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LEAN TRAINING METHODS

Optimisation and innovation of training methods to be implemented at a Lean training centre

Autor:

Gómez Valdivieso, Violeta

Responsable de Intercambio en la UVa:

Sánchez Bascones, Isabel

Universidad de destino:

HAMK HÄME University of Applied Sciences,

Valkeakoski Campus, Finlandia

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ALUMNO: Violeta Gómez Valdivieso.

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CENTRO: HAMK HÄME University of Applied Sciences, Valkeakoski Campus.

TUTOR: Susan Heikkila .

ABSTRACTO

Este trabajo fin de grado trató de encontrar y reunir los métodos y herramientas de formación, así como proporcionar una recomendación sobre cómo pueden estos ser implementados en un centro de formación Lean. La organización que propuso el tema fue Fadeno Oy, consultora Lean.

La recomendación de implementación para un centro de formación de Lean combina los diferentes hallazgos realizados en el proyecto, proporcionando ejemplos de cómo y cuando cada una de las herramientas se podrían utilizar. Más específicamente, la formación comenzaría con un taller seguido de ejercicios online a través de un Learning Management System. Para mantener la motivación de los alumnos, un resultado exitoso en los ejercicios otorgaría puntos a cada empleado, quien competiría para conseguir la mayor puntuación a fin de ganar un premio al final de cada semana, mes y, finalmente, al terminar el programa de formación. Puntos extra pueden ser ganados compartiendo los resultados y logros de los ejercicios través de las redes sociales. Además, reuniones para compartir lo ocurrido pueden ser organizadas al final de la semana para aumentar la motivación de los empleados y el sentimiento de equipo, y para mejorar la comunicación y el ambiente de trabajo en la organización.

Palabras clave

Lean management, métodos de formación, producción Lean, empresa Lean, innovación

HAMK
HÄMEEN AMMATTIKORKEAKOULU
HÄME UNIVERSITY OF APPLIED SCIENCES

ABSTRACT

This thesis project sought to find out and gather training methods and tools as well as to provide a recommendation on how these could be implemented at a Lean training centre. The commissioning organisation was Fadeno Oy, a Lean consultancy.

Qualitative research methods were used for this study. For both the theoretical background and the empirical research process, data was collected from published literature, the Internet and from an interview with a professional from a Lean training school.

The theoretical background introduces essential information and the main concepts of Lean to the reader to provide a basic background on the topic. This thesis presents four different research results: practical training, online training, the ACCS methodology and integrated training. Inside each of these outcomes, examples on different tools are displayed.

The implementation recommendation for a Lean training centre combines the different findings made in the project by providing examples on how and when each of the tools could be used. More specifically, the training would start with a workshop followed by online exercises through a Learning Management System. To keep up the motivation of the trainees, a successful execution of the exercises would award points to each employee, who will compete to get a higher score so as to win a prize at the end of each week, month and finally at the end of the training program. Extra points can be won by sharing one's results and achievements in exercises through the social media. Moreover, sharing meetings would be organised at the end of the week to boost employee motivation and team-building, and to improve the communication and working environment in the organisation.

In this thesis project the author could have presented more specific recommendations if the Lean training centre project had been scheduled to be realised, and had it not only existed as an idea for the future expansion of operations of Fadeno Oy.

Keywords   Lean management, Lean training methods and tools.

Pages   33 p. + appendices 15 p.

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ABBREVIATIONS

JIT – Just In Time

TPS – Toyota Production System

VSM – Value Stream Mapping

QCStory – Quality Control Storyboard

LMS – Learning Management Systems

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Appendix 1   Course Management System" Features and Criteria
Appendix 2   LMGT: Lean Manufacturing Gold Training Program

1   INTRODUCTION

1.1   Background

Lean methodology is a concept that is more and more being used in businesses, not only in the industrial sector, but also in other fields all over the world. It has spread from Japan towards the USA and Europe in the last decades and step-by-step it is going to become the future tool that all enterprises will strive to implement.

