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Chapter

Continuous Improvement

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Abstract

The principles and concepts originated mainly in Toyota in the 1950s and now presented in models such as Lean Thinking, Shingo Model, and The Toyota Way itself are powerful ideas to bring success to organizations, but the path is not easy. In theory, there are two main features to reach effective and sustainable success, the right vision (True North) and continuous improvement toward that vision. Those two main features are as easy to understand as they are difficult to accomplish. Even when senior leaders have full understanding and belief, the effective implementation on a daily basis is an enormous challenge. This chapter will show how organizations can implement sustainable and stable continuous improvement systems. It will describe the principles that must be followed, the necessary requirements that must be fulfilled, the way the organizations must be structured in teams, the necessary routines, and all the practical steps necessary to reach that sustainable and stable continuous improvement system.

Keywords: continuous improvement, lean thinking, Toyota way, Shingo model

1. Introduction

In the view of many senior industrial engineers and managers, the production philosophy that emerged in Toyota during the 1950s represented a major paradigm shift in the way of thinking about production. The previous milestone had been the mass production paradigm exemplified by the creation of the production and assembly lines. The assembly line concept developed at Ford (curiously another car construction company) revolutionized the industry and society of that time (beginning of the twentieth century). This paradigm produced huge cost reductions and it made possible for people from all over the world to gradually gain access to products that they were unable to have before. There is a less positive side of this way of working, especially in the way operators were seen by the system. The human operator was seen in this system as a purely mechanical resource with the ability to repeat small operations over long periods of time. This repeatability was seen, and is seen still, as a way to achieve high efficiency gains because it is admitted that those who do repeatedly the same operation become masters at doing that operation. With experience, we began to understand the problems that can result from this approach, namely an increase in errors that lead to loss of quality, greater risk of accidents, greater risk of developing musculoskeletal injuries and greater propensity for demotivation at work.

Although Toyota had been using its new production paradigm in its factories since the early 1950s, the first scientific publications on TPS emerged much later. It was not until the 1980s that both Taiichi Ohno and Shigeo Shingo – the two engineers to whom the development of TPS is essentially attributed – published in English about this new paradigm, their concepts and main techniques and practices.

Although Shingo's work (translated by Andrew Dillon), entitled "A Revolution in Manufacturing: The SMED System" (Shingo, 1985), was published earlier, it does not present TPS in general, but rather a concrete methodology, called SMED (Single Minute Exchange of Die), specially designed to reduce equipment setup times. Thus, the first English-language book on TPS was that of Taiichi Ohno, entitled "Toyota Production System: Beyond Large-Scale Production" (Ohno, 1988).

However, it was in 1977 that the first scientific paper on TPS was published in English [1]. This article featured several facets of TPS, including technical aspects such as kanban number calculation (way of controlling production, explained below). However, what aroused the most interest in this publication was one of the two fundamental concepts of TPS. The authors state that TPS is based on two fundamental concepts, the first being the "reduction of the cost of eliminating waste" and the second "treating workers as human beings and with consideration". Although the former is "relatively" easy to understand, the same cannot be said of the second. In fact, none of the concepts are easy to grasp and practice in its fullness, but the second is much more complex. This side of the TPS is also referred by Mike Rother in his book about Toyota Kata [2] as the invisible side of the Toyota approach. This side is also referred by the Shingo model as the social science part of the TPS. It is exactly on this invisible side or social sciences side that the West has struggled to understand and master.

This chapter is dedicated to continuous improvement (CI), and CI is only really effective if the less visible side of the TPS more related to people and culture is seriously taken into account. The continuous improvement (CI) concept is not fully understood by every manager, practitioner, or academic. The three main misconceptions are: (1) CI frequently assumed as being the same as Lean; (2) any improvement is CI, and (3) occasional improvements are CI.

CI is one of the five principles of Lean Thinking and not the same as Lean Thinking. CI is a very important component of Lean but there are other important components as well. Lean without CI is not Lean at all but Lean is more than just CI. There is another word, "Kaizen", which is also used frequently and adds to the confusion. The meaning of *Kaizen* is something similar to continuous improvement but that same word is also used as including the other dimensions that are observed in Toyota factories such as pull production concept, value and waste, visual management, and so on. For many industrial engineers and managers *Kaizen* is similar to *Lean* or TPS itself. CI is only one part of Lean or part of the TPS while the other part is in short a set of principles that define the direction that the CI should follow, as depicted in **Figure 1**.

In contrast, it is wrong to consider any improvement as CI. Any improvement that is not aligned with the defined direction or "true north" cannot be considered as an improvement. Improvements must be increments toward the direction that is defined by the top management people (see **Figure 1**). Let us imagine that the direction is defined as being toward one-piece-flow. The meaning is that the effort should always be in finding solutions to reduce the lot size again and again. Then by some reason a team of engineers promotes an "improvement" that results in a reduction of production cost per unit achieved with bigger lot size and a consequent increase in inventory. Can that "improvement" be considered an improvement? The answer is no because the direction defined was exactly the opposite, the equivalent of pursuing lot size reduction.

Finally, an occasional improvement is not CI. Many articles are published where authors referenced CI which only described a single occasional improvement, either being a setup reduction project or layout improvement project resulting in less transport and motion waste. In reality, these type or actions are important for companies' competitive, no doubt about it, but CI is completely different. CI is

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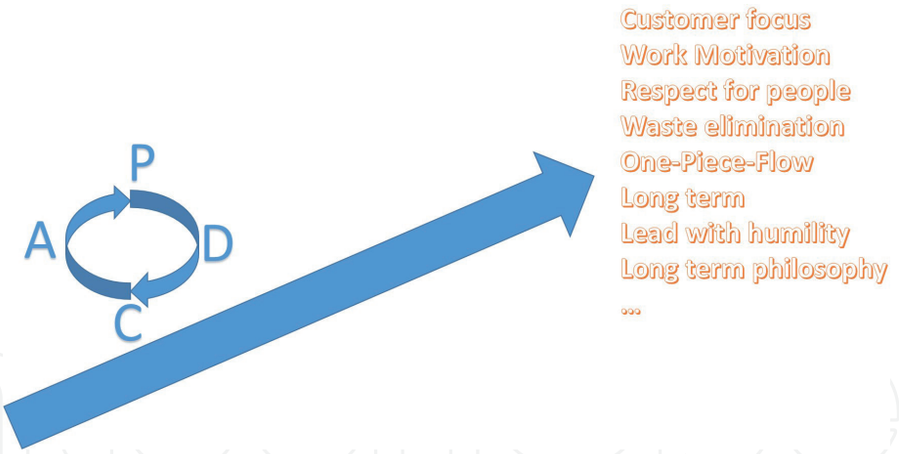


Figure 1.
Continuous improvement direction.

the platform, the systems, the structure, and routines that allow the generation of improvements in a continuous, stable and sustainable way.

