An individual must know how many incidents he has to resolve.

9. Related to the formula, it is vital to define which data is used to calculate the KPI. This is to ensure that each time the KPI is measured, it is measured consistently. The data collection process includes both the data and the way it is processed as it is turned into the performance indicator. Are there, for example, any exclusions? If we are measuring the performance of changes, do we include or exclude standard changes?

10. We must also define the measurement accuracy. Will we round percentages up or down to the nearest integer or will we present a percentage to hundredths of percent? This will depend on what kind of improvement is possible. Moving the performance from 60% to 80% is unlikely to depend on 10ths of a percent. Going from 98,7% to 99,5% may even make it interesting to measure 100ths of a percent, to understand progress of improvements.

11. Lastly, under the euphemism of "issues", we need to understand how the KPI can be manipulated. Knowing how to fudge the numbers will enable us to be alert to any manipulation.

You may feel that you are missing a key aspect: the norm. Within Lean IT, norms are used as improvement goals rather than absolute levels of performance.

It is vital to manage the trend of a KPI, not just look at a single data point or a norm. When managing the trend, we must not only ask ourselves what to do when the trend goes the wrong way, but also ask ourselves what we are doing right when the trend goes in the right way. In the latter case, we need to understand what we did right and how we can continue to do the right thing.

8.4 Time Usage

Within an IT organization, the key component for delivering the performance that customers require is people. It is people who decide which technology choices to make. It is people who design, deliver and manage IT services. Breaking down the "people" component, we find that it is all about ensuring the availability of the right amount and allocation of skills (and attitude) at the right time.

The aspect of people can be subdivided into two key components. When we hire a person, we are in essence "buying" skills and knowledge for a specific amount of time. Time is therefore the key production factor within IT, since it is only through the skills and knowledge of the people that the money spent on technology (hardware and software) can be put to good use.

There are two characteristics of time that make it useful as a performance indicator: Control and Immediacy.

- The first is **Control**. We have direct control on cost through time usage. It is more difficult to control cost based on managing salaries since in most cases contractual agreements are not easy to change in most countries.
- The second is **Immediacy.** We can almost instantaneously change what

somebody is doing with their time. If someone is working on a change and an incident comes in, we can ask the person to stop working on the change and pick up the incident in a matter of seconds. This obviously has a downside: too much chopping and changing will lead to a "fire-fighting" culture within the IT organization.

Lean IT requires an intimate knowledge of time usage within the IT organization. We need to understand how time is used, particularly related to the delivery of value. We can define time based on the activity that is being carried out: Value-Add, Necessary Non-Value-Add and Non-Value Add. Achieving flow in processes is one of the ways in which Lean changes the way time is used. The key question is how free time is used. Lean recommends using it to carry out improvement initiatives or respond to changes in customers' requirements.

We can analyze the use of time through the Lean concept of Process Cycle Efficiency (or PCE). With this tool, we gain a detailed understanding of what time is spent on. This helps us to identify areas of waste. The time measured in a PCE analysis is based on and can provide input for the (activities of the) key Value Streams in which people work.

Process Cycle Efficiency is calculated by dividing the total Value-added Time within the process by the total Lead Time. The closer the PCE is to 100%, the greater the process has the characteristic of flow.

Within IT, we can quite easily get an estimate of the PCE of a process. We do this by:

- Identifying the average amount of time spent working on, for example, changes.
- Determine the average end-to-end or lead time of a change.
- Dividing the amount of time worked by the average lead time, we get an approximation of the PCE for changes.

8.5 Skills and Knowledge

The second measurable part of people, next to time usage, is their **Skills and Knowledge**. The vital aspect here is to determine whether the IT organization has access to the right amount of skills and knowledge to provide the value that customers expect from IT. The objective of understanding the level of skills and knowledge within the organization is to balance the skills and knowledge to deliver the value with the future demand required by the customer.

Skills and knowledge are important since we must know whether the organization has enough to deliver the value their customers are looking for. A lack of skills and knowledge is a driver of both Muri and Mura, and a contributor to all kinds of waste.

In this paragraph we explain the Lean IT tools that are used to develop people and build competencies with the Skills and Knowledge matrix. To improve the performance of a team or department and to develop a group of people, we need to understand their current capabilities. The objective of the Skills and Knowledge assessment tools is to develop people in the team so they can acquire skills and knowledge that are in line with customer demand.

One of the elements that contributes to waste is the lack of flexibility (Muri) to align with customer demand because employees do not have the right skills available. For example: an IT organization's customer requires more Java than .Net expertise, but the IT team cannot match the Java demand. The customer migrated to Java and the IT organization did

not follow at the same speed. The consequence is that the IT organization has .Net-skilled people who are under-utilized due a lack of the right skills.

IT organizations tend to focus on the development of expertise in narrow technology areas which takes years to mature, when they should aim to develop people who are more flexible, agile and adaptable to the changing needs of the customer. Of course, a team needs a mixture of experts and more multi-skilled people.

The Skills and Knowledge Analysis is a Lean IT assessment tool that analyses current team skills and competencies and matches that to current and future customer demand in types of skills and volume.

How does the Skills and Knowledge Analysis work? The team determines what skills and knowledge are needed to deliver the customer value. This is based on an understanding of what has been asked of the team in the past and an estimation of what will be asked in the future. Using the Voice of the Customer and associated CTQ, the team can identify where more or a change in skills and knowledge are required.

The result is a gap analysis showing where there is a mismatch between the skills and knowledge available. Based on the gaps, the team can manage its own development by creating a plan to drive the development of existing people from single skilled to more multi-skilled, thus removing personnel bottlenecks and increasing the flexibility and consistency of performance within the team.

Based on this analysis, people in the team are encouraged to develop in a certain direction.

The opposite model is that employees develop skills based purely on personal preference. On an aggregated team level, a mismatch with customer demand may be identified. Another aspect is that one person in a team holds unique skills or knowledge, which implies a continuity risk. This happens regularly in IT-teams. The radar graph shows the customer demand (red line) and the current available skills (blue line).

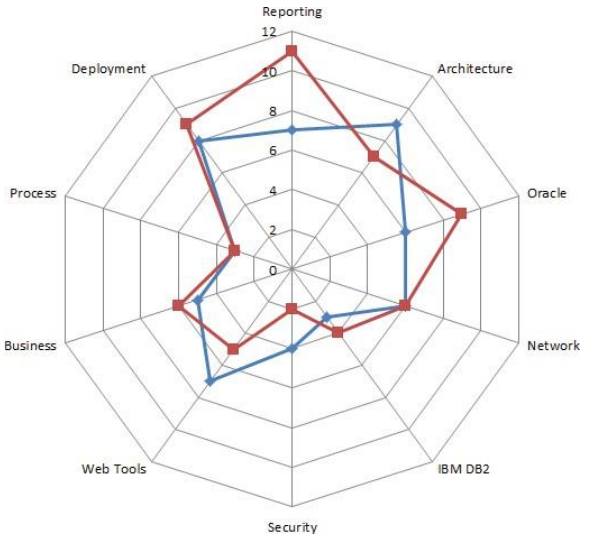


Figure 5: Example of the results of a skills and knowledge analysis

To apply a Skill and Knowledge Analysis follow these steps:

- Analyze skills and knowledge currently available in the teams based on the voice of the customer. For overview purposes, group them in categories
- Create a form with the skills and knowledge categories and items
- Send it to every employee and request a response
- Aggregate all the responses to develop a team view on the current and future skills and knowledge requirements
- Discuss the Skill and Knowledge matrix with the employees during coaching sessions

- Change and update personal development plans and track progress both on individuals and at the team level
- Repeat these steps at least four times per year because the Voice of the Customer – the key driver for required skills and knowledge – will change

The most common approach is to build an Excel spreadsheet model. The benefit of the Lean IT assessment tools is that they are very powerful in reaching a result but not very complex to implement.

In the end, we need to balance the skills and knowledge with the time factor in the form of a resource plan to ensure that both are available in the right quantities when needed to deliver value to the customer.

9. Organization

Without mechanisms to anchor these aspects within the IT organization, we will not be able to consistently deliver value. The Organization module focuses on the structures for ensuring cooperation between people.

We will look at three interconnected mechanisms. First, the way the IT Organization is **Structured**, and how decision-making information flows through the hierarchy. Second, a key behavior linked to the structure:, **Performance Dialogue**. Last, the role of **Visual Management** as a vital organizational mechanism for ensuring the progress of work.

To organize for Lean means we need to shape our organization to deliver value for customers.

Traditional IT organizations are shaped in functional silos. Lean IT organizations ensure there is a strong customer orientation in the way they are structured with their value streams. In this way, they empower the people in the frontline of the organization to operate effectively and resolve problems quickly.

We must also organize the flow of information through the entire IT organization. In a performance dialogue, people define an objective, offer each other support and evaluate the achieved results. In order to discuss progress on results and communicate rapidly across all hierarchical levels, a cascade of performance dialogues needs to be in place for a Lean organization to work swiftly and smoothly. Performance dialogues help teams to discuss progress or problems and the cascading mechanism helps them to get support from a higher lever for rapid resolution.

Visual Management is about effective team communication and real-time updates on the team's work. Team performance and workload is shared on the Day Board for visibility and effective team communication.

