

Chapter 2

Troubleshooting a Lean Environment

Moisés Tapia-Esquivias, Manuel Darío Hernández-Ripalda,
José Antonio Vázquez-López and Alicia Luna-González

Abstract Due to the necessary of having a systematic and disciplined approach to attack the root and not just to manage symptoms; methodologies have been developed from the vast literature of tools for the solution of problems. This chapter will focus on assessing the troubleshooting methodology on a Lean environment, especially with the use of A3 Problem Report. The Lean methodologies approach shall be submitted in the first section of this chapter, which allows characterizing each of them, in the second section it takes the self-assessment proposed by the ISO 9004 standard and a case is presented in the third section.

Keywords Lean manufacturing · Format A3 · Problems solving

2.1 The Troubleshooting Methodologies Lean Environment

The methodology for troubleshooting Lean environment is presented as a series of activities including a toolset alternatively described in terms of an essential logic of each of its steps.

A troubleshooting methodology is an improvement strategy (De Mast et al. 2000) it helps to find both the causes and the atypical situation, as the variation of the components within the process performance.

M. Tapia-Esquivias (✉) · M. D. Hernández-Ripalda ·
J. A. Vázquez-López · A. Luna-González
Department of Industrial Engineering, Instituto Tecnológico de Celaya,
Av. Tecnológico y A. García Cubas s/n., Celaya, GTO, México
e-mail: moises.tapia@itcelaya.edu.mx

Under the premise that the methodologies are improvement strategies that are required to be placed in a context which is characterized in three parts: structure, deployment and method (Pozos et al. 2012), same as described below:

- Structure: The people involved in the process of troubleshooting methodology.
- Deployment: Objective of the methodology for troubleshooting.
- Methodology: As the name implies, is the method, steps or tools that takes place in the methodology for troubleshooting.

2.2 Lean Environment and Evolution

Lean Environment is defined as troubleshooting to the developed environment around the methods generated from best practices to improve processes of Japanese auto companies.

These practices range from the formation of the mentality in the general management of the organization, to the development of routine practices at all levels.

Lean environment now includes several definitions that reflect the historic step of the concept, ranging from; Lean is what makes Toyota, passing tools to attack the waste in processes, to a philosophy and administrative culture.

Unlike systems linked to quality improvement, it starts in the attack on the variability or other cost reduction. As discussed in the Shingo Prize, part of identifying the value demanded and then flowed into the required amount. However, it shares with quality initiatives based on the concept PDCA (Plan, Do, Check, and Act) and have influenced each other. For an academic discussion on the definitions of Lean, the reader may refer to Bhasin and Burcher (2006), Pettersen (2009).

We recognize that each organization must actively choose to adapt the elements that best suit their needs. Through this process of recursive adaptation of the elements that help you improve and learn how, the organization increases its ability to have a predictable and successful implementation.

The original purpose of the studies of Japanese auto companies was to increase the performance of equivalent organizations in the United States of America, especially getting shorter times, lower costs and better-quality to produce and develop their products Cusumano (1985), Krafcik (1988), Womack et al. (1990).

The first studies on the best practices of Japanese auto production Cusumano (1988) reported as findings include:

- Production on small lots and Just in Time
- Inventories minimum process
- Processes pull production processes
- Production level
- Rapid changes in models
- Streamlining of machinery and line

- Standardization of work
- Poka Yoke Devices
- Workers with multiple skills
- High levels of subcontracting
- Mechanisms for continued incremental improvement
- Selective use of automation
- Replacement and rapid expansion of new models
- shorter Phases in product development
- Supply Engineering high level
- Project Managers with full authority and expertise.

Thus Lean started as the study of manufacturing processes. It was later on when the development of Japanese automotive companies began to be studied (Kamath and Liker 1994), Sobek et al. (1999), leading to better results in the launch of new products.

American producers also observed in Japanese producers, obsessive process for improvement, “kaizen” which involved direct work with continuous improvement tasks. Besides speed of material flow rate was observed to find and solve problems.

It began to be discovered so that not only the production process should be “Lean”, how to run the organization was also important, that is, the internal environment can be formed for positive effects.

Competitors of the Japanese in North America began to improve their quality and manufacturing efficiency, but Japanese firms had increased further as they created new technology and new brands. Suddenly they realized that only imitating the leader’s job at one point in time and space would have better results.