2. Reference models

The production management and organization models that are used here as frameworks to CI are all of them inspired from Toyota approach to production or the Toyota model itself. These models will be here described basically in terms of their principles because their principles lead the possible practical solutions developed and implemented in organizations that adopt them.

2.1 Lean thinking

During the 1970s and 1980s, Western companies gradually became aware of what Toyota was doing, especially car manufacturers, because of the impressive results they were achieving. Terms such as *Just In Time* and *Kanban* became very popular as referring the Toyota practices during the 1980s but the word "Lean" as referring the general Toyota approach to production was introduced in 1988 [3] and later popularized by the famous book "The Machine that Changed the World" [4]. The word "lean" attached to words such as "production", and "manufacturing", started to be part of the vocabulary of industrial engineers and managers around the world. Lean as a way of thinking, called "Lean Thinking", was then proposed by [5] and supported by the following five principles:

- Identify value: The idea is that one should try to identify as best as possible what the market interprets as value for the products that the company offers in the market. It is much more important to interpret the value given by the customer to the different characteristics of our product than the value given by the creator of the product itself. This idea is very much linked to popular knowledge "No One Should Be a Judge in his Own Cause". The value should not be given by the cost of the product. Many of the costs that are associated with the product may be associated with characteristics that are not recognized as value by the customer.

- Identifying the value chain: Once identified what is the value of a product from the customer's point of view it is important to identify which processes add value and which processes do not add value and try to eliminate or reduce the latter.

- Create flow: This principle argues that products when they are stopped waiting for the next step in the process represent waste. Ideally, products should always be either transformed in operation (or process) or being transported (as little as possible) to the next operation or process. This principle identifies products that are waiting for the next step, as waste.

- Create customer-pulled production: Implement the production pulled by the customer: ideally means that an operation/process is only performed when the downstream operation/process needs it, with the delivery to the customer being the last of these operations (i.e. the customer "pulls" the production).

- Pursue perfection: This principle is very important and requires major transformations in the structure and culture of organizations. This is where the continuous improvement and the central theme of this chapter is framed.

Lean principles suggest a stronger connection to the physical part of the Toyota approach than to its human side. The term "Lean", in my interpretation, may have been the term chosen by the perception that the researchers had to what they observed in Toyota factories. The reduction of waste ("fat"), especially the reduction of WIP (and the consequent increase in the flow of articles throughout the manufacturing processes) would be easy to observe. This fact may have given the idea of "leanness" as can be interpreted when looking at **Figure 2**.

As it can be seen at the bottom part of **Figure 2**, a smaller amount of WIP is metaphorically represented by a narrower pipe, i.e., it can be said that the production looks "leaner".

Different scholars of Toyota's approach vary greatly in the emphasis they give to the technical aspects and human/culture aspects. If we look at the five Lean principles, we realize that 4 of them are dedicated to technical aspects while only one is dedicated to a mixture of technical aspects and human/culture aspects. It is the principle of continuous improvement or pursuit perfection which is in fact the central theme here in the chapter.

2.2 Shingo model

The Shingo Model was developed in the same period as the Lean Thinking model. The Shingo Model however gives more emphasis to human and cultural

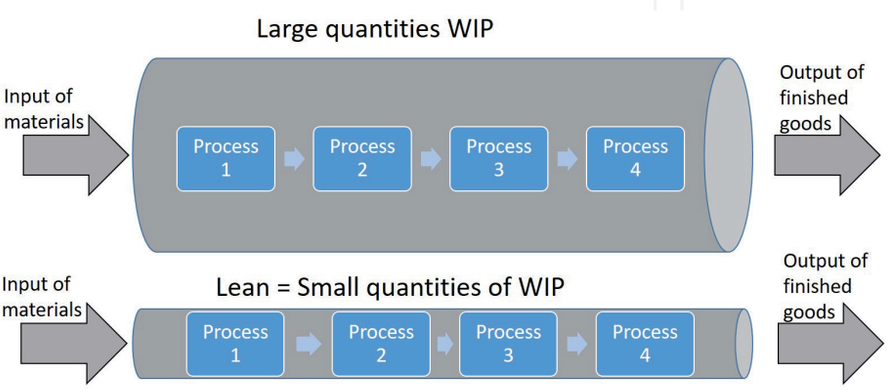


Figure 2.
The physical "leanness" observed with low levels of WIP.

aspects than Lean Thinking. The Shingo Model [6] is the basis of the Shingo prize created by the Shingo Institute in 1988, curiously at the same time that the term "Lean" was being coined by the previously referred MIT group led by James Womack [3].

The Shingo Institute was established in 1988 at Utah State University in the USA following an honorary doctorate awarded to Shigeo Shingo himself. Shigeo Shingo contributed, with Taichi Ohno, with various theories and methodologies for the development of the Toyota Production System. He has written several major books including "A Study of the Toyota Production System: From an Industrial Engineering Viewpoint (Produce What Is Needed, When It's Needed)" first published in English in Japan in 1981 and then published in the US in 1989 [7]. The name of the institute was assigned in his honor. The Shingo Prize was established in 1989 and, in that year the prize was awarded to a single company, located in Bekerley in the USA, called Globe Metallurgical [8]. Since then, it has been awarded to numerous companies that meet the requirements established for this important award of excellence. The Shingo award is based on a set of criteria to assess how "Lean" an organization is, or, if otherwise perhaps more correct, how close to Toyota's way of working an organization is.