9.1 Organizing Lean IT

When looking at how to deploy people within IT in such a way that they are facilitated in delivering value, the principles for organizing are customer orientation and speed of communication.

Why should an IT organization be customer-oriented? Traditionally, IT organizations have been technology-centric, shaped in functional or technical silos. Quite often the department for application development is structured separately from the operations department. In each of these departments, we may further compound the silo problem by creating teams focused on a particular technology, for example, databases, server management, network management, website development, COBOL programming and so on.

This has led to the impression that IT organizations are essentially not interested in what customers want, only in how to ensure the technology works. In the current world, IT organizations must respond quickly to the needs of the customer. In order to do this, they must gain a customer-centric focus. This does not necessarily mean that they should be organized in customer teams, but it does mean that the orientation through the IT Value Streams must have a strong customer-focus. One of the ways of doing this is to ensure that frontline employees are empowered to

understand and deliver the value required by customers without having to gain permission from management.

IT's customers demand the full service, not just development or operations.

Lean IT organizations ensure a strong customer orientation in the way they are structured with their value streams. The aim of the customer-oriented IT organization is to empower the people in the frontline of the organization to operate effectively and resolve problems quickly. Teams are ideally organized around the full service for a customer or a specific group of customers.

Increasingly, technicians do not necessarily need to be close together. It has become more beneficial to cluster people serving the same customer (group) in a value stream.

The key argument of "technical knowledge sharing" can be solved in other ways. The preferred way of organizing is through multidisciplinary teams that have the mandate to serve the customer integrally.

Quite often, the biggest barrier to adopting lean practices is organizational structure. As products move from one department to another, a big gap often develops, especially if each department has its own set of performance measurements that are unrelated to the performance measurements of neighboring departments. Sub-optimizing measurements are very common, and overall optimization is virtually impossible when they are in place.

9.2 Communication Cascade

Rapid and effective communication is established when information can easily cascade through all levels of the organization.

Therefore, we need to:

- Build an infrastructure of meetings so that ideas, suggestions and requests for help can flow readily through the channels of the organization. When an issue exceeds the mandate of a given hierarchical level, there must be an efficient information cascade to ensure that the request for support gets to the correct hierarchical level as quickly as possible, so the "support" is delivered as soon as possible
- Replace the old for the 'new' meeting structure: Making it more effective and efficient, including the participants who can decide on the relevant issues. Meetings in the new structure are time-boxed and tied together to ensure rapid decision making, and avoiding interruption or lack of focus

Based on above, the new communication cascade works like this:

- At the team level, the team uses a Day Board to start the day. They discuss the planning for the day, synchronize their activities, evaluate issues or production interruptions and they make sure everyone gets the right support for their tasks at hand
- Issues that cannot be solved by the team or exceed the mandate of the team will be handed over to the Team Manager who takes the issues up with the next level of management
- Teams ask for help and will be supported on each issue they face and cannot solve alone
- On a weekly basis, the team discusses its Key Performance Indicators, evaluates team results over the past week and determines what goals need to be achieved in the next week to come. Any impediments the team identifies are discussed. If the team cannot solve these impediments, they will ask for support from a senior level
- At a senior level, the same routine is followed

- On all levels, discussing performance will lead to improvements being identified and appropriate counter measures being implemented

Once the Cascade has been defined and aligned, it is embedded into the IT organization through everyone's agenda. An efficient cascade has been proven to free up time for other important activities. Particularly, the aligned agendas allow for reserving open time-windows for specific problem solving activities like Kaizen events.

Since management needs to spend time on the shop floor for on-the-job coaching, these open time-windows can also be reserved up front.

Common activities to align all agendas for optimal sharing of information are:

- Capture the agendas of all involved and identify recurring meetings, time-frames, involved roles, required decisions
- Start with the shop floor; focus on the work, on operations. Then align coordination and managerial effort with whatever needs to be facilitated on the shop floor

The alignment of agendas is a vital activity for freeing up time. This freed up time can then be used to carry out more improvements. Thus, creating a virtuous cycle in which the delivery of value is continually improved.

9.3 Objectives, Feedback and Performance dialogue

One of the key elements of Lean IT is transparency with regards to objectives and the performance against these objectives at both the team and individual level. If we aim to improve the value stream we should regularly go through the Plan-Do-Check-Act Cycle. The essence is to give and receive feedback and reflect on actions and work completed. The time between the action and feedback is short, which makes the impact much stronger. There is very little impact from feedback received on work completed weeks ago. What were the exact conditions? The perceptions will be quite different. So, improving performance and providing timely feedback are the key methods for continuous improvement.

In a Lean transformation, a lot of attention is given to teaching people how to give and receive constructive feedback. In Lean IT, several instances for reflecting on achieved performance are defined. First, at the start of the day, teams briefly discuss the previous day's results and issues. Second, at the start of the week, the team's performance during the previous week is also discussed. Third, performance is discussed one-on-one between the manager and the employee during the performance dialogue. So, what is new here? Almost all companies have one-on-one manager-employee meetings. Usually, however, those meetings are unstructured and only the current daily tasks are discussed. It becomes more of a social meeting to build the working relationship between manager and employee. Of course, this is positive, but not sufficient enough if continuous improvement is the objective.

The performance dialogue brings together a number of Lean behaviors in a single meeting: Goal-setting based on an integral and factual view of the work, providing support, giving feedback, showing respect.

The following three topics are discussed in a performance dialogue meeting:

1. New and ongoing objectives should be discussed between the manager and employee. What are the mutual

expectations and how are these defined? Unclear expectations are the most common cause for disagreement between a manager and employee. In the performance dialogue, specifically defined objectives are discussed and agreed. These objectives should (again) be SMART. To do this, the manager should be knowledgeable about the daily operations of their team. This is one of the key reasons that a manager should spend 50% of their time with the team in the workplace. A Lean manager cannot be in meetings all day.

2. The manager offers support to the employee for the achievement of their objectives. Why does the employee need to achieve these objectives? How can the manager help facilitate this? The manager has the role of a coach to help the employee and discuss how they can achieve the objectives.

3. Constructive feedback and suggestions for improvement are given. The manager will have observed the employee while working. The manager then gives feedback on how the employee performed or behaved, with the intention of further developing the employee. Ideally this happens in a climate of trust and respect. This is difficult to achieve but essential for building a high performance organization. As the chairman of Toyota once said: "Build people first, then cars."

A performance dialogue can be a one-on-one discussion, but carrying out a day start or a week review is also a form of performance dialogue. The ability to do performance dialogues effectively is a key skill requirement of anyone working in a Lean IT environment.

9.4 Visual Management

In order to improve performance, early feedback and the knowledge of what is happening are key elements of operational management. The biggest change when transforming to Lean IT is the introduction of Visual management - upon entering a workspace or office the presence of Boards indicates a Lean team. The concept of Lean Visual Management is extensively covered in the book "Creating a Lean Culture" by David Mann (2010).

Visual Management fulfills a crucial role in Lean. It ensures we can achieve Jidoka, the aim of which is to create a visible and clear view to ensure that any disturbances to flow can be identified. In effect, Visual Management is about effective team communication. Transparency and visibility are created by a smooth flow of information. This ensures that everyone can follow the progress of work which makes for an efficient coordination of the work.

Visual management covers a number of topics: Steering the work, planning and reviewing progress and managing improvements. For each of these topics, visual management has a set of objectives.

The objectives are:

- To connect management to the day-to-day operation of the team. This ensures that managers are aware of the state of value delivery to customers
- To share information on the progress, priorities and problems of the team, The aim of visual management is to ensure that the information is as current as possible with real-time status updates preferred
- It also facilitates dialogues that are more fact-based. Through the clear definition of work, the team is better able to identify what has been done, what is being done, and what still needs to be done
- Visual management enables the team to see which task is not progressing. In traditional

IT organizations, we find team meetings that happen once a week, sometimes once every 2 weeks. These meetings lead to a list of action points. The dynamic tends to be that most action points do not get carried out by the next meeting. The owner of the action point is put under pressure to carry out the action. This may happen multiple times and may lead to an intended action never being carried out, due to shifting priorities and new action points. Visual management ensures that actions points are reviewed on a daily basis and that time is reserved for the goals that are set

- Visual management also helps to create consistent and effective communication. It removes the need for a series of one-on-one communication that inherently has the risk of an inconsistent message. The communication is effective because the entire team hears the same message at the same time
- Lastly, frequent feedback loops are established within the team. This is based on common knowledge of what is going on in the team. The knowledge is common because it is continually visible and up to date

Quite often, managers spend less than 10% of their time with the team, and are not aware of what the team is doing or where support is needed.

Managers need to embrace the adage 'go see, ask why, show respect' and to really observe the flow of value and what is preventing it from flowing, they need to spend substantial time on the Gemba, the place where the work is done.

9.5 Making work visual

A Lean team uses three types of boards as a technique to create a visually managed workplace: The **Day or Kanban Board**, the **Week Board** and the **Improvement or Kaizen Board**. The objective of **Visual Management** is real time updates, sharing of lessons learned, and reflection/feedback on the work done the previous day. Visual management creates transparency in the status and progress of the work. The benefit of the system is that it is always clear what is going on in the team or department.