The first studies about the Japanese automotive production methods had only studied the results of a self-improvement mechanism, therefore a study of how they think when designing or improving a process was began, which involved not only production processes but also training people processes, product design, strengthening administrative capacity and maintenance.

2.3 The DNA of Toyota’s Production System

In 1999, the work of Spear and Bowen on Toyota System DNA appears subsequently Spear’s work applies in other non-automotive especially in hospitals, creating a new application and development.

Spear and Bowen find that organizations are places not only to produce but also are places to learn how to produce and keep learning. In the activities of organizations seems to be the possibility of losing what they have learned to focus on the tools and forget the development of a culture.

The culture that Spear and Bowen (1999) propose in their industrial application, is a culture that they identify as a scientific method, since when it is going to specify something, is done through a rigorous process based on a number of

Table 2.1 The four rules of DNA

Rules	Sign of Problem
Rule 1, How people work: all work must be completely specified in content, sequence, timing and outcome	The activity is not made as specified The result is defective
Rule 2, How the connections between the People are: all client-provider connection must be direct, in a way yes-or-no unambiguous for sending requests and receiving responses	The responses are not keeping pace with the requirements The provider is idle, waiting for requests
Rule 3, How to build the production line: the path for every product and service must be simple and direct	A person or machine is not really needed An unspecified provider catered for intermediate goods or services
Rule 4, Improving: any improvement must be made in accordance with the scientific method, under the guidance of a teacher, at the lowest level possible in the organization	The actual result differs from expected result

Source Based on Spear and Bowen (1999)

assumptions that have to be tested, and to make any changes using a rigorous process of solving problems that require detailed assessment of the current state of the facts and a plan to improve it, and for this purpose an experimental test of the proposed change.

This culture has a method that is based on four rules; all rules require that activities, connections and flow paths have built tests to signal problems automatically. The continuing response to the problems makes a seemingly rigid system to remain flexible and adaptable to changing circumstances. Rules and issue signals are as shown in Table 2.1.

Spear and Bowen (1999) report that when the first rule is taught by a supervisor, the person is asked a series of questions that help him/her to understand and discover.

How do you do this work, how do you know that you are doing it correctly? How do you know that the outcome is free of defects, what do you do if you have a problem? This recalls Juran’s principles of self-control, as seen in Defeo and Juran (2010), and the Shewhart-Deming cycle of Plan, Do, Check and Act.

We also found that there is a teaching-learning path that will cascade from the highest administrative levels to workers. The needs of people in direct contact with the work determine assistance, problem solving and higher activities. Very different to who works for whom in the traditional command and control, where orders diffuse downward and upward reporting job status.

In brief, the guide is to specify all design, test it with every use and improve as close in time, place and person to the occurrence of any problem. If the company does consistently is showing through action, that when people come to work, they are entitled to expect to achieve something of value to another person. If they cannot, they are entitled to know immediately that they did not, and have the right to expect to be involved in creating a solution that makes the achievement more

likely next time. If a person cannot subscribe to these ideas, either in words or actions, it is unlikely that they can lead effectively in this system.

These rules were translated to implement them to an environment of health care, Spear (2005) presents the “four basic organizational capabilities in operations excellence,” same as illustrated below:

1. People at all levels of the organization are trained to become experimentalists.
2. Solutions are disseminated adaptively through collaborative experimentation.
3. Problems are addressed immediately through quick experimentation.
4. The work is designed as a series of ongoing experiments that immediately reveal problems.

2.4 The First Kaizen Event

The application of Lean tools and especially A3 Format used to document a summary of the experiences to confront the problems of the organization, in resolving problems as a result of a Kaizen event, in the Kaizen event teams of people directly involved in a workplace to bring about change that generates waste disposal and performance enhancements.

Norman Bodek (2004) narrates the first Kaizen event held in North America in the Jake Brake Danaher plant in Bloomfield, Connecticut. This happened in 1988. The event was conducted by Iwata and Nakao from Shingijitsu consulting firm. It was called “five days and one night” and describes the program implemented as follows:

1. Monday: Principles of Toyota Production System.
2. Tuesday: Five teams of 10 people with the goal of forming manufacturing cells, studying processes observe and estimate cycle time, takt time, studying how to fill out standard worksheets, look for wastes and how to eliminate them.
3. Wednesday: Finish the value stream map showing value added, cycle time, takt time, inventory, and opportunities for improvement by removing waste in operations, in addition to the standard worksheets.
4. On Wednesday night, machines are moved to form 5 cells. A list of pending projects is produced that generate post-event projects to enhance the implementation.
5. On Thursday operators are instructed (those who had not participated) in the new process, relying on standard worksheets.
6. On Friday morning the five groups present their case reports.