Due to the current economical situation in Europe, companies will try to tackle that situation by searching for innovative ways to differentiate themselves and survive, and this is where Lean plays a major role.

For that purpose, professionals, experts in Lean, will be demanded by these companies to help and support them to become Lean, cope with the competition, stand out and reach a successful business.

Therefore, believing in this fruitful future for Lean, the author of this thesis examined the different ways that Lean can be trained and gives recommendations for its implementation. This project helped improve the author's knowledge and experience in Lean, it provided her a chance to get closer to master the topic. Moreover, the performance of this Thesis has helped the author achieve a higher and deeper overview of Lean, with a possibility to pursue a professional career in that direction after graduation.

1.2   Objective

The objective of this thesis was to examine and gather the Lean training methods used around the world, evaluate their advantages and propose the optimal and most effective training plan, providing recommendations for its implementation at a Lean training centre connected to an organisation.

The thesis project sought to answer the following questions:
−   Which training methods/tools are used at the moment to train Lean?
−   Which new training methods/tools or ideas will be used in the future?
−   Which would be the optimal way of training Lean? And for a Training Centre?

1.3   Scope

The scope of the thesis project were the results of the research on the Lean training methods available to implement in a Lean training centre. However, this thesis project does not evaluate whether the implementation of the conclusion is successful, due to the fact that it is not known if it will be implemented.

1.4   Commissioning organization

Fadeno Oy is a Management Consultancy firm founded in January 2014. Fadeno Oy provides Lean consulting, coaching and training for Finnish companies. Its specialities are developing Lean culture change and increasing flow efficiency in any operational environment.

Kati Väljä and Riitta Ahonjoki are the owners and Lean consultants in Fadeno Oy. They are experienced professionals and have come from operational backgrounds. They have both line management experience and extensive experience in delivering improvement-based transformation programmes. Lean Consulting was born out of a desire to provide high quality consultancy services without the gold-plated costs of the larger consulting firms.
Finally, they have been in the customer´s shoes, so they can relate to the problems because they once were theirs too.

1.5   Research methods and data collection

The research methods used for this thesis were qualitative and concluded in a wide range of sources found.
Regarding the data collection, both primary and secondary sources were used here. As a primary source, an interview was conducted with a professional in the field of Lean training. For the theoretical background and the rest of the research, Internet publications (articles, videos, webinars, documents) and relevant published literature were used, and these were the secondary sources in this project.

1.6   Structure of thesis

This thesis is divided into four chapters. Chapter 1 serves as a mere introduction to the rest of the work. Chapter 2 introduces essential information about Lean to the reader to provide a basic background on the topic. Chapter 3 presents the research results of different training methods and tools, pointing out their advantages and limitations. As a conclusion, recommendations for the combined implementation of training methods are exposed. Chapter 4 provides a conclusion to the thesis.

2 THEORETICAL BACKGROUND: LEAN

The purpose of this chapter is to provide a short presentation about Lean in order to give the reader some basic information and background on the topic.

2.1 What is Lean

Lean (also known as Lean management, Lean manufacturing, Lean production or Lean thinking) is a management philosophy based on the Toyota Production System (TPS).

Lean consists on the combination of corporate values, principles, methods, tools and activities, towards the elimination of waste, keeping only the value-added operations in the consecution of a product or service. Waste is considered any action or activity that consumes resources but does not generate any value. Taiichi Ohno, founder of TPS, identified seven types of waste and an eighth one was added afterwards by Womack and Jones (further detail on 2.3).

These last two authors summarised that Lean provides the tools and methods for organisations to be able to make more with less. The aim is to get closer to the customers and reply effectively to their demand.

Lean then can be seen as a five-step process: defining customer value for a product, defining each products' value stream, making value flow without interruptions, pulling back from the customer's demand, and implementing a corporate culture that strives for excellence. (Womack and Jones 2003, 15-16.)