Lean requires transparency. Visual management means that even someone who is unfamiliar with the work of a team can, upon entering a Lean workplace, scan and quickly ascertain which aspects of the processes are under control and which are not. Visual management is all about being present on the work floor and using visual aids to show how the organization is performing.

A benefit of working transparently and inclusively is trust. Once employees are brought into the creation, maintenance and improvement of the process, they then have a stake in its success.

9.6 Day or Kanban Board

The **Day Board or Kanban Board** is the visual tool used to support the start of the day's activities.. This 15-minute time-boxed daily meeting offers the team a window to discuss operational performance and allows for synchronization of workload among team members. Impediments that block the work flow can be identified and avoided. As a result, impediments may also find their way to the right level of management or on to the improvement board.

There are two ways of designing the board used on a daily basis:

The first is based on the days of the week. This supports a team that needs to do work on a specific day or wishes to plan work for specific days in the week. We call this a **Day Board**.

Each team member records all the activities they are going to perform that day. On the day board, work is represented with tickets; small cards which make it possible to see which work is progressing and which is not. Regular work, for example, on white tickets, ad-hoc or unplanned work on yellow tickets.

Name	Monday	Tuesday	Wednesday	Thursday	Friday	Done	Blocked

Problems	Tip of the day	Manager's Agenda	☺ 😐 ☹

Figure 6: Example of a Day board

The second is a visualization of the process in which the team ensures tickets 'flow' across the board as the work progresses. This board helps to identify where there is spare capacity for work to be pulled into the next step in the process. This is known as a **Kanban Board**. The design of the board is dependent on the team and type of work they perform. In software development, we may find alternative versions of the Kanban board. These will generally be designed along the lines of the software development process. They may include Backlog, Ready to Code, Coding and Complete or a simpler variation on this theme: To Do, Doing, Done.

The **Day Start** is a daily, morning ritual in which each team member shares with the group their daily tasks and goals, as posted on the Day Board. It is also an opportunity to determine if the previous day was successful and to ask for or offer help if needed. The Day Start is facilitated by a Team Leader.

Typical questions to be asked by the Team Leader are:

- Were the goals of the previous work day achieved?
- What went well and what can be improved?
- What did we learn?

- What is the objective for this day and when are we successful?
- Who needs help on what and who will offer help?

During the day start, the team also takes time to check the morale within the team. In this way, the team leader can identify and act on any problems as they arise. Discussing morale is often initially quite difficult. However, as

team members become more open they will increasingly be prepared to discuss morale issues. This is a sign that the team has a higher level of trust.

Remember to focus on finding and resolving problems. In the bottom left corner of the Day Board, there is a place to document any problems that have been identified. These remain on the board until they are addressed. Also the team leader's daily agenda is available on the board so that the employees know when the leader is available.

9.7 Kanban

Kanban is the embodiment of the pull/replenishment system, as opposed to a push/scheduling system. It uses signals to ensure that production is levelled. The ultimate form of production is single-piece flow, which enables mass-customization.

Kanban is not an inventory control system; it is a scheduling system that helps determine what to produce, when to produce it, and how much to produce. A simple example is that an empty slot on the day board means that there is space for new work, the empty slot works as a replenishment signal for a new Kanban.

Again, this is a visual system that benefits from clear simple information that can be identified at a distance. Often, different colors are used to identify different types of work. These Kanban tickets are typically used on the day board. The benefit is that the requirements for information processing can be simplified as a result of Kanban, since we know exactly what information is needed to ensure the progress of the unit of work.

9.8 Week board

The **Week Board** provides at glance information on the team's objectives for the week to come.

A limited set of key performance indicators offer insight in the development of the team's quality, timeliness, and cost. Other indicators include customer satisfaction and employee satisfaction.

In the week start, the team gathers around the week board and discusses team performance. Identified problems find their way to the improvement board. The week board supports the week start, a team meeting that generally last one hour.

Topics to be covered in the week start meeting are:

- The work objectives for the week to come and whether the objectives from the previous week were achieved
- Improvements that can be made, also given the status of the key performance indicators the team has selected
- Performance on the team's performance indicators, specifically including the way the team works and what the customer thinks of the team's performance

Discussing the improvements on the Improvement Board is often part of the weekly meeting.

Typical questions the team answers include:

- Did we meet our KPIs and team goals last week?
- What went well and what can be improved?
- What are our goals for next week?
- Do you need help?

9.9 Improvement (or Kaizen) board

All improvements identified by employees are registered on the improvement board and discussed and prioritized based on achievability and impact during the weekly reflection meeting. However, having a visual display of organizational goals, activities and performance is not enough for success. The visible presence of managers on the work floor, their contribution to problem-solving and the consistent offering of help are key.

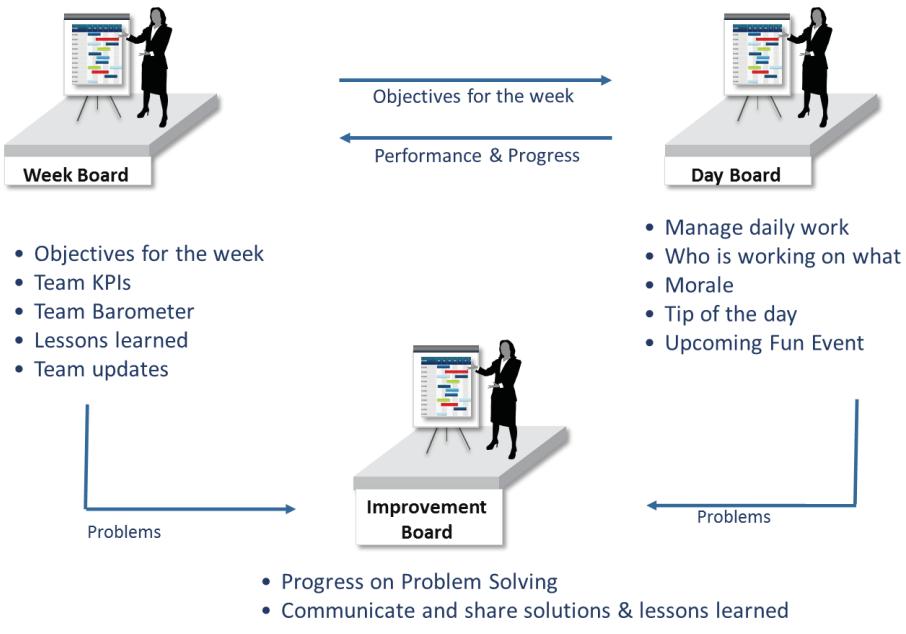
The last board is the Kaizen or Improvement Board. In this example of an improvement board, the team has selected a variety of columns that help them drive the appropriate action to resolve identified problems.

On the improvement board, all problems are listed. For each listed problem, the team determines whether they should solve them right away, solve them later or not solve them at all, once they have defined the impact of the problem and the feasibility of driving a solution. For more complex problems, a Kaizen Event will be planned, using one of the reserved time-slots in the aligned agenda.

Each improvement is evaluated by imagining the business impact of its possible solution and the feasibility for the team to implement the solution. The weekly meeting allows the team to drive continuous improvement. In regular time-boxed windows throughout the week, the team can work on Kaizen events and drive impediments towards resolution. Typical questions the team answers include:

- What problems have been identified on the day and week boards?
- What is the status of kaizen events?
- What are the results of implemented improvements?

Below is a figure in which the role of each board and the relationship between the boards are described.



Both team and individual performance are openly discussed. There is often a great deal of initial resistance and "yes, but..." responses to criticism. This is why management needs to back up any criticism with real data. It is important that the manager constantly clarifies and directs change in order to make daily improvements.

Managers and employees should hunt for problems and find solutions together in order to maintain the spirit of co-operation. In this way, managers can actually steer the organization in the direction desired.

10. Behavior and Attitude

We have discussed how people are the most important asset in the IT organization, based on their ability to bring skills and knowledge to the workplace. Equally important is their attitude towards the work and how they behave.

In this chapter, we will look at:

- The Lean IT mindset
- The attitude and behavior that accompanies this mindset
- How management should lead the way by example, setting goals and motivating employees
- We will look at a concrete example of Lean behavior: the empowerment of employees
- How to handle and overcome resistance by being persistent

10.1 Lean Mindset

As we have discussed numerous times so far, Lean is a way of thinking and acting. Lean behavior starts with Lean thinking followed by Lean acting. The Lean mind-set has the following characteristics:

- It seeks perfection by acknowledging that good is not an end state but a step towards further improvement. Perfection is about delivering quality at the source. The eradication of waste through continuous improvement leads to the Lean principles of Flow and Perfection
- In the same way, problems are seen as opportunities to improve customer value, rather than a reason to apply blame
- Lean challenges people to think differently in the process of delivering value. In Lean organizations, people do not talk about the procedure but the "best known way" of doing something. This implies that there is a better way, only we do not know it yet. Thinking counter-intuitively can lead to new "best known ways" of doing work
- In the process of delivering value for people who are prepared to buy your product and by continuously removing waste from the system producing the value, profit takes care of itself
- Invest in people to create long term relationships. In IT, we also need to look at how we develop long term relationships with external service providers. They can play a crucial role in the value delivered to customers
- Being Lean in the long-term depends very much on what you do in the next five minutes. If you behave in such a way as to deliver value in the short term, the ability to meet long term goals will be much easier. In this way, we can sustainably deliver value
- Within organizations and IT organizations, we have a tendency to look at our department or immediate surroundings. It is vital to look at the whole picture to avoid sub-optimization. For IT this means at least taking an integral view of a service towards a customer

The behavior underlying these characteristics is learning. People working within Lean IT organizations distinguish themselves from other organizations by the fact that they are prepared to learn and that their environment encourages them to learn.