Bodek recounts the psychological impact on workers and suggests that workers should have been part of the teams that made the change, also narrated that the job change, elimination of inventories and the new responsibilities of people working on the floor taking 3 months to eliminate the problems that at the time became

visible. Spear (2009) notes that Kaizen events typically do not ensure increased capacity to design operate and improve daily working people in the process; additional Kaizen event within the Lean environment, there are also systems suggestions for improvement, self-study groups to increase learning ability and Kaizen projects among others.

2.5 Shigeo Shingo Prize

In 1988 the Utah State University created the awarded “Shigeo Shingo” to honor the engineer who developed at Toyota, along with Taiichi Ohno, the changes and the necessary tools for a production system that was not dependent on the mass production.

The award aims to encourage the creation of enhancement in organizations systems and create a canon against which you can compare how close or far is an organization in their efforts to improve, especially at Lean environment.

The award is a qualification that gives 1,000 points distributed in four dimensions, specifically, the second dimension called “Continuous Improvement Process” account for 350 points and must describe the philosophy of the organization to the principles and concepts of Lean, reviews several principles of the prize compliance, among which may be mentioned: seek perfection, quality assurance at the source, necessary level flow value, take scientific thinking and focus on the process.

In the dimension of continuous improvement were 18 examples of systems, one of which is the troubleshooting system, which in turn points 3 options PDCA, DMAIC and “A3 Thinking” (The Shingo Prize 2013).

A3 thinking refers to the use of A3 Format to achieve a disciplined way to report on the problems and in turn encourages a disciplined way to solve guided primarily in the application of PDCA, documenting the findings and enabling learning and improvement process learning thereof by applying it recursively.

The Lean environment has evolved from a competitive comparison of systems of automotive production to an administrative system that involves the whole structure of the organization in planning the work, checking if it is good, acting immediately if not well, learning and making explicit what is found. The Lean method goes into an experimental approach that can work as an experiment to learn and perform a show based on the PDCA cycle ensuring organizational learning, which allows you to convert the extraordinary into standard.

Turn into explicit what was found to confront and solve problems involving a system of documentation and at the base of this task is A3 format that enables to leave explicitly what was learned.

Table 2.2 A3 format characteristics as methodology

Methodology	Structure	Display	Method
A3 for problem solving	Multifunction team in the workplace	Eliminating special causes, maintaining common causes conformance to the customer and getting knowledge	Plan, Do, Check and Act

2.6 Format A3

Here is characterized the tool called A3 at Lean environment as the tool used to manage and document the solution of problems, as shown in Table 2.2.

The standard ISO 216 defines a size of paper called “A3,” which corresponds to a rectangle of 297 × 420 mm (11.7 × 16.5 inches) and the area is close to an eighth of a square meter, which is similar in size to the American standard called “tabloid” of 279 × 432 mm (11 × 17 inches), which in turn corresponds to twice the size chart (letter) American (215.9 × 279.4 mm or 8.5 × 11 inches).

In the transformation initiatives “Lean” in organizations, A3 refers to information concerning a difficulty encountered in the course of business in a single sheet of paper. A3 therefore relates to a summary of the experiences to confront the problems of the organization.

The use of A3 emerged from Toyota to perform two administrative processes: Hoshin Kanri (Strategy Management) and the solution of problems.

A3 is used as a tool to solve problems, make improvements and get things done. A3 ensures rapid reporting thought necessary for a team facing a problem; encouraging to take a learning management process to solve problems and make decisions, and encourages the formation of a team of people learning how to do their job, if well and if it is not correct it by continuously improving operations and results.

There is no unique A3 Format, as each organization adopts its own style, however, the use of the experiences in Japanese car company Toyota, and formats found are generally derived from the definitions of Toyota. We present versions of A3 format elements in Table 2.3.

A3 format elements must have a logical and natural sequence, which allows you to bind the problem, its root causes, the goal, the actions to achieve the goal and the means to judge the success in a clear and easy way to be understood. The format should allow participants in the care of an issue or problem follow the thought through the PDCA cycle (Plan, Do, Check, Act).