The principles that were established in the Shingo Model are grouped into different classes, see **Table 1**. Comparing these principles with the principles of Lean thinking, it is easy to identify differences. Shingo principles are much more comprehensive than Lean principles and probably reflect in more detail the reality of Toyota's philosophy and culture, as they place a lot of emphasis on the less visible aspects of Toyota that are associated with human involvement, vision and culture (**Figure 3**).

The first two principles are clearly dedicated to the side of respect for the individual, referred to by Sugimori et al.[1]. These principles are vital to develop a culture where everyone is motivated to contribute with work and creativity for the benefit of all. These principles are essential to "motivate the elephant" as nicely referred by Chip Heath and Dan Heath in their book entitled "Switch" Heath & Heath (2010). The idea is that even if everyone knows the direction to where their company wants to go, as well as knowing what they are supposed to do in order to go in that direction, no result is expected if motivation does not exist.

Shingo principle	**Class**
Respect Every Individual	Cultural enablers (People)
Lead with Humility	
Seek Perfection	Continuous improvement (Processes)
Embrace Scientific Thinking	
Focus on Process	
Assure Quality at the Source	
Improve Flow & Pull	
Think Systemically	Enterprise alignment (Purpose)
Create Constancy of Purpose	
Create Value for the Customer	Results (Shareholders)

Table 1.
Shingo principles.

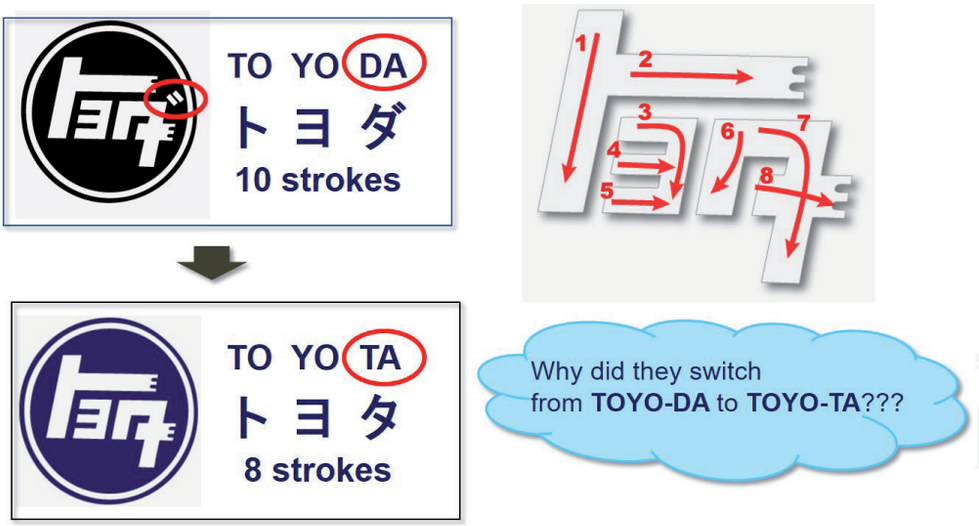


Figure 3.
Toyoda vs. Toyota.

The second class of principles is related to CI. These five principles include almost all technical aspects and behaviors with direct influence in the production process. In this class of continuous improvement, three Lean principles are included, "Seek perfection", "Flow" and "Pull Flow". The principle of "Embrace Scientific Thinking" is also very much related to CI because it brings reliability in problem solving as well as reducing erratic judgment and erratic decision making. Erratic judgment as well as erratic decision making is the classic "jump to conclusions" that happens when managers or supervisors decide very quickly what is the best solution to a problem without using a systematic approach previously defined.

There also two principles related to the enterprise alignment creating the environment where everyone knows where to go (*Create Constancy of Purpose*) and how to act (*Think Systemically*) in order to go toward the vision of the company. The last principle is related to the need to be profitable to sustain the organization.

2.3 Toyota way

The Toyota Way is the title of the book by Jeffrey Liker [9], it is the result of a change of designation that occurred at Toyota in 2001. As the Toyota Production System refers only to the production area, The Toyota Way was adopted to show the intention that the philosophy would extend to all sectors of the organization. As with Toyota, this extension to other areas than just production, has also occurred in various organizations around the world. Thus, with the designation of Lean <anything>, the most varied implementations were appearing, for example, in hospitals (Lean Hospitals), in accounting (Lean Accounting), in administrative environment (Lean Office), in services environment (Lean Services), in academia (Lean Teaching), as well as in many other areas.

This Toyota Way is referred to on the Toyota Europe website [10] as being based on two pillars: Continuous improvement and Respect for People (includes respect and teamwork). It is curious to be close to the concepts that were presented by Sugimori et al. [1] referred to at the beginning of this chapter. Toyota Way is broken down into 14 principles that were published by Jeffrey Liker [9] and which are grouped into the four sections as shown in **Table 2**.

Section	Principle
Section 1 Long-term philosophy	Principle 1. Base your management decisions on a long-term philosophy, even at the expense of short-term financial goals
Section 2 The Right Process Will Produce the Right Results	Principle 2. Create a continuous process flow to bring problems to the surface
	Principle 3. Use "pull" systems to avoid overproduction
	Principle 4. Level out the workload (*Heijunka*)
	Principle 5. Build a culture of stopping to fix problems, to get quality right the first time
	Principle 6. Standardized tasks and processes are the foundation for continuous improvement and employee empowerment
	Principle 7. Use visual control so no problems are hidden
	Principle 8. Use only reliable, thoroughly tested technology that serves your people and processes
Section 3 Add Value to the Organization by Developing Your People	Principle 9. Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others
	Principle 10. Develop exceptional people and teams who follow your company's philosophy
	Principle 11. Respect your extended network of partners and suppliers by challenging them and helping them improve
Section 4 Continuously Solving Root Problems Drives Organizational Learning	Principle 12. Go and see for yourself to thoroughly understand the situation (*Genchi Genbutsu*)
	Principle 13. Make decisions slowly by consensus, thoroughly considering all options; implement decisions rapidly (*Nemawashi*)
	Principle 14. Become a learning organization through relentless reflection (*Hansei*) and continuous improvement (*kaizen*)

Table 2.
Principles of Toyota way.