Let's go one step deeper and take a look at the attitude that contributes to a Lean environment. We have seen the characteristics of a Lean mindset. But the mindset is nothing without the right attitude.

Attitude is largely built up from the way we see the world and the beliefs that we have.

The beliefs of Lean are relatively universal and can be summarized by the words of Kiichiro Toyoda, founder of the Toyota Motor Corporation: "Do whatever you please. Just take responsibility."

The following are beliefs that are consistent with a Lean attitude:

- If we believe that improvement is possible, it is a small step to take the responsibility to make the improvement happen
- The vast majority of people come to work to do the right thing, especially if it means having a happy customer. Adding value is therefore a fundamental attitude to most people
- One of the more difficult aspects of a Lean attitude is to be critical AND to bring a solution. Most people are capable of being critical but forget to bring the solution

The last two beliefs are related to a positive view of people: their ability to rise above themselves and to work together to produce better results than what an individual can do alone.

Fundamentally, when building a Lean IT organization, it is vital to help everyone understand the attitudes that will help them and the team succeed. Attitude is the foundation on which Lean behavior is built. Toyota has built its entire behavioral construct on two basic principles: Continuous Improvement and Respect for People.

We will look at continuous improvement from a methodical perspective in the Kaizen chapter. However, it is important to understand the impact of continuous improvement in terms of behavior. Understanding that small concrete adjustments can make a considerable difference from one day to the next is vital to ensuring that these adjustments are made.

These adjustments can only be made if learning is turned into part of the daily routine within the Lean IT organization.

The essential difference between attitude and behavior is that attitude determines the way people approach the situations they meet and behavior is how they react, i.e. what they do as a result for an occurrence. Behavior follows these beliefs in that people will go looking for waste, will treat people with respect and share knowledge based on these attitude characteristics. The figure below lists a non-exhaustive list of Lean and non-Lean behaviors.

Figure 7: Examples of Lean and non-Lean behavior

We have seen that continuous improvement is a fundamental goal of Lean. The most important behavior associated with this goal is learning. Of all behaviors, the ability to learn at an individual and organizational level is the one behavior that truly discerns a Lean IT organization from a non-Lean IT organization.

10.2 Lean Transformation

What makes a Lean transformation a long-term success? When an organization starts with Lean, the first improvement proposals are often evolutionary. These are often quite quickly identified and these quick wins are swiftly implemented. At the start, the success of Lean is particularly visible. As time goes by

and many improvements are identified and implemented, it becomes more difficult to identify new improvement opportunities. The low hanging fruit is taken (or "quick wins"). This leads to comments such as "we're finished with Lean; there's nothing left to improve". Generally, people forget that each per cent improvement is an improvement. Organizations like Toyota do so well because they improve each year with a two percent increase in productivity. Remember that Toyota is more than fifty years down the road with Lean. That is a lot of improvement!

How do organizations succeed in integrating the Lean way of thinking into a long-term source of success and truly adopt a continual improvement attitude? One of the key challenges is for Lean principles to become an integral part of the paradigm used by managers for steering the organization. This means that the consistent set of models and theories used as the thought framework (paradigm) to steer reality must be enriched with Lean principles and methods. Lean, as part of the management paradigm for IT organizations, means managing based on the results produced for the customer; is the customer actually satisfied? The Lean transformation means a significant change in the way managers and employees do their work. We all know how difficult it is to change our behavior!

Changing behavior and attitude is always related to people's expectations of what the change will bring them. Expectations follow a generic development when new working practices are introduced. The figure below shows this generic development.

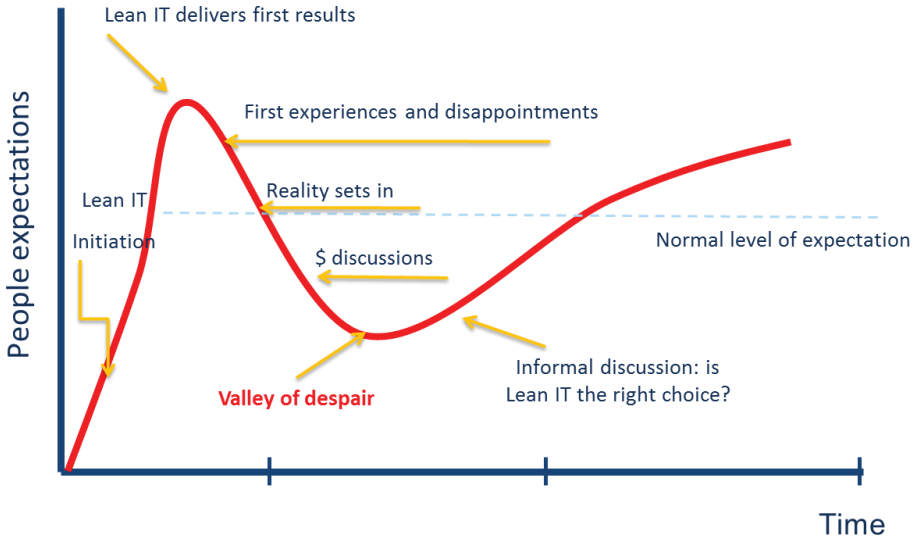


Figure 8: Chart showing how people's expectations develop over time during a transformation

In every change, people's expectations of the results start by moving from low to very high as they see that the change can provide the improvements desired. Unfortunately, these improvements tend to be the "low-hanging fruit", leaving the more difficult improvements to be tackled.

Implementing Lean IT in an organization is not easy. When starting an implementation the benefits of bringing focus on customer value and waste will bring benefits fast. There are examples where throughput times were reduced by more than 30 percent in less than 5 weeks.

After the initial start, a Lean implementation gets more difficult. The tools are in place, and to let them really work, behavior has to be changed. 'Traditional' behavior must be stopped and Lean behavior must become the habit. Changing habits takes time and effort. As a result, some people get disheartened by the hard work needed or start discussions about whether Lean IT is the right choice for the organization.

This despondency is known as the "Valley of Despair". It is then the role of management to show constancy of purpose in seeking to remove waste from the IT organization and provide more value to customers. This is the way out of the Valley of Despair to more realistic expectations regarding what Lean IT can deliver. Both individuals and teams go through this phase. When in the valley of despair, motivated Lean leaders and employees are needed to encourage the IT organization to proceed. After this phase, reality sets in and a real Lean IT team or organization is formed.

For a more detailed discussion of the Lean IT transformation, please refer to the APMG Lean IT Leadership Publication.

10.3 Lean Leadership

Lean Leadership is much more than managing a Lean Transformation. Lean leadership is the behavior and attitude necessary for a Lean organization. Many managers are excited about Lean and they want to "lead by example"(i.e. walk the walk and talk the talk). Often they are able to apply Lean methods but do not know exactly what Lean behavior means. The right leadership behavior and day-to-day modelling are crucial for the long-term success of Lean and continuous improvement.

As we saw earlier, Toyota's Lean behavior is built on continuous improvement and respect for people. It is important to consider problems as opportunities to continuously improve.. This is a marked contrast to organizations where the reaction to problems is to apportion blame. In the end, behavior in the Lean IT organization is all about doing things, rather than just talking about them.

Respect for people is an altogether more difficult and less tangible concept. We have already seen that apportioning blame is counterproductive to continuous improvement; it is also not a very respectful thing to do.

Respect starts by going to see what is actually happening on the work floor. You need to go and understand the situation yourself. The real discussions about the work happen on the work floor, in front of the real situation, with the people who do the work. This does not happen in the manager's office.

Lean IT is about adding value to customers, creating flow, eliminating waste and continuous improvement. We have seen that a positive attitude towards people and working together is necessary. In many IT organizations and teams, people talk about Lean IT but do not really practice Lean. They have the right tools in place but they do not work as well as they could, mainly due to the associated behavior. Managers and employees create waste by exhibiting non-Lean behaviors. Negativity, ego, criticism, gossip, cynicism and sarcasm take away energy from working together and creating customer value.

In Lean IT organizations, the role of managers is different than that within traditional IT organizations. The role of management in a Lean IT organization is one of supportive

leadership. Traditionally, managers do the thinking in meetings. They come up with answers and the employees just do what they are told. Activities are carried out because that is how they have always been carried out. Also, there is an acceptance of errors as part of daily work.

Lean managers give their employees and teams direction, stimulate them to improve their value by asking questions, giving them support to take responsibility for their own work and that of the team. Lean IT leaders also know the value of eliminating defects. They know that the customer value goes up and the costs go down as they stimulate quality at the source.