Incorporating A3 in the activities of the teams, the organizations learn to face problems, and begin to recognize problems as opportunities to learn and improve. Leaders in Lean initiatives direct preferably working groups based on knowledge, based on the facts, strong-willed yet flexible. Media are administered, the same process that actually leads to the results. An A3 process directly identifies the owner’s responsibility—Direct author of the A3 process. This person may not have direct authority over every aspect of the proposal, but the owner is clearly

Table 2.3 A3 format elements versions

A3 components		Shook	Jackson
Theme		Title: name of problem, difficulty or theme	Statement of the problem or issue at the beginning of the format
Problem statement		Background: the business context and the extent of it Conditions in this: what is known today about the issue or problem?	Statement of the problem—the reason for the project definition (including the present initial state)
Goals and objectives		Goals and objectives: what outcomes re desired?	Goal statement—(future state) defining project scope
Methodological environment		PDCA	PDCA, 8-Ds, CEDAC, DMAIC
Systematic analysis		Analysis: method of analysis and the identified causes that produce the difference between the present situation and the desired outcome	Systematic analysis (5 whys, cause and effect diagram, design of experiments, etc.)
Proposed solution		Countermeasures proposed: proposed corrective actions or countermeasures to address the problem, reducing the difference or achieving a goal	Proposed solution (including coordination of functional resources)
Timeline for implementation		Plan: prescribe an action plan indicating who will do what at what time to reach the goal Tracking: a process is created for reviewing and monitoring anticipated learning difficulties	Implementation time (with actions, responsible, and dates for the deliverables of the actions)
Graphical illustrations			Graphical illustrations to convey information at a glance
Date and reporting unit or owner		Date: the date of the most recent done Owner: who is the “owner” of the process where the problem or issue is identified	Date and reporting unit or owner the end of the format individual or team responsible for this matter A3

Source Shook (2008), Jackson (2006)

identified as the person who has taken or accepted the responsibility to ensure that decisions are taken and implemented.

The use of Toyota A3 format emerged at Toyota to perform two administrative processes: Hoshin Kanri (Strategy Management) and the solution of problems.

On a macro level of the organization, Hoshin Kanri aligns the goals and objectives of the organization with the operations and activities, the solution of formalized problems creates micro-level organizational learning. A3 process combines and incorporates both. A3 is a means to propose projects, take initiatives, show responsibility, sell ideas, gain agreement and learn. Managers can use A3 to guide and teach, to clearly assign responsibility, empowerment and accountability, to get good plans of their subordinates and encourage learning.

Jackson (2006) reports, for example, six different types of A3 formats, one for Trouble Reporting, five related to Hoshin Kanri process: 1. Intelligence Report, 2. Matrix X, 3. Team Charter, 4. Status Report, and 5. Summary Status Reports.

Matrix X is a tool that can generate an action plan in about a year to develop new capabilities and maintain paths aligned organizational operations within the broader strategy. Link through relationship matrices attempted strategy, tactical actions, outcomes and operational teams.

A3 form for Reporting Problems is associated with problem solving immediate action to address the special causes that arise during the daily standard work or to take advantage of identified opportunities for improvement. It is usually associated with a Kaizen event conducted by a team to address a problem or seize an opportunity for improvement in the workplace.

A3 form is a structured process to create problem solvers at the same time it is a troubleshooting tool; A3 format helps search and spread structured knowledge, allowing participation in decisions in an environment of critical discussion, forces individuals to observe reality, present data, propose countermeasures designed to achieve a stated goal and follows a process of checking and adjusting for actual results.

An organization using A3 thinking, achieves that: decisions taken to achieve goals and get things done, guiding individuals and teams along common goals and learn to get effectiveness, efficiency and improvement.

2.7 Self-Evaluation in ISO 9004:2009

Since February 1947 there is an international organization called ISO, International Organization for Standardization (2013), whose function is to develop, publish and promote the use of applicable standards or international standards, to assist the development between industry and trade. Within these rules, the ISO organization has launched a system called ISO 9000 standards of quality management, the rules guiding the organizations and businesses in meeting the requirements of its customers and consistent improvement in quality. The rule is

explained based on eight principles of quality management, defined by a technical committee.

The system of quality management ISO has many rules, the main one is the ISO 9001:2008 standard that establishes the requirements for a quality management system, is the only standard that can be certified from all the other dedicated to the administration of quality. Another is ISO 9004:2009 guiding continuous achieving better efficiency in the organization or company, this rule does not certify or have regulatory or contractual use.

The international standard ISO 9004:2009 quality management complements the ISO 9001:2008 international standard providing guidance on continual improvement of quality management.