3. Continuous improvement

Constantly pursuing perfection means never being satisfied with what has already been achieved and always seeking to do better. There is a very interesting story of Toyota, on this subject, which was told by the manager, already retired, Isao Yoshino, who was involved in the installation of Toyota's first factory in the USA. This was the NUMMI (New United Motor Manufacturing, Inc.) project, which resulted from a partnership between Toyota and General Motors and led to the construction of a plant in Fremont, California, in 1984. This car factory was the first experience outside Japan, of implementing Toyota's way of management and culture. Returning to Isao Yoshino, the story he told did not convince me at first, but after a long and informal conversation, I was convinced. This story reveals one of the most fascinating aspects of Toyota's culture, and that is as follows: The word "Toyota" comes from the word "Toyoda", which already existed as a brand (Company Toyoda Automatic Loom Works) and which is actually the name of the family that created that company. In terms of writing, both Latin and Japanese, the words Toyota and Toyoda only differ in tenuous detail. However, it is in Japanese

writing that it is important to describe this difference: as can be seen in **Figure 4**, the writing of the two words differs only in two small strokes.

So, 10 strokes are needed to write "Toyoda" while only eight are needed to write "Toyota". Why would they then have changed the name from Toyoda to Toyota, being mentioned that even in this change is present, symbolically, a part of Toyota's culture? The first answer that occurred to me, and that may eventually arise to those who know vaguely the Toyota culture, is that movements are spared when writing the word (fewer traces). Although there is an understandable logic here, this is not the answer. The real reason, explained personally by Isao Yoshino, is that in many cultures, the number 10 symbolizes the top (the maximum) and then, according to this logic, 8 means to be good but still a little below the maximum, which implies that it is necessary to improve to reach the top. This allegory aims to make all the people who work at Toyota understand that you are never good enough that you do not have to improve. As Eiji Toyoda said [11]:

"Being satisfied with the current situation can be the first step towards corruption"

The constant search for perfection (seeking to be 10 assuming that one is always 8) is like a healthy "paranoia", which is based on the fear of letting ourselves relax with the successes of the past and thereby increase the risk of being overtaken by competitors. It is never to allow one to accept that everything is fine, and the truth is that there is always something to improve, there is always some problem unresolved.

On this same topic, Dr. Shigeo Shingo, the co-founder of TPS, said the following: "It is universal truth that those who are not dissatisfied will never make any progress. Yet even if one feels dissatisfaction, it must not be diverted into complaining; it must be actively linked to improvement" [12].

3.1 Continuous improvement versus lean thinking

Continuous improvement is a concept apparently understood by all but actually being able to implement continuous improvement in an organization is a major challenge. Very often, continuous improvement is confused with Lean Philosophy. This subject can be addressed from various perspectives, and may give rise to numerous discussions, but according to one of the publications of the research group responsible for the name "Lean" itself [5], continuous improvement is only one of the five principles of the "Lean Thinking". The other four principles point in the direction in which companies should align improvement efforts, that is, they tell us where continuous improvement should be directed to.

By way of absurd example, suppose that a company assumes as strategic objective to improve the utilization of all its equipment - that is its vision. This is how the company thinks it can lower costs and be more competitive and sustainable (it does not want to have equipment stopped because it wants to monetize its use). According to this objective, all actions that result in increased use of equipment are interpreted as improvements. However, the truth is that these "improvements" may be increasing stocks, worsening quality, increasing response times, and driving the company into bankruptcy. That is why improvement has to be consistent with the direction ("True North"), vision, purpose and values, which are adequate to the survival and sustainability of the company in the long term. Another example: let us imagine that a change introduced on an assembly line resulted in increased productivity. Now let us imagine that this change has also degraded ergonomic aspects or increased the risk of accident, can we still consider it an improvement?

We believe that the most effective and successful direction to align their continuous improvement work, is guided by the principles that underpin the Lean

Philosophy, the Shingo Model, and the Toyota Way. A necessary factor for success occurs when the top decision makers of an organization deeply believe that these principles are the direction to follow. The other major factor is the implementation of the dynamics and routines necessary for the organization to progress in this direction and this is achieved with a continuous improvement system. This is the form of success: define a good direction (Lean Philosophy, Shingo Model and Toyota Way) and start moving in this direction in a systematic and sustainable way (continuous improvement system). In fact, we can only know whether or not there is improvement if we define the direction we want to take. By saying something very obvious, we only know if we move forward if we know which way we want to go.

Many famous stories and phrases allude to this fact. For example, in Alice's story in Wonderland at one point the girl asks the cat: "Where is the exit? It depends, answered the cat. From what? Alice replied. It depends on where you want to go...". Another example is a phrase from the great thinker Seneca: "When one sails without destination, no wind is favorable."

It is essential to define and believe in a path and constantly share it with the whole organization.

3.2 Continuous improvement versus occasional improvements

It is important to clarify the difference between doing improvement and doing continuous improvement. For many, notably Rother [2], continuous improvement is something that happens periodically through technical innovation, projects or improvement events. However, these types of disruptive occasional improvements do not in fact create an effective culture of continuous improvement. As mentioned above, getting an organization to actually have continuous improvement is no easy task and requires very large structural changes. Moreover, continuous improvement can no longer be seen as just a factor of competitive advantage over the competition, but as a survival factor. Companies that do not continuously improve their performance will eventually succumb to their competitors. Continuous improvement is no longer an option and has become the form of survival; the question is: how can each company materialize continuous improvement?

In its fullness CI happens when everyone, every day, implements a small improvement in their area of influence. It is much better for many small improvements to happen continuously than major improvements happening occasionally. When everyone continually contributes to improving their areas aligned with the strategy and the higher purpose of the company, everyone benefits from learning, everyone feels included and everyone grows up with the organization. If the improvements are the result of large projects carried out by external people, there will hardly be a sense of belonging and learning.

The difficulty of implementing and maintaining continuous improvement is enormous, and few companies can do so effectively. It cannot be believed that CI can be achieved and maintained effortlessly and without constant dedication and attention. It is a bit like maintaining equipment or maintaining relationships. It is necessary to maintain constant attention and care. This difficulty is reported in "Toyota Way to Continuous Improvement" [13]. In this work, the authors state that even Toyota has difficulties in maintaining continuous improvement, especially in Toyota factories deployed outside Japan.