Being a Lean Leader requires some concrete actions such as:

- Not spending time in meetings. Lean management means showing true interest in how employees execute their tasks. This can only be done by seeing it with your own eyes, and being present on the work floor.
- Using their time on the work floor to stimulate and inspire employees through dialogue and by setting challenging expectations. This is done both at an individual level and at a team level.
- People need to understand that their work makes a difference and it is needed to achieve the goals of the organization, and helping customers to achieve their goals. It is different from just doing your work.
- Taking responsibility. It is vital to build systems and processes that cascade responsibility so that people are able to make a difference. The Cascade we saw in the Organization chapter ensures that help is given by the right level of management. Leaders must take responsibility for ensuring problems are identified and solved.
- One of the most positive ways of influencing people is by coaching and teaching them in the application of existing and new skills and knowledge. This requires that leaders self-develop to ensure that they are able to coach and teach.
- Giving strategic direction, setting goals and stimulating the constancy of purpose. It is vital for all levels of management to work consistently, i.e. Lean management must be implemented at all levels not just at team (operational) level or strategic level.

A good example of Lean leadership is illustrated by the chairman of Toyota, Fujio Cho. He is able to focus on performance objectives without losing an honest interest in people. He spent time on the shop floor to motivate his people to build better products, using 3 steps:

1. **Go See:** observe what is going on (Go to the Gemba; carry out a Gemba Walk),
2. **Ask Why:** Ask questions why things are done a certain way looking for ways to improve quality and customer value,
3. **Show Respect:** Listen to the answers of people working daily with processes and products and show respect for their work and ideas.

The hardest part of a Lean IT transformation is to walk the talk. Really having your focus on Lean attitudes and behaviors; being a real Lean leader and an example for the organization. And by doing so motivating others to become Lean … this takes time and attention.

For a more detailed description of Lean IT Leadership, please refer to the APMG Lean IT Leadership Publication.

10.4 Jidoka

We have seen that Lean leadership is about stimulating and motivating employees and managers to create customer value and

continuous improvement. That is why a Lean organization has a different focus than traditional organizations. The focus of a Lean organization is on the frontline employees creating value for the customers. Employees are empowered to operate effectively. Employees are made responsible for the quality and value of their work. Ideas and ongoing development and improvement of employees is also important.

A clear way in which this empowerment is stimulated is Jidoka, the concept we introduced through Visual Management. **Jidoka** is one of the two pillars of the Toyota Production System, along with just-in-time production. Jidoka highlights the causes of problems because work is stopped immediately when a problem is uncovered. This leads to improvements in the processes that build in quality by eliminating the root causes of defects. With Jidoka, employees are asked to take responsibility for stopping the line to ensure there is quality at the source. The expectation is that everyone is responsible for quality at the source.

A central concept within Jidoka is the **Andon Cord**. This is a physical cord that employees can pull to stop the production line. The Andon cord is pulled some 3,500 times per day in a typical Toyota manufacturing plant. The question is: what are the Andon Cords within the Lean IT organization?

Certainly, with regard to changes, the Change Advisory board meeting must act as an Andon cord, stopping changes that will introduce new errors into the IT infrastructure from progressing in the process.

11. Kaizen

In this chapter, we will investigate how to put continuous improvement into practice using a structured problem-solving method.

Kaizen is the Japanese word for continuous improvement using small, incremental changes. It translates as change for the better. When applied to the workplace Kaizen means continuous improvement involving everyone, managers and workers alike, every day, providing structure to process improvement.

Most importantly, the Lean paradigm calls for the dual focus of doing the work and improving the work every day in parallel to incrementally increasing overall business performance. The preference for gradual change stems from the fact that smaller gradual changes are easier to incorporate to the way of working.

We identify two types of Kaizen: **Daily Kaizen** and **Improvement Kaizen**. Daily Kaizen focuses on carrying out small improvements on a daily basis that are aimed at making work simpler, quicker or more pleasant. For a more detailed discussion of Daily Kaizen, please refer to the APMG Lean IT Kaizen and Lean IT Leadership Publications. Generally, the problems solved are uncomplicated, but cause waste in the value stream. Improvement Kaizen deals with larger problems for which more research needs to be done. Improvement Kaizen is carried out in Kaizen Events.

First, we will discuss what the intent is of improving business performance and doing it continually. Next, we will discuss Kaizen Events and Kaizen Teams.

11.1 Continuous Improvement

The main objectives for improving the performance of IT are:

1. To deliver value better: better quality of service; easier to use by identifying and removing the causes of incidents and minimizing variation in the delivery of services
2. To deliver value faster: faster time to market and innovation, earlier customer feedback to drive further improvements, improve competitive advantage of customers of IT
3. To supply services cheaper: to increase profitability through lower costs of IT services.
4. To create more meaning in our work: pride of workmanship; motivate, and retain the best employees, create a safe environment
5. To leave a healthier environmental footprint: responsibility to society, next generations, and all life on the planet

There is always a trade-off decision. In order to maximize our effectiveness, we need to be aware of the consequences of our balancing act between the five basic objectives. Lean, in essence, encourages us to continually strive to improve performance.

Kaizen Events are used for intensive projects where employees are taken away from their regular jobs for a focused improvement initiative. Kaizen teams are a key part of any Lean initiative. The team gets engaged in a Kaizen event or rapid improvement workshop.

The event is a powerful engine for change as cross-functional teams of people with deep and distinct process knowledge are brought together for a highly focused period to analyze their processes and realize improvements. Kaizen events may also be used as an action-oriented method to systematically deploy the organization's strategy; they have the greatest impact when they are linked to an organization's overall strategic direction.

The Kaizen team is a cross-functional group of people, (often 5 to 8, including the Kaizen Lead and Kaizen Sponsor) working together to implement meaningful improvements to a value stream. The Kaizen team uses the creativity of people working in the value stream, independent of place in the

organization, to take a fresh objective look at current performance and the value that is actually desired by customers. Kaizen teams tend to use visual observations and simple data gathering tools to identify and drive waste out of processes.

11.2 Kaizen Event

While everything should be questioned and anything could be improved, only a few key things are important to improve at any given time. Generally, if a project is important, the organization has an easier time providing appropriate resources to work on the project. Unfortunately, resources are not unlimited. So on most projects, there are some things that cannot be changed at that point in time.

Typical exclusions from Kaizen Events include: Large capital expenditures, adding people to processes, spending more than 3-5 days on one event. Kaizen is a low-cost solution. Projects are usually broken into smaller parts to maintain focus and deliver improvements as quickly as possible. Although the Kaizen event lasts for a few days, preparation can take place over several weeks prior to the activity.

If you are going to do a **Kaizen Event** and want to assemble a team, you first need a problem to solve or an opportunity to take advantage of. There are three basic qualifications for a Kaizen Event to take place:

1. There is gap between current and desired performance
2. The cause of the problem is not clearly understood
3. The solution is not predetermined nor is the optimal solution apparent

11.3 Selecting a subject for a Kaizen event

Good Kaizen event selection can be a key to early success. The selection results in a Kaizen event rationale which serves as a starting point for the Kaizen team, and includes a description of the issue or concern, the focus of the Kaizen event, a broad goal or type of results to be achieved and an overview of the value of the effort.

Deciding on which of the best candidate Kaizens to implement first and allocate resources to, involves a strategic decision about what is most important to the customers and the company, and a check on feasibility. The best Kaizen selection is based on identifying the ones that best align with the organization's current needs, capabilities and objectives. Target areas are usually identified by looking at three categories to answer the question whether the initiative is meaningful and manageable: Results for the customer or business benefits, feasibility and organizational impact

The rationale strikes a balance between giving

clear guidelines to a team on Kaizen event direction and expectations, while not overly narrowing options or dictating solutions. Ensuring support and buy-in for the Kaizens you select means providing a good rationale for your priorities. Common results that can be achieved include:

- Throughput time reduction of 50%
- Productivity improvement of 25%
- Work in progress reduction of 40%
- Defect reduction of 80%

11.4 Roles in a Kaizen Event

Kaizen Events demand certain roles are present on the team:

- **Kaizen Sponsor**. The sponsor is responsible for selecting the initiative, facilitating the selection of a team, deciding on resources required, sponsoring the team towards achieving success, removing roadblocks for the team and reviewing the event.
- **Kaizen Leader**. The leader clarifies the Kaizen rationale with the sponsor, develops a Kaizen charter, selects and supports the team members, maintains the Kaizen approach and schedule, supports the transfer of new solutions to ongoing operations and helps the team towards success by providing the skills, knowledge, and tools to achieve meaningful improvement.
- **Kaizen Team Member**. Team members provide brains and muscle behind the problem definition, measurement, analysis, and improvement of a process.

It is acceptable to adjust the members of the Kaizen team over the course of the event, especially in the transition from developing solutions to implementing them, as long as it does not disrupt the cohesiveness of the group. Different skills and talents often are needed to make process improvements work successfully. Often, a team member who understands the problem but who is less familiar with the value stream may contribute largely by asking insightful questions and forcing other team members to really clarify the issue at hand or the logic of a solution. The Kaizen Leader and Kaizen Sponsor remain the same throughout the event. Ideally, Kaizen Team Members are chosen based on the following criteria:

- Who has the best knowledge of the process being improved and/or contact with the customer?
- Who has the most knowledge about the problem, and/or the best access to data?
- What key skills or perspectives will be needed throughout the course of the Kaizen event and who has these?
- What groups of functions will be most directly affected by the project and who will represent?

11.5 Running a Kaizen Event

Kaizen events follow three stages: Preparing for the Kaizen event, the Kaizen event itself, closing the event and follow-up activity.