An important tool in ISO 9004:2009 is the self-assessment that allows management to know the points to act on their own system. Although ISO 9004:2009 and ISO 9001:2008 complement, ISO 9004:2009 can be used independently.

The self-assessment is a comprehensive and systematic review of the activities and results of an organization with respect to a selected maturity level. In the context of the methods of solving problems provides an overview of the performance, which identifies priorities in each of the methodologies, which allow a better understanding of each is steps and/or stages.

The way in which ISO 9004 proposes self-evaluation is based on five levels of maturity, maturity levels describe these six elements that indicate the attachment to the effective management of quality in the organization or company, the maturity levels ranging from basic (Level 1) to the development of best practice (level 5).

These maturity levels are grouped into six elements which are:

- Managing for the sustained success of an organization
- Strategy and Policy
- Resource Management
- Process Management
- Monitoring, measurement, analysis and review
- Improvement, innovation and learning.

In order to carry out self-assessment, it is necessary to define what features are most relevant in each of the maturity levels; the maturity levels suggested by ISO 9004 are shown below as an important tool to review the level of maturity of the organization. An organization may be at different levels of maturity between different elements.

Management maturity levels for the sustained success of an organization:

1. The focus is on products, shareholders and some customers with ad hoc reactions to changes, problems and opportunities.
2. The focus is on customers and statutory/regulatory requirements with some structured reaction to problems and opportunities.
3. Processes are defined and implemented for reacting to problems and opportunities.

4. Continual improvement is a as part of the organization's focus.
5. The focus is on the balancing the needs of emerging interested parties.

Maturity levels for policy and strategy:

1. Decisions are based on informal inputs from the market and other sources.
2. Decisions are based on customer needs and expectations.
3. Decisions are based on the strategy and linked to the needs and expectations of interested parties.
4. Decisions are based on the deployment of the strategy, into operational needs and processes.
5. Decisions are based on the need for flexibility, agility, and sustained performance.

Maturity levels for process management:

1. There is non- systematic approach to the organization of activities, with only some basic working procedures or instructions in place.
2. Activities are organized by function, with a basic quality management system in place.
3. Activities are organized in a process-bases quality management system that is effective and efficient, and which enables flexibility.
4. There is a quality management system that is effective and efficient, with good interactions between processes and which supports agility and improvement. The process addresses the needs of identified interested parties.
5. There is a quality management system that supports innovation and benchmarking, and which addresses the needs and expectations of emerging, as well as identified, interested parties.

Maturity levels for monitoring, measurement and analysis:

1. Results are achieved in a random manner. The commercial and financial indicators of productivity are implemented.
2. Corrective and preventive actions are performed in a systematic way.
3. It keeps track of the satisfaction of people of the organization and its stakeholders.
4. The key performance indicators aligned with the strategy of the organization are used to keep track.
5. The achieved results are above the sector average for the organization, and are maintained long-term.

Maturity levels for improvement, innovation and apprenticeship

1. Improvement priorities are based on errors, complaints or financial criteria.
2. Improvement priorities are based on customer satisfaction data or corrective and preventive actions.

3. Improvement priorities are based on the needs and expectations of some interested parties as well as those of suppliers and the organization's people.
4. Improvement priorities are based on trends and inputs from other interested parties.
5. Improvement priorities are based on inputs from emerging interested parties.

2.8 Key Elements and Estimated Maturity Level

Sustained success management: 2, the focus is on the costumers and the statutory/regulatory requirements with some structured reaction to problems and opportunities.

Strategy and Policy 2, decisions are based on the needs and expectations of customers.

Resource Management: 3, resources are managed efficiently.

Process Management: 3, activities are organized in a process-based quality management system that is effective and efficient, and which enables flexibility.

Monitoring, measurement and analysis: 3, it keeps track of the satisfaction of people of the organization and its stakeholders.

Improvement, innovation and learning: 2, improvement priorities are based on customer satisfaction data or corrective and preventive actions.

The maturity level stated in each of the elements, notes a type of practice in organizations and companies that meet the immediate requirements of everyday life, without greater involvement of senior management, or developing recursive learning mechanisms.