3.3 Start with CI

A common first step toward continuous improvement is based on hiring consultants with experience in implement lean tolls to improve processes performance

and flows. This path is feasible in the first improvement interventions, but it is not sustainable in the medium and long term. The reason is that, although in the first interventions the consultants can, with little effort, obtain significant performance gains, the following actions will achieve fewer and fewer gains. At some point, the cost inherent in consulting becomes higher than the small gains obtained, and this approach becomes unfeasible. Hiring consultants specialized in implementing improvements according to Lean principles and concepts is very often the approach that companies choose to start adopting continuous improvement practices.

The next step is, for many companies, the development of Lean skills within the organization itself, giving training in this area to a small group of people from top and/or middle management and assigning them the role of drivers for improvement actions, with improvement events or other practices. As the company becomes more mature in terms of continuous improvement, the number of employees who devote part of their time to this type of activities increases more and more, until, in an ideal state, all workforce end up becoming engines of this same continuous improvement. The trend is that more and more companies, and other organizations, start to include continuous improvement activities in the daily routines of all its employees. Companies that do not, will gradually become more and more vulnerable to small crises and market changes.

A very high percentage of companies with continuous improvement systems have suggestion systems. Some of them even integrate rewarding systems, which can contemplate all suggestions or only the best ones. There are cases where the author of the suggestion receives an economic reward proportional to the gain that the company had from the suggestion. This is known as gainsharing. In other cases, all suggestions are rewarded with a fixed premium (cash, gifts, company products, clearances, etc.). In addition, many companies formalize in visual frameworks and internal publications, the recognition, before the whole organization, to this or that employee for their suggestions.

Those who have already gone through the experience of creating suggestion systems quickly learned that the first difficulty is to get employees to start giving suggestions and the second – much more complex – is to follow up on the ideas that begin to enter in the suggestion system. This is another of the topics on which it is necessary to reflect deeply, conscious of unintended consequences, before moving on to implementation. It is notable that Frank Devine's Cathedral/Higher Purpose Model [14], which is highly correlated to success in achieving Shingo awards (25% of all awarded in Europe 2010–2017) explicitly excludes reward as it, as opposed to recognition, did not feature highly enough on the Pareto analysis on which his model relies and is prone to unintended consequences. A frequent temptation is to give incentives for suggestions when you want suggestions to appear. Another is to force a minimum number of suggestions per week for each section of the company. Regarding the first temptation, much could be said but let us mention a very interesting book entitled "Drive" by Daniel Pink [15]. Pink, based on results from many published scientific experiments, suggests, in short, that incentives can be counterproductive when creativity is to be used. As much of what is intended with suggestions is based on people's creativity, it gets a little strange to add something that seems to limit creativity. According to the author, wage incentives are more effective when it comes to increasing productivity in uncreative work, namely repetitive operations without the need for intellectual tearing.

3.4 Resistance to change

It is undeniable that an organization wishing to implement continuous improvement must be prepared for resistance to change. It must be accepted naturally, otherwise it can lead to frustrating situations, and in this sense, it may be important to try to understand.

If it is true that resistance to change is greatly evoked as being present in human nature, it is no less true that the will to change is also present in human nature. These are in fact two seemingly contradictory truths. In a way, all people are willing to change. For example, they are willing to change when they get married or decide to have children, and these changes completely change their lives. Any father knows that having children results in drastic changes in routines, poor quality sleep, constant worries, permanent attention, fear of the unknown, visits to the doctor, and more. Even knowing all the problems that come with having children many people all over the world is deciding to change into it. Many, on the other hand, want to change cars, others from employment, and others from the city, etc. In fact, we are willing to make changes as long as they are the result of our own will. On the other hand, we are not always willing to change when someone wants us to change something in our routines. According to Chip Heath & Dan Heath [16] – for people to change three conditions must be met: (i) clarity of what to change to; (ii) motivation for change and (iii) clarity of the steps needed for that change. With regard to the first condition, it is sometimes not very clear to people what needs to be changed, and this, of course, is undesirable. When you want a team to make a change, you need to make very clear to where or to what they are going to change. With regard to the second condition, it is necessary that the people who will be involved in the change have the necessary motivation to do it. If they do not identify something that is attractive or worthwhile, then these people will not want to change. This is not necessarily a selfish position. People may be motivated for a change that brings benefits to others (and not to themselves) or that is aligned with a belief, a principle, or simply because it is a cause for which they are willing to make the change. Lastly, it is still necessary for people to understand very clearly the steps necessary for a change to occur. Even knowing the reason for the change and having all the motivation to do it, people may not be able to make that change if they do not know what needs to be done.

3.5 Human resources required for CI

In terms of the materialization of CI, ideally the efforts for improvement are part of the normal day-to-day work at all levels of the organization. All people in the organization routinely devote a portion of their daily time to CI tasks. Not spending any time on improvement tasks is bad but spending all the time on improvement tasks is also bad because it is necessary that the work is done for the products to be delivered and the services are provided. Many are the ones who say they do not have time for continuous improvement. On this argument, there is an interesting metaphor:

> *"A lumberjack was cutting down trees uninterrupted with his axe and you could see he was very focused on it. His goal was to cut down as many trees as he could in the time he had. There is however evidence that needs to be met, is that the more cut the less effective the axe to cut. Another man watching approached him and suggested that he should sharpen the axe. The lumberjack replied that he could not sharpen the axe because he did not have time for it."*

This well-known story is referred to by Stephen Covey in his famous book "The 7 Habits of Highly Effective People" [17] In this book, the seventh habit, proposed by the author and which is called "fine tuning the instrument", is directly related to the lumberjack metaphor and also aligned with the principle of continuous improvement.

Returning to the question of what should be the ideal time spent on CI operations, or time spent sharpening the ax, there is a famous metaphor attributed to Abraham Lincoln:

> *"If I had six hours to cut down a tree, I'd spend the first four sharpening the axe"*

In this sentence it is suggested to spend more time on CI tasks than on the tasks of the work itself to add value to products and services. This is not really the practice in organizations. The percentage of time spent on CI is much lower. Although publications that advance with an indicative value are very rare, Mark Hamel & Michael O'Connor argue [18] a value of 3% as a reference for the percentage of human resources that in a company should be dedicated to CI tasks. Interesting value as a reference. However, 3% of the human resources dedicated to CI should be more expensive than 3% of the time of all human resources simply because by assumption the human resources dedicated exclusively to CI, with knowledge of CI and able to promote CI have higher salaries than the average employee.