Preparing for a Kaizen event is almost more important than the event itself. Poor preparation strongly relates to whether or not the event will drive successful outcome.

Before the Kaizen Event takes place, typical activities are:

- The Kaizen Sponsor clearly defines the Kaizen rationale
- Select the Kaizen Leader
- Select the Kaizen Team Members (people who are intimately acquainted with the problem to be investigated) and complete logistics planning (schedule event, meeting area, workshop materials). Arrange for a

meet and greet with all participants

- Arrange for coverage during participants' absence from their workplace and/or during disruptions
- Assemble background information and draft the Kaizen charter. This document sets objectives and scope for the event, targets for improvement, process start and end points, and lists all participants and their roles
- Perform a Lean assessment of the area and gather data on process attributes such as takt time, cycle time, staff numbers, overtime, process flows, demand data, backlog data and current standard operating procedures
- Select and prepare the appropriate Lean training materials (as required by the event objectives and train the team upfront in the probable methods and tools that will be utilized during the event if required)

During the Kaizen Event, the Kaizen team should follow a disciplined methodology to go from a problem to implemented solution. For the purpose of process improvement, we recommend DMAIC as a five-phase improvement cycle:

- **Define:** clarify the problem and break it down if needed, define requirements, set target and objective
- **Measure:** validate the process, refine the problem, measure inputs, key steps and outcomes
- **Analyze**: develop cause and effect relationships, identify the vital few root causes, validate hypotheses
- **Improve:** develop ideas to remove root causes, test solutions, standardize solutions and measure results
- **Control:** establish standard operating procedures to communicate the way of working and maintain performance, correct problems as needed, present result to the sponsor, and start the next iteration

After the Kaizen Event, the improvements that were made during the Kaizen need to be sustained and further cycles of improvement need to be initiated. A verification that the claimed cost savings are real may be a key success factor for future Kaizens. Just as important as the actual physical results from the event is the way people have developed and grown as leaders as a result of their participation in a Kaizen event.

11.6 A3

Information is generated throughout the Kaizen event. A highly effective way of capturing and presenting this information is by using the A3 Method. This is a method for structured problem-solving in which the Kaizen team is challenged by the scarcity of space (an A3-sized piece of paper) to record the key elements of the Kaizen event concisely and succinctly. The aim is to facilitate the communication of improvements to others within the organization.

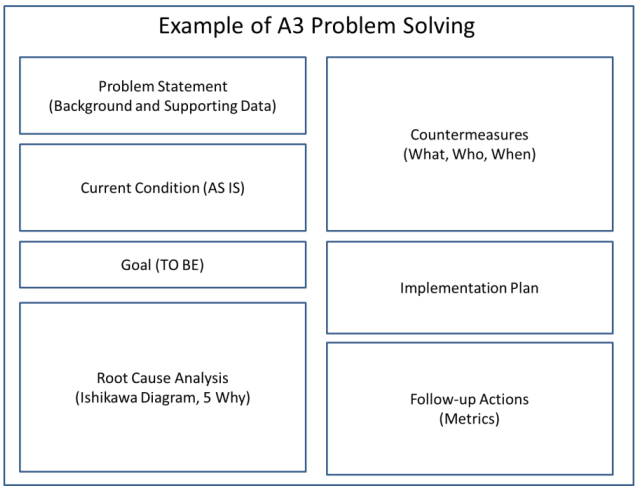


Figure 9: Example of an A3 template

We will now take a closer look on the Five Phases in the Improvement cycle: Define, Measure, Analyze, Improve, and Control.

11.7 Define

The starting point is the problem description. The complication is that the early definition may sometimes be focusing on a symptom rather than on the key-issue. The challenge is to find the key issue. Remember that the initial attempt to formulate the problem may not be exactly right and might need to be revisited throughout the Kaizen event. Working with DMAIC is an iterative exercise.

The problem statement details when the problem has been identified, what the problem is, what its magnitude is, and its impact or consequence. The problem statement does not go into possible causes or solutions.

Once the problem is clarified, it is often broken down in its contributing parts. It's important to keep focusing on customer-centric values. Put the customer first in your problem solving activity. If you have a hard time defining a problem, looking at a process area from a Muri, Mura or Muda perspective will be helpful. Where is the overburden, where is the variation, and where is the waste? In this regard, it is important to note that waste is always a symptom of a problem and not the problem itself.

The purpose of the define phase is to have the team and the sponsor reach agreement on the scope, goals, and financial and performance targets for the Kaizen event.

The results of the **Define** phase consists of four deliverables:

1. A completed Kaizen charter covering the problem statement, business impact, goal statement(s), scope, defined team which is presented to the sponsor and stakeholders. The team should try to capture their communication towards stakeholders on one A3 and use an updated version to visualize their problem solving effort. This way, the team limits itself to the essentials, also making it easier for others to understand what they are trying to solve. Next to a general identification of the Kaizen, we describe the problem, the background, the current condition, the target condition, the countermeasures, the plan to implement them and possible follow-up actions. The relevant elements should be captured on the A3;
2. Documentation showing what customers are affected by this Kaizen and what their needs are;
3. A map of the process that captures the boundaries and scope of the process to be improved (SIPOC). This map helps the team to verify what the inputs of the process are and if they match the outputs of the supplying upstream process, and what the process outputs are and if they match the expectations of the customers of the downstream process;
4. Rules of engagement of the team and an understanding of their way of working throughout the rest of the event

11.8 Measure

In the Measure Phase, the Kaizen team provides factual evidence that a problem or an opportunity actually exists. The starting point is the question: "What is our performance?" Most of the Kaizen team's metrics tend to be process-centric and time-oriented. Process times should be captured for each step of the process. This is the actual elapsed time for each step in the process and it includes:

- **Lead Time**: is the total elapsed time between the customer placing an order and the delivery of the product or service.

- **Cycle Time**: is the time per unit of work in the value stream or total cycle time is the time from start of the value stream to its conclusion. Cycle time is impacted by wait or setup time as well as the capacity and throughput at the limiting work station, constraint or bottleneck in the process. A key element to remember is that the process cannot produce faster than the limiting work station or constraint.
- **Machine Time**: for the automated portion of the process
- **Queue Time**: time while materials of information wait in queues

The Kaizen team should visually display their measurement results using histograms, Pareto diagrams and other simple data displays. Once the information gathered looks useful for analysis and decision making purposes, the team is ready to move on to the next phase.

It is possible in this phase that quick win improvements are identified. During the Measure phase, the first concrete insights are gained into the nature of the problem. It may be that certain necessary, easy-to-implement improvements related to this problem statement are very clear. These should be implemented as soon as possible, preferably before moving on to the Analyze phase.

The purpose of the Measure phase is to thoroughly understand the current state of the process and collect reliable data on process speed, quality, and costs that you will use to expose the underlying causes of problems. Therefore, the deliverables of this phase are:

- A Value Stream Map that displays baseline measures on time, quality, and cost. The map should show the main process steps relevant to the project scope, customer demand rate, and cycle times for those steps. Supplier and customer loops need to be clearly identified and input and output clearly understood by the team
- An updated Kaizen charter or A3 which is presented to the Kaizen sponsor

11.9 Analyze

The **Analyze** Phase is where the team determines the key improvement opportunities. Analysis builds on the work started in the Define and Measure phases. At this stage, teams should not try to justify or improve, but merely capture the ideas and use their best judgment to describe potential opportunities. Every process step does not need to have improvement potential. The team should focus on those where meaningful improvement exists. Value added steps typically change the form, fit, function, or information content of the IT service, and these steps tangibly contribute value in the customer's eyes. Non-value adding steps are waste, all of which should be targeted for potential elimination, if possible.

From an analysis standpoint, the Kaizen team is seeking to balance the rate of production to the customer's rate of demand in order to establish flow. Bottlenecks and constraints in the process have a negative impact on the process throughput and possibly the ability of the process to meet demand.

The observed effects all have a cause. Drilling deep to the root cause is often supported by the "5 Why" technique, to prevent the team from being satisfied with superficial answers that won't fix the problem in the long run. It is the team's challenge to identify the root cause of process effects and define which will be targeted for improvement in the next phase. The team answers 4 questions:

1. What are the causes?
2. What are the effects?

3. What is the relationship between causes and effects?
4. How important is each cause regarding the problem?

Often, the causes and effects are visualized in an Ishikawa or Fishbone diagram to provide structure in the team effort uncovering cause and effect relationships. The diagram is also to ensure a balanced list of ideas has been generated during brainstorming or that major possible causes are not overlooked.

The purpose of the analyze phase is to pinpoint and verify causes affecting the key input and output variables tied to the goals of the Kaizen. The primary deliverables typically include a list of improvement opportunities, data analysis that describes a 'before' and proposed 'after' state, identification of the problem's root causes and their priority. An updated Kaizen charter or A3 should, again, be presented to the Kaizen sponsor.

11.10 Improve

In the **Improve** Phase, the team has validated the causes of the problems in the process and is ready to generate a list of solutions for consideration. They will answer the question "What needs to be done?" As the team moves into this phase, the emphasis goes from analytical to creative. The first task in this phase is to develop ideas for improving the process. Often, ideas are generated by use of brainstorming. Ideas can also be generated using other tools. For every situation, people have assumptions about what can or cannot be done. Reversing the assumption, or modifying it, may help the team think of new ways to do the process.