A3 thinking has much potential to help in a Lean environment to these actions and learning strategies, but as seen in the Shingo Prize, A3 Format is considered just one option among several possibilities, within a subsection. On the other hand, Liker and Rother (2013) report on a survey conducted on November 2007 by Industry Week finds that the two percent of the companies have a Lean program that has achieved the anticipated results, Liker and Rother also reported that a review by the committee that awards the prize Shigeo Shingo at the same time, have found that many of the winners had not maintained or increased their level of performance after winning the award, a large percentage of those evaluated in the award were found to be experts in implementing Lean tools but did not have them deeply embedded into their culture. The presented levels reflect regulatory compliance but not growth in learning and strategy.

A methodology may be at different levels of maturity for the different elements. Recalling that in the implementation of Lean initiatives A3 format role runs from a simple format for recording to "A3 Thinking" recursive learning, improvement and action.

2.9 Enforcement Case A3: Case of Study

2.9.1 Problem Description and Objective

The following case study is an application of the solution of a problem by following the steps and documentation required by A3 format. The case is presented in a car wash business and consists in an increase in service demand causing the installed capacity to be exceeded since 2009. From vehicles entering the car wash, 26 % are not treated and as a result, complaints increased having as its main complaint the poor quality or lack of cleaning or service, as observed in Fig. 2.1:

The problem is assigned to a project team consisting of 4 employees of the business. The team is responsible for resolving the problem by following the steps in A3 format.

2.9.2 Methodology

In the understanding of the situation the following is discovered.

The distribution of business is designed on 2 levels, on the ground floor the mechanical service is performed and in the first level the washing is done, with a dead time of 10 min to raise and lower the vehicle. Furthermore, KPI's has not been defined (key process inputs) as the washing area and there is no standard working method, the washing time is 46 min with 4 people. Benchmarking was conducted in a different car wash, finding an average time of 27 min wash. Currently 74 % of cars entering the business are washed.

When decomposing the problem to find the root cause it is determined that 26 % of vehicles entering the service facility are not washed because there is no suitable distribution facilities. From the previous discovery, the goal is assigned to be achieved by the end of March 2010, 100 % of clients attending the accommodation cleaning service should be offered in a timely manner see the plan activities in Table 2.4.

Do

A plan is made to ensure an adequate distribution for washing cars, which consists of the following:

2.9.3 Results

These actions resulted in a need to redesign the distribution to implement the activities required for washing (see Fig. 2.2). It was also implemented a standard process considering ergonomics work and establishing a control board to level workloads of operators, thus washing the cars efficiently and effectively according to the needs and expectations of customers.

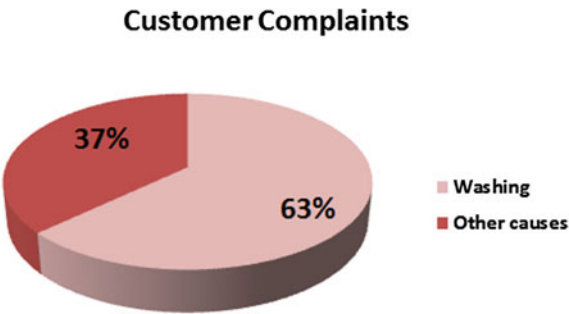


Fig. 2.1 Customer complaints about the poor quality or lack of car wash

Table 2.4 Plan activities

Activities			Dates	
What	Who		Onset	Term
1 Assessment of the architectural project (costs, space, materials)	General Manager		01/10/2009	15/10/2009
2 Benchmarking with other washing services	Service Manager		19/10/2009	24/10/2009
3 Design of the layout according to the space	Service Manager		26/10/2009	28/11/2009
4 Taking motion and time	Practitioners		26/10/2009	18/12/2009
5 Execution of civil works	General Manager-Architect		31/11/2009	01/02/2010
6 Stations equipment	General Manager		18/01/2010	30/01/2010
7 Standardization of the process with board	Kaizen Promoter		01/02/2010	27/02/2010

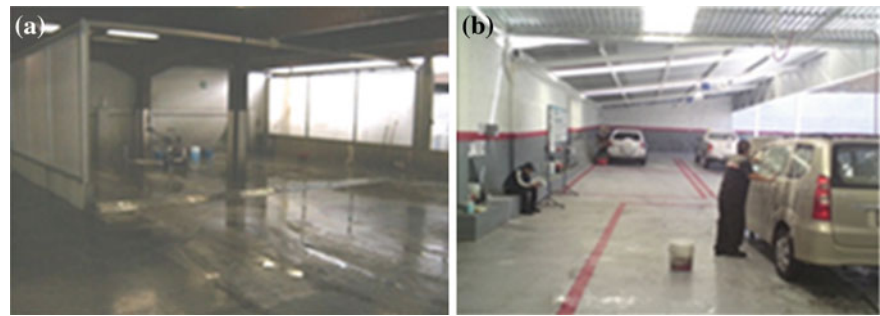


Fig. 2.2 Layout before and after actions. **a** Prior distribution, **b** Improved distribution