Considering a round number of 460 minutes that each employee dedicates per day in his work, then 13.8 minutes (3% of 460 minutes) should be used on average for CI tasks. The daily meetings of 5 minutes of the operational teams have a very common practice in companies with organized continuous improvement systems. If we add these 5 minutes daily of all employees with some possible weekly meetings that have longer duration, if we also add the time spent in occasional continuous improvement events and the management and support time in the improvement continues then easily reaches the value of 3% referred.

4. Suggestions systems

An article published in 1999 in the scientific journal Total Quality Management entitled "Stuff the suggestions box" [19] refers to an example of an ancient system of suggestions that existed in Japan at the beginning of the 18th century, created by the eighth Shogun (high-ranking military member) named Yoshimuni Tokugawa. This system of suggestions consisted of a box placed at the entrance of his castle with the following sign: "Make your idea known. Rewards will be given to ideas that are accepted". Rewards were given to people who provided good ideas, but any ideas seen as criticism of the Shogun were often rewarded with beheading.

Modern suggestion systems began to appear in some companies in the early twentieth century. There is reference to suggestion systems in American companies such as Kodak and NCR and Japanese companies such as Kanebo even in the early twentieth century. Later but even before the Second World War, more precisely in the 1930s, companies such as Hitachi, Yasukawa Electric and Origin Electric introduced suggestion systems.

Toyota's suggestion system was introduced in 1951 with the designation "Creative Ideas Suggestion System" and it is described in some detail in the book "40 Years, 20 Million Ideas: Toyota's Suggestion System [20]. It is very interesting to note the importance that Toyota already gave at the end of the first half of the last century to the potential for creativity and innovation of employees. This was so clear that as early as 1953 they formally adopted the slogan "Good Thinking, Good Products" [21]. Both the aspect of respect for creativity and the aspect of putting the customer first were well expressed in that motto.

Operators were led to take a very central role in solving problems that were occurring in the course of their work and also in developing suggestions for introducing improvements. According to some internal Toyota documents I had access to, the attitude of the operators should be as follows:

> *"When we have an idea about a better way to perform the operation, we first clarify the idea with our supervisors and then experiment and evaluate the results. Then we fill out a creative suggestion and submit it for evaluation."*

Each proposal is then verified by a supervisor or group leader, who assesses its usefulness, effectiveness, and originality using a standard scoring system to ensure fairness. Evaluations are carried out almost immediately and a monetary premium is paid about 2 months after the suggestion has been approved.

Another alternative for forwarding suggestions is through quality circles. A quality circle, or quality control circle is a group composed of many people from the same area of work or not, whose goal is to find solutions to solve quality problems or solutions to improve quality. When a good solution is found, that same solution or countermeasure can be applied to all other places facing the same problem. When the members of these quality circles belong to different areas of production, the dissemination of good practices becomes easier. Quality circles were popular in the 1980s but gradually lost their popularity as quality was taken over as part of production. The new type of team that began to exist began to take on purposes other than just quality. This type of team that is often named kaizen teams are the type of teams that would evolve from the initial quality circles. These kaizen teams are a very relevant entity in the structure of most continuous improvement systems.

Although it is assumed that Toyota's suggestion system was inspired by American suggestion systems (such as Ford's) the great effectiveness of Toyota's system is in the emphasis that Toyota has always been given to employees. In texts shared by John Shook[1] in 2009 on suggestion systems it is suggested that one of GM's flaws was clearly neglecting the human aspect of the equation in suggestion systems. Shook argues that GM decided that suggestions that did not bring 20 USD of savings would be refused because the costs to process a suggestion were estimated at that value of 20 USD. The system was focused on the interest of the business and not integrated with the personal dimension. In general terms the conventional suggestion systems existing in America are oriented to encourage GREAT suggestions, to give GREAT prizes, evaluated by LARGE committees with the expectation of GREAT RESULTS. Unlike Toyota encourages small improvements with small prizes. According to the same author, most of the prizes at Toyota are around 10 USD maximum. At Toyota, each employee submits one suggestion per week on average and 98% of the suggestions are implemented. Reflecting on the purpose of Toyota's system the idea is not simply to improve processes, the idea is to improve employee involvement in management and thereby improve processes as a consequence.

In the book "A Study of the Toyota Production System" published 1989 [22] the number of suggestions presented at Toyota by the workers goes from 10.6 suggestions per worker in 1976 to 18.7 suggestions per worker in 1980 and 94% of these suggestions were implemented in that year. The same author suggests that these suggestions have been responsible for the productivity advantage that Toyota's factories have over their competitors. Joakim Ahlstrom [23] found 13 improvements implemented per person per year was a number that very few companies in Europe could achieve. He also mentions that 20 improvements implemented per person per year were the best that was being achieved in the world. The accuracy of these numbers is difficult to guarantee but they are indicators that can be used as a reference.

Yasuda [20] describes the spirit of Toyota's suggestion system in the simple thought: "I want to make my job easier, even if only a little easier". It also says: "If people remain alert to detect problems, in an environment created that facilitates

[1] John Shook is one of the greatest figures in the Lean movement. He is the author of several books on lean as the famous "learning to see" dedicated to VSM (Value Stream Mapping). John Shook was involved in the first experience of applying TPS in America, the NUMMI project. It was a car factory that is born from a consortium between Toyota and GM.

their identification, the generation of creative ideas will not be exhausted". The idea of making very frequent small improvements seems counterintuitive in the culture of most of our companies. In many companies we are always looking for a very good solution that makes us have significant performance gains and we do not give much credit to insignificant or sometimes intangible gains but that, in the long run, by their frequency, are extremely powerful. This is a key idea for the sustainability of continuous improvement.