After a list of solutions has been developed, the team will need to select the desired solution that will be presented to the Kaizen sponsor. The team could take each solution, one at a time, and determine what current business conditions would be obstacles to implementation versus what would be beneficial to the implementation. The solutions are prioritized by assessing the impact and feasibility of each opportunity. Each solution could also be compared by ranking them against the others, to help clarify priorities and give structure to making decisions in the team.

However, finding a good solution is not enough. A solid cost/benefit analysis, and the presentation to the sponsor are important to convince others in the organization. Often, the precise value of the financial impact is not known, and neither are the direct and indirect costs. For example, at times it may be difficult to determine how an anticipated improvement in customer satisfaction of a given item will translate into financial benefits. In these cases, a range of values can be used, of what can be reasonable expected. This analysis attempts to understand the total range of variation associated with the 'most likely' situations. By displaying the total range of variation, the decision-maker is more equipped to understand the risks associated with the proposed solution. This way, even if the benefit cannot be quantified, it is still made visible in the decision-making process. By running a pilot implementation, the team reduces risk of failure and tests the validity of the solution, even though running a pilot causes a delay to full scale implementation and realization of benefits.

The purpose of the improve phase is to learn from pilots of the selected solutions and execute a full-scale implementation. The primary deliverables typically include an evaluation, selection and optimization of the

best solution, the execution of a pilot and full-scale implementation plan and, as a result, an improved process that is stable, predictable and meets customer requirements. Again, the updated Kaizen charter or A3 should be presented to the Kaizen sponsor.

11.11 Control

In the **Control** Phase, the emphasis is on a successful implementation and maintaining the gains achieved. The question the team is trying to answer is, "How can we guarantee performance and ensure that the improvement is sustainable?" The team needs to ensure that the success they have seen from the Improve Phase will continue. This includes transferring the responsibilities to the process owner, for instance by leaving tools and knowledge to help the owner manage the process after the team has gone. Tools help monitor and control the process and they need to be institutionalized. The team created 'as-is' performance measures in the Define phase. In the final phases of the Kaizen event, these measures need to be updated and they should indicate the effect of the implemented solution in the target area.

Often, a new way of working will help sustain the implemented solution. The team should capture this in a **Standard Operating Procedure**, preferably created together with the people responsible for working in that area.

One of the powerful aspects of running Kaizens in an organization is to take successful implementations and expand them across the entire organization. Replication is taking the solution from the team and applying it to the same type or a similar type of process. Standardization is taking the lessons learned from the team and applying those good ideas and solutions to other processes. The team should consider standardization and replication opportunities to significantly increase the impact on the business to far exceed anticipated results by the pilot and solution implementation.

Ensuring that people use new ways of working is always difficult. Lean includes the concept of **Poka Yoke**. This is all about making it impossible to make mistakes. Literally, Poka Yoke means to prevent unintended mistakes. Examples are designing processes or products so that there is only one, preferably easy, way to use the process or product. For each solution that we aim to implement we must ask ourselves whether it is poka yoke.

When the Kaizen event is officially over, a team evaluation may be done to assess how each individual did as a team member. Management may devise rewards to recognize the work of the team, and the team may share the knowledge gained with others.

The purpose of the Control phase is to complete Kaizen work and hand off the improved process to its owner, with procedures for maintaining the gains. The primary deliverables typically include the before and after data on process metrics, operational training on Standard Operating Procedures and a completed Kaizen charter, including lessons learned and recommendations for further opportunities.

11.12 Kaizen Tools

A variety of tools can be useful to the Kaizen team:

1. **The Kaizen Charter / A3 Visualization**: Next to a general identification of the Kaizen, the team, and the process area, its content is: the problem, the background, the current condition, the target condition, the countermeasures, the plan to implement them and possible follow-up actions. This tool is used throughout the Kaizen event to record the results.
2. **The Pareto Diagram:** A type of chart that contains both bars and a line graph, where the cumulative total is represented by the line. The purpose of the Pareto chart is to highlight the most important root causes of the problem among a (typically large) set of factors. This tool is mainly used in the Analyze phase.
3. **The Value Stream Map**: A method for analyzing the current state and future state for the series of events that take a product or service from its beginning through to the customer. Key metrics associated with value stream mapping are value adding times and no value adding times. The VSM is developed in the Analyze phase.
4. **The 5 Why Technique**: An iterative question-asking technique used to explore the cause-and-effect relationships underlying a particular problem, used in the Analyze phase. The primary goal of the technique is to determine the root cause of a defect or problem
5. **The Fishbone or Ishikawa Diagram**: A type of relationship diagram that shows the causes of a specific event usually grouped into major categories to identify sources of variation. Categories most commonly used in Lean IT are People, Process, Policy and Technology. This tool is mainly used in the Analyze phase.
6. **The Solution Matrix**; A matrix, used in the Improve phase, in which solutions are plotted after an impact and feasibility analysis, to visually demonstrate which solution should be pursued with the highest priority.

11.13 Kaizen Pitfalls

Experienced Kaizen leaders have identified the key factors for running a successful Kaizen and the common pitfalls to avoid. We will discuss these briefly.

Common pitfalls and the associated steps to rectify the situation are:

Phase	Pitfall	Countermeasures for pitfall
Define	Too much detail in the process map	Strive to cover about 80% of all possibilities
	The scope is too big	Use data and a refined SIPOC to re-scope; use a Pareto chart to identify and select the biggest cause of the problem

Measure	Too much data	Use the cause and effect diagram to find the data that should be analyzed
	The measurement system is not valid	Study the process to better understand it and to design a collection plan that result in representative data points
Analyze	The assumptions were not checked	Verify assumptions with a variety of stakeholders
	Jumping to conclusions	The team should always use a selection of appropriate graphic tools to endorse its analysis
Improve	A preferred solution is pushed	Use a structured decision-making technique to select the best quantified solution that all team members can support
	The impact of the change on people in the process is underestimated	Give proper attention to communicating the solution to all stakeholders by relating to all interests and objections
Control	Early finish	The team needs to define tools to monitor the process and appropriate actions to be taken
	Poor benefit realization	The team should always consider opportunities for replication and standardization by use of Standard Operating Procedures

The DMAIC methodology is a powerful five-phase approach to addressing a process that needs improvement. The keys to having a successful Kaizen Event are:

- Establishing that the project is a business priority
- Understanding the true requirements for the process
- Using data to tell the story
- Picking the right tool for the right situation
- Communicating the Kaizen goals, accomplishments and successes
- Building credibility and support for the Kaizen

Literature

Lean Thinking, James P. Womack and Daniel T. Jones, Simon and Schuster, 1996

The Lean Toolbox for Service Systems, John Bicheno, PICSIE books, 2008

Creating a Lean Culture, David Mann, CRC Press, 2010

Glossary

Term	Description
Agility	Increasing agility means being more able to adapt to customer value requirements
Andon	Literally, this is a signal. An Andon System or Cord is one of the principal elements of the Jidoka quality-control method pioneered by Toyota as part of the Toyota Production System and now part of Lean. It gives the worker the ability, and empowerment, to stop production when a defect is found, and immediately call for assistance
Batch and Queue	A Push production model where products are created before customer demand and in a certain quantity at production cycle. After production the products are stored (queued) in stock until the customers demand is received.
Behavior and Attitude	The way people think and act.
Cause and Effect Diagram	See Fishbone diagram.
Change Over Time	Time needed to reconfigure a machine between two different products
Common cause variation	Sources of variation in a process that are inherent to the process, also referred to as noise.
Continuous Improvement	Ongoing process in an organization with the objective to find, resolve and share solutions to problems. The objective is achieve perfection, in other words to improve value streams, product and customer value. A philosophy of frequently reviewing processes, identifying opportunities for improvement, and implementing changes to get closer to perfection.
Cost of Poor Quality	The price you have to pay for poor quality products or services. For example claims, fines and loss of customer confidence.
Critical to Quality	Critical to Quality is an attribute of a part, assembly, sub-assembly, product, or process that is literally critical to quality or, more precisely, has a direct and significant impact on its actual or perceived quality.