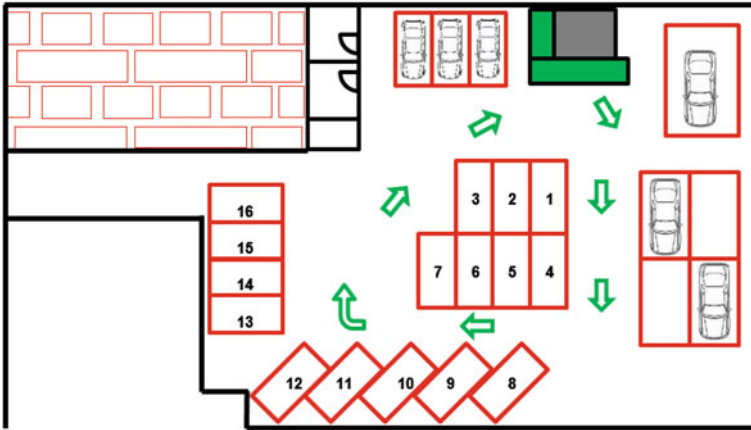


Fig. 2.3 Layout redesigned for car wash

The resulting distribution is immediately shown in schematic form (see Fig. 2.3), where the cars are placed in specific areas waiting to be served once the cars advance they are placed in different stations to be processed then they are put in a waiting place to be delivered to their owners.

2.9.4 Verification of the Results

With operations previously carried out, after 4 months, the results achieved by the implemented actions are verified quantitatively. For the percentage of vehicles washed after the implemented actions the 100 % is achieved as shown in the Fig. 2.4 below, thus achieving the goal.

The car wash time improves from 46 to 30 min and washes complaints decrease from 60 to 34.8 %. To keep improving, we outline a series of recommendations that can be made in the future such as acquire a foaming machine and implement flexible workforce.

As seen in the previous case, we can conclude that everything can be improved; hence the importance of adopting continuous improvement as a life philosophy and document improvements in a logical format and orderly as is the case of A3 format. The following shows the documentation of the previous case in A3 format (see Fig. 2.5).