In 'Human Resource Development in Toyota Culture' [24] the authors mention that the relationship of trust created between the employee and the company or institution is extremely important and perhaps that is the reason why 90,000 suggestions per year are presented by Toyota employees. It is also curious to note that, according to the same authors, Toyota intentionally does not give emphasis to cash rewards. This is consistent with Devine's work stressing recognition rather than reward [14]. Generating ideas is supposed to be part of the work and as such does not reward a person for having done only his work. The ideas generated are part of the relationship of trust between the parties and this relationship of trust is the currency of exchange between employer and employee. Employees individually can and should place suggestions in suggestion boxes placed in specified places. They are encouraged to write them or ask for help from more experienced engineering personnel to write them if necessary but can also give suggestions verbally so that there is no excuse for suggestions not to be given.

Toyota handles the suggestion system in a very similar way to how the system was originally implemented many years ago. There is a committee that evaluates all the suggestions of the workers. Whenever a worker has an improvement idea in his work, he first talks about his idea with his direct boss, as a team leader, and tries to implement it as a test to find out how the idea works. If they find it would work, the worker will put the idea in a specific predefined format, with the support of the boss, if necessary, and formally send the idea to the committee. The committee then assesses the suggestion very quickly and decides whether it is implemented or not and what the reward should be. However, it is important to emphasize that the main objective of the system is NOT to give money to the employee who sends the suggestion. The main objective of donating a small amount of money is to APPRECIATE the worker's initiative and encourage him to continue the approach. Therefore, the main objective of the system is not to compensate the worker with the money, but to encourage his attitude.

5. Main features of effective CI systems

To be effective a CI system needs top managers to master not only the technical management skills side but also the behavior and cultural side. Mike Rother [2] refers to the visible and the invisible side. The visible part has been more easily copied from Toyota many times without success because the invisible part is difficult to copy and is often overlooked. This type of division is also referred to in other forms such as the Shingo Model, dividing the KPI (Key Performance Indicators) and KBI (Key Behavioral Indicators) [25].

This invisible side of organizations or the side of behavior and culture is as present and vital as it is neglected. Edgar Schein argues: "The only thing leaders do of real importance is create and manage culture. If you don't manage the culture, the culture manages you, and you may not have the slightest idea of the extent to which it is happening."

Leaders in the organization must define the long-term vision trying to include a higher purpose that may create among all workers a sense of being part of

something big. Something that makes them proud of being part of such organization. Leader and managers must also fully understand principles such as "respect for people" and "lead with humility". These principles must be more than just understood, rather they must be really living in their hearts. Devine's 'Rapid Mass Engagement Process [reference Conference Book?] amplifies this effect when the employees themselves create their own CI culture, and, sometimes, their own Higher Purpose by consensus with their senior leaders. In the face of a problem managers must behave in a systematic way starting with a "not blame and not judge" attitude. Most problems occurred because the systems allow them to occur and blaming on workers is the wrong approach to start with. The idea is to try to find the root cause and eliminate it. Manager must welcome problems and encourage workers revealed them since they promote improvement.

5.1 Operational teams

Another important feature of CI is teamwork. A common feature in effective CI systems is the presence of teams everywhere in the organization. Workers are organized in teams and managers gradually empower those teams with management responsibilities such as performance measurement and monitoring, scheduling their work, problem solving, and routine meetings. Transparency is an important tool to the benefit of all. Visual management must be used by teams to show and update daily most important aspect of their work.

These operational teams, also sometimes called "natural teams", are teams that normally share the same workspace and the same tasks, or complementary tasks. The term "natural" is used because in fact these teams already exist in a natural way even if they have no formal routines, no goals, and no team spirit. These teams are the essential units of CI systems as they are largely responsible for adding value to products and as such where CI is first most important. When we hear the term "operational teams" we often associate with teams operating in the production units, but the operational teams extend to all levels of the organization. These teams can be teams with administrative tasks, development tasks, sales or even management tasks.

The size of a team is a major factor as their performance can vary with their size. A good rule is to try to create small teams. On this team size issue, Sutherland [26] suggests that teams of 3–7 people needed 25% less effort than 9–12 people to do the same job. The size of the team is often determined and/or forced by constraints of context and typology of personality and relationship between team members. There are teams of 3 that work very well but others there are the same number but that do not work at all. Whether or not a strong team leader exists is also a key factor in the team's performance and ideal size.

5.2 Teams meetings

The meetings of the operational teams are events of enormous importance for the sustainability of continuous improvement. The frequency of these meetings is commonly proposed as one meeting per day. In the Kaizen Institute CI model, it is even called Daily Kaizen. Typically the meeting follow a standard agenda lasting 5 minutes and in general terms the objectives of these meetings are: to preserve and improve the cohesion and motivation of the team, to become aware of the state and evolution of performance indicators, to plan the work of the day, to monitor ongoing improvement actions and if necessary to report occurrences. For these meetings to be effective it is necessary for teams to be trained and monitored very closely in the first few weeks. It is necessary that someone with experience accompanies the first meetings giving suggestions and feedback on the content of the agenda

and how to conduct the meeting. At first these meetings tend to take more than 5 minutes and some issues remain un-addressed but as the team gains experience it becomes more effective in managing time and eventually manages to do the whole meeting in about 5 minutes in most cases.

It is important to repeat that the meeting cannot include any kind of blaming or judgment of team members. The spirit of the meeting should always be positive and motivating. It should always be sought to encourage team members to try to identify something that may be preventing them from doing their job better, with less effort and less risk.

In some organizations, workers are trained in coaching and in constructive feedback in order to help creating the perfect atmosphere to approach problems, improvements, and improve motivation and work satisfaction. The well-being of team members should always be valued because respect for the human person has an unquestionable intrinsic value and also because people who feel good can produce better, with more quality and with more safety. It is important to remember what was said in the first article published in English about the Toyota Production System (TPS). In this article it is said that one of the two basic concepts of TPS is "treating workers as being human and with consideration" [1]. It is important that the whole organization breathes awareness of this concept and that it creates standards, routines and practices that materialize this concept and that gradually becomes the culture of the organization.

5.3 Project teams

The effort for continuous improvement must be widespread throughout the organization. That is true, however, although everyone in the organization must be involved in the constant search for improvement, it is common the need to create temporary teams that aim at significant improvements in the process, also called disruptive changes.