Customer	The person or group of people who buys, uses or derives value from your product or service OR the person next in line in the value stream. The person 'next in line' is sometimes referred to as a 'partner in the value stream', or an 'internal' customer.
Customer Value	A capability provided to a customer at the right time at an appropriate price, as defined by the customer. The more a product or service meets a customer's needs in terms of affordability, availability and utility, the greater value it has. Thus, a product with true value will enable, or provide the capability for, the customer to accomplish his objective.
Cycle Time	Cycle Time is the total elapsed time to move a unit of work from the beginning to the end of a process
Day board	A board used to share information and updates within the team focused on identifying short term priorities, blockages and dependencies. The Day board is used during the Day start meeting and is a key element and enabler of Lean Visual Management
Defect	Output of a process that does not meet requirements. For example a product that does not function as specified. Defects generate rework.
DMAIC	Acronym for the five steps in problem solving with Kaizen, i.e.: Define, Measure, Analyze, Improve and Control.
Failure Demand	Demand from the customer based on a failure of the IT service as opposed to a request for value, e.g. findings from an acceptance test or resolving an incident
Failure Stream	A sequence of activities triggered by a customer as a result of failure in the product/service, aiming to resolve a defect, or to provide information on how to best use the system. Opposite of a value stream. A failure stream does not add value to the customer. For example, resolving an IT incident.
First in First Out (FIFO)	Work is processed on a' first come, first served' approach.
Fishbone diagram	The fishbone diagram identifies many possible causes for an problem. It can be used to structure a brainstorming session. Also known as an Ishikawa diagram

Five "Whys."	A root-cause analysis tool used to identify the true root cause of a problem. The question "why" is asked a sufficient number of times to find the fundamental reason for the problem. Once that cause is identified, an appropriate countermeasure can be designed and implemented in order to eliminate re-occurrence.
Flow	The smooth, uninterrupted movement of a product or service through a series of process steps. In true flow, the work product (information, paperwork, material, etc.) passing through the series of steps never stops.
Gemba	The place where the work is done. Within a lean context, Gemba simply refers to the location where value is created
Gemba Walk	Go to the place where the work is done with the intention of understanding what is actually happening there. The opposite is a Gallery Walk, in which management walks around but does not take time to understand problems.
Improvement Board	Board that presents current problems and the follow-up to resolving or addressing that problem (also Kaizen Board); an element of Visual Management
Inflexibility	Inability to meet customer demand with a certain resource. For example, you have sufficient employees but they do not have the right skills to work on the current customer demand.
Input	IThe resources used or transformed by a process; also known as the Xs or the input variables.
Inventory	All components, work in process, and finished products not being processed but stored and waiting.
Ishikawa diagram	See Fishbone diagram.
IT Outcome	The delivery of IT products or services to the business (customer).
Jidoka	Japanese word for autonomation, which aims to prevent the production of defective products or services.
Just-in-time	A system for producing and delivering the right items at the right time in the right amounts, so that inventories are kept to a minimum.

Kaikaku	Japanese for "radical change" is a business concept concerned with making fundamental, transformational and radical changes to a production system, unlike Kaizen which is focused on incremental minor changes.
Kaizen	An improvement philosophy in which continuous incremental improvement occurs over a sustained period of time, creating more value and less waste, resulting in increased speed, lower costs and improved quality. When applied to a business enterprise, it refers to ongoing improvement involving the entire workforce including senior leadership, middle management and frontline workers. Kaizen is also a philosophy that assumes that our way of life (working, social or personal) deserves to be constantly improved.
Kaizen board	See Improvement board
Kanban	Literally, a signal. Kanban is a scheduling system for lean and just-in-time (JIT) production. Kanban is the embodiment of the pull/replenishment system (see Pull)
Kanban Board	A Kanban board is a workflow visualization tool that enables team collaboration focused on monitoring the flow of work. Physical Kanban boards often use simple work records like sticky notes on a whiteboard to communicate status, progress, and issues.
KPI	Key Performance Indicator, a measure indicating a key performance metric of a process, condition or state. A KPI should be in line with the strategy, long lasting, and consistent in the cascade from top to operational level.
Last in First Out (LIFO)	Work is processed in a 'last arrived, first handled' approach.
Lead Time	The time needed between the customer placing the order and the product or service delivery.
Machine Time	The time a machine is working on a product.
Metric	A measurable characteristic of a variable that is regarded a performance indicator.
Motion	People or equipment moving or walking more than is required to perform the processing.
Muda	Japanese word for waste. See Non-value-added and Waste.

Mura	Japanese word meaning unevenness; irregularity; lack of uniformity; variation
Muri	Japanese word meaning overburdened, unreasonableness; excessiveness. Often related to policy-based waste
Necessary non-value-added	Activities that add no value from the customer's perspective but are required in order to operate the business. This could include legal and regulatory requirements as well as certain internal business processes which would put the business at risk if eliminated in today's environment.
Non-value-added	Activities that add no value from the customer's perspective nor are they necessary to properly run the business. These activities are often legacy in nature ("we've always done it that way").
Organization	Lean IT is structured in five dimensions. Organization is the dimension that covers all aspects related to the way the company is structured.
Output	Products or services created as a result of a value stream or process.
Overburden	See Muri
Over Processing	Type of waste. It means doing the work better than requested by the customers. Also referred to as gold-plating.
Over Production	Type of waste. It means producing more than requested by the customer.
Parallel Lines	Number of lines of production that can operate in parallel. For example 3 cashiers in a supermarket handling customers at the same time.
Pareto diagram	Bar chart showing the causes of problem or condition order from large to small contribution. Effective tool to show what the big contributors to the problem are.
Perfection	A key objective of Lean to bring a product or service into a state where the number of defects is zero or as close as possible to zero. Relates to continual improvement.
Performance	Performance is the ability to achieve defined goals in time, related to customer value.

Performance Dialogue	Conversation between to two people in which three topics are discussed: defining objectives, offering support and giving feedback on achieved results. For example a Performance Dialogue between manager and employee. Also, a meeting at the Day Board or Week Board is also a performance dialogue.
Poka Yoke	Literally, to prevent an unintentional error, this is a concept aimed at ensure that activities can only be done in one way, the right way; foolproofing an activity
Problem Board	See Improvement board.
Process	A series of actions that must be performed correctly in the correct sequence at the correct time to create value for a customer.
Process Cycle Efficiency	A measure of overall process health focused on the percentage of value-add time (work that changes the form, fit or function as desired by the customer) divided by process lead time. PCE = Value Add Time / Process Lead Time. PCE is an indication of how efficiently the process is converting units of work to process outcomes.
Process Throughput	The number (volume) of products or services that a process can produce within a timeframe.
Process Throughput Analysis	A tool to perform a process analysis with the objective of calculating process output, e.g. process throughput and constraints. Used to improve the capacity of a process.
Pull	A system of cascading production and delivery instructions from downstream to upstream activities in which nothing is produced by the upstream supplier until the downstream customer signals a need.
Push	Push Production. A system where an upstream process produces as much as it can without regard to the actual requirements of the next process and sends them to the next process whether they have capacity to begin work or not. Push Production typically results in queues of work building up, which result in delays.
Re-work	Activities required to fix defects of a product or service produced by a process to meet the requirements

Root cause analysis	Studying the fundamental causes of a problem, as opposed to analyzing symptoms.
Skills and Knowledge matrix	Skills and Knowledge matrix is used to steer team development to meet skills demand. The objective is that team skills are aligned with the customer demand for those skills.
Standard time	Estimated time within which a specific process or process step can be executed, e.g. we should be able to complete receive and record an incident in 10 minutes. The average time may, in practice, be higher or lower.
Takt Time	The pace at which work must be completed to meet customer demand. Takt, a German word meaning pace, is the heartbeat of any Lean system. Process Time divided by Takt Time yields the number of workers required to support a specific product. To calculate, divide the available work time by the customer demand for that period. For example, if a call center receives 900 calls per shift, and there are 27,000 seconds of available work time, the takt time is 30 seconds per call. Therefore, one call must be completed every 30 seconds to meet customer demand.
Transportation	Movement of products in a factory. It is a type of waste if products are transported more the strictly needed.
Trend	A gradual, systematic change of a metric over time
Unit of Work	Describes the unit (the thing) that goes through the process, for example incidents, cars, designs etc.
Value Stream	A value stream is a set of specific actions to create a product or service. The specific activities required to design, order, and provide a specific product or service from the point of product (or service) concept, through launch, ordering raw materials, production and placing the product (or service) in the hands of the customer. From a shareholder's perspective, the Value Stream could also include the steps and time required until the receipt of revenue.

Value Stream Mapping (VSM)	A technique used to analyses the flow of materials and information currently required to bring a product or service to a consumer. A visual representation of all of the process steps (both value-added and non-value-added) required to transform a customer requirement into a delivered good or service. A VSM shows the connection between information flow and product flow, as well as the major process blocks and barriers to flow. VSMs are used to document current state conditions as well as design a future state. One of the key objectives of Value Stream Mapping is to identify non-value adding activities for elimination. Value Stream Maps, along with the Value Stream Implementation Plan are strategic tools used to help identify, prioritize and communicate continuous improvement activities.
Value-add	Activities that add value in the eyes of the customer. The customer is willing to pay for this work.
Variability	Variation in the output of a process in quality and demand volume. Fluctuation in cost, quality or throughput time in the delivery of value. See also Mura
Visual Management	Visual management concerns the use of displays, metrics and controls to help establish and maintain continuous flow, and giving everyone a view of the work along the value stream. Its aim is to ensure transparency and understanding of the situation.
Voice of the Business (VOB)	Defines the needs and requirements of the most important stakeholders from the organization, for example market share, growth and profitability.
Voice of the Customer (VOC)	Term to describe the in-depth process of capturing a customer's expectations, preferences and aversions with the objective to create products or services that that meet the customer's needs and preferences.
Voice of the Process (VOP)	Defines the needs and requirements of the processes
Voice of the Regulator (VOR)	Defines the needs and requirements of the external regulator
Waiting Time	Waiting for the next production step to begin.
Waste	Any activity that consumes resources but does not provide value as defined by the customer. Also referred to as Muda or Non-value-adding activities.

Week board	Board used to share information about the team's performance over the previous week, and objectives for the coming week; an element of Visual Management
Work in Progress (WIP)	Number of items worked on (in progress) in the process.

Authors

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