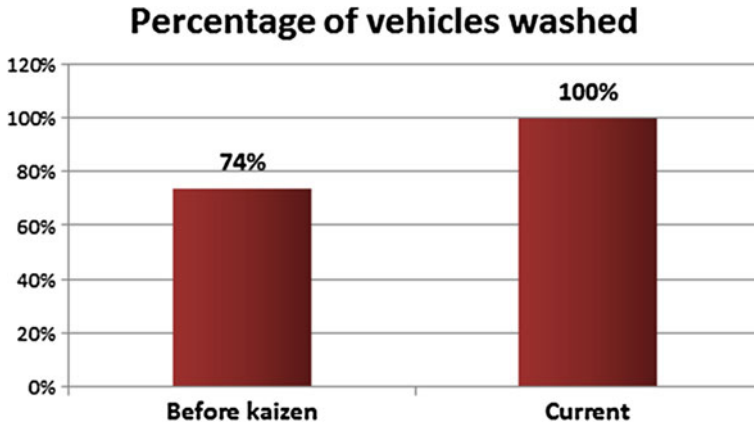


Fig. 2.4 Percentage of vehicles washed after the implemented actions

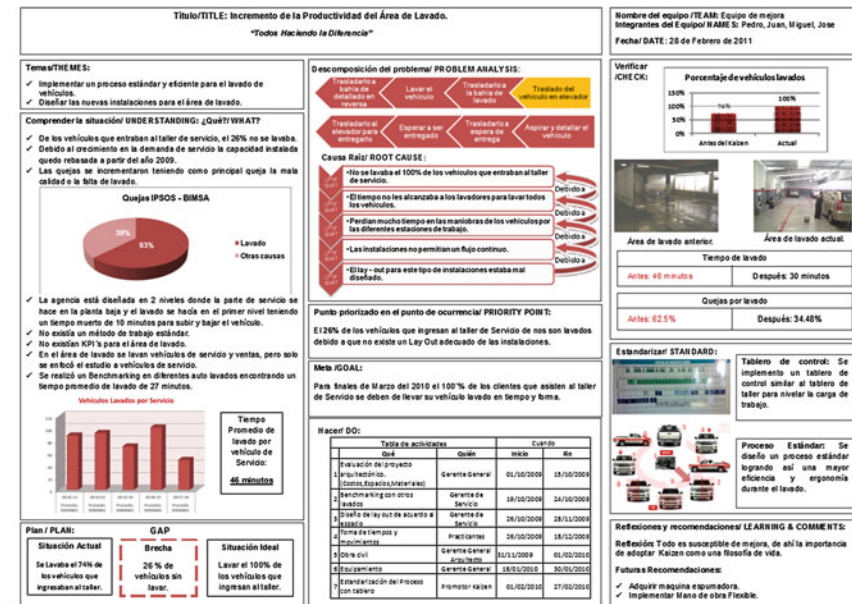


Fig. 2.5 A3 format for the case described above

References

- Bhasin, S., & Burcher, P. (2006). Lean viewed as a philosophy. *Journal of Manufacturing Technology Management*, 17(1), 56–72.
- Bodek, N. (2004). *Kaikaku: The Power and Magic of Lean*. Vancouver, WA: PCS Press.
- Cusumano, M. A. (1985). *The Japanese automobile industry: Technology and management at Nissan and Toyota*. Cambridge, MA: Harvard University Press.

- Cusumano, M. A. (1988). Manufacturing innovation: Lessons from the Japanese autoindustry. *Sloan Management Review*, 30(1), 29–39.
- De Mast, J., Schippers, W., Does, R., & Van de Heuvel, E. (2000). Steps and strategies in process improvement. *Quality and Reliability Engineering International*, 16, 301–3011.
- Defeo, J., & Juran, J. M. (2010). *Juran's quality handbook: The complete guide to performance excellence* (6th ed.). New York: McGraw-Hill.
- International Organization for Standardization. (2013). Home. Retrieved September 20, 2013 from www.iso.org
- Jackson, T. L. (2006). *Hoshin Kanri for the lean enterprise: Developing competitive capabilities and managing profit*. London, England: Productivity Press.
- Kamath, R. R., & Liker, J. K. (1994). A second look at Japanese product development. *Harvard Business Review*, 72, 154–173.
- Krafchik, J. F. (1988). Triumph of the lean production system. *Sloan Management Review*, 30(1), 41–52.
- Liker, J., & Rother, M. (2013). *Why lean programs fail*. Retrieved September 20, 2013 from http://www.lean.org/admin/km/documents/A4FF50A9-028A-49FD-BB1F-CB93D52E1878-Liker-Rother%20Article%20v3_5_CM.pdf
- Pettersen, J. (2009). Defining lean production: Some conceptual and practical issues, *The TQM Journal*, 21(2), 127–142.
- Pozos, T., Tapia, M., Hernández, D., & Luna, A. (2012). ISO 9004-2009 y las Metodologías de Solución de Problemas. *Congreso internacional de investigacion*, 4, 2396–2400. Celaya, Guanajuato, Mexico.
- Shook, J. (2008). *Managing to learn: Using the A3 management process to solve problems, gain agreement, mentor and lead*. Cambridge, MA: Lean Enterprise Institute.
- Sobek, D. K., Ward, A. C., & Liker, J. K. (1999). Toyota's principles of set-based concurrent engineering. *Sloan Management Review*, 40(2), 67–82.
- Spear, S. (2005). Fixing health care from the inside, today. *Harvard Business Review*, 83(9), 1–15.
- Spear, S. J. (2009). *The high-velocity edge: How market leaders leverage operational excellence to beat the competition*. New York, NY: McGraw-Hill.
- Spear, S. J., & Bowen, H. K. (1999). Decoding the DNA of the Toyota production system. *Harvard Business Review*, 77(5), 96–108.
- The Shingo Prize. (2013). Application Guidelines. Retrieved September 20, 2013 from www.shingoprize.org
- Womack, J. P., Jones, D. T., & Roos, D. (1990). *The machine that changed the world*. New York, NY: Rawson/MacMillan.

Lean Manufacturing in the Developing World
Methodology, Case Studies and Trends from Latin
America

García-Alcaraz, J.L.; Maldonado-Macías, A.A.;
Cortés-Robles, G. (Eds.)

2014, XVI, 584 p. 149 illus., 16 illus. in color., Hardcover
ISBN: 978-3-319-04950-2