Disruptive project teams are teams designed to introduce disruptive process improvements to clearly improve performance levels and typically lead to changing working standards. These new standards are then followed by natural teams in order to stabilize them. In some companies the main aim of operational teams is to stabilize standards and never improve them. These projects are projects for significant changes in the process, relate to striking/disruptive improvements that result in layout changes, task change, line resizing, technology changes in the process, reduction of product change times, etc. Unlike natural teams that remain stable for a long time these teams are formed when the project begins and is extinguished when the project ends.

These disruptive Kaizen events typically are held for 1 week every 3 months. Kaizen events should start with a well-defined problem, described in a clear and short sentence, to enhance the effectiveness of the event and should also be seen as an investment for their very effective role in training employees [27]. Bastos & Sharman [28] suggest that for there to be significant improvements, this level of action called the disruptive improvements, together with the CI performed by natural teams, has a multiplier effect on the improvement of processes and consequently on the performance and competitiveness of an organization. The main message is that the combination of the two types of efforts for improvement (Continuous and Disruptive Improvement) result much more effectively than just the CI. In contrast Mike Rother [2] argues:

> *"... Toyota considers the improvement capability of all the people in an organization the "strength" of a company. From this perspective, then, it is better for an organization's adaptiveness, competitiveness, and survival to have a large group*

> *of people systematically, methodically, making many small steps of improvement every day rather than a small group doing periodic big projects and events."*

Despite that, Mike Rother also argues:

> *"... If your business philosophy is to improve, then periodic improvement projects or kaizen workshops are okay but not enough..."*

5.4 Coaching

As in everything in life the CI systems needs be maintained and improved to stay alive. Some kind of structure is necessary to maintain, coach and guide natural teams and promote improvement projects. In the Toyota Kata (TK) model presented by Mike Rother [2] represents how the Toyota CI system works. The role of maintaining the natural teams' moral and focus on seeking perfection is assigned to a coach. The coach's role is very relevant in the TK model since it is up to the Coach to play the main role of maintaining the Toyota culture, maintaining the team's motivation and guiding it to the identification and implementation of improvement actions that ensure learning, clear knowledge of the process and evolution toward challenges and vision. The structure that ensures the sustainability of continuous improvement is represented in **Figure 4** where the coaching structure can be represented. Each team leader meets with his Coach once a day (whenever possible) in front of his team's board for a follow-up session of the actions and evolution of the team always having as support the data that is visually presented on the team board. The team leader's daily sessions with the coach are occasionally accompanied by a second-level coach who will help the first-level coach evolve his coaching skills.

When a vacancy for 2nd level coach emerges, the 1st level coach, who is more advanced in terms of coaching skills, will be selected. The vacancy left by the first-level coach will have to be filled by a team leader with more coaching experience and skills. This vacancy in turn will be occupied by the team worker with more leadership skills. In this way the coaches were workers who absorbed Toyota's culture and assumed the responsibility of maintaining it and passing it on to the new workers.

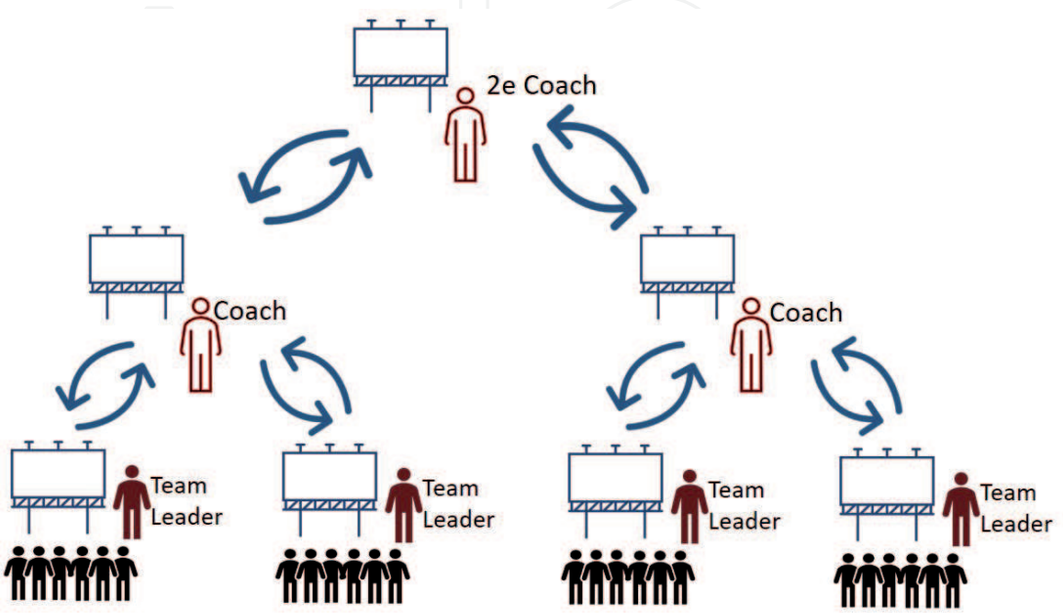


Figure 4.
Coaching structure of the TK.

6. Conclusions

Continuous improvement is a key feature to include in the culture of organizations that want to play a major role in people and society. The CI culture with the right direction and higher purpose was created by Toyota and now is being spread around the world with many other organizations also contributing to enrich those concepts and practices. In this chapter, three models were referred as including the right set of principles to be followed by those who want to also benefit from the wonders of CI. Nevertheless, CI is not easy to implement nor to master and a lot of hard work and perseverance is required to succeed with effectiveness. The main ingredients to implement CI are at least the following: The right mind set of the top management, a clear definition of the vision/ "True North", leadership system explicitly designed to create a CI culture, generation of natural teams, empowerment of natural teams, daily team meetings, visual management everywhere, supporting people with CI experience, always questioning the existing CI system, coaching skills spread around the organization, constant search for people engagement.

Unfortunately, very few organizations succeed in perfect align all the different required elements to create the right culture. In this line of thought my friend Frank Devine in one of his articles [14] also argue that most Corporate Leadership Programs are detached from, rather than integrated with, CI. These leadership programs are almost random collections of often unintegrated leadership skills rather than a system of leadership.

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