A different approach is defined in *This is Lean* (Modig & Ahlström, 2013). The authors describe Lean as the transformation from resource efficiency, focusing on maximising the utilisation of the resources, towards flow efficiency, focusing on the unit in process and maximising the received value during the throughput time. The throughput time is related to the satisfaction of customer's needs: it starts when a need appears and finishes when this need is fulfilled.

Resource efficiency has been the traditional strategy connected to mass production, while flow efficiency is the strategy that Lean prioritises.

Therefore, Lean strives to reach the top right corner of the efficiency matrix (Figure 1).
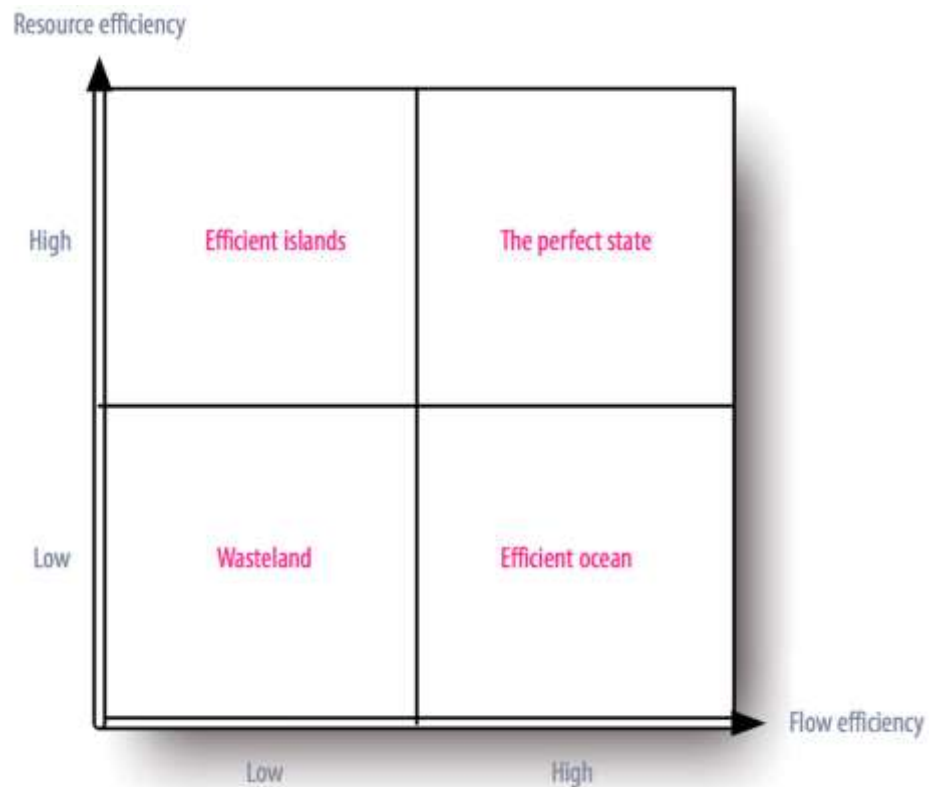
Figure 1   Efficiency matrix (Modig & Ahlström 2013, 142.)

The efficiency matrix represents four different operational states in which an organisation can find itself. The perfect state is very difficult to reach (both high flow and resource efficiency) because of variation.

Variation is the factor that limits the positions inside the matrix. This variation refers to the changing customer demand, their needs, and supply, the resources an organisation has. Due to these two agents, in order to reach the perfect state, organisations should be able to predict their customers' demand pattern, in other words, to know exactly what, when and which amount they will demand. Moreover, this would require the supply to be perfectly flexible and reliable: what, when and which amount has to be supplied, this needs to be flexible. However, perfect demand predictions, 100% flexibility and reliability are impossible to achieve. Consequently, the level of variation creates the border of efficiency in the matrix (Modig & Ahlström 2013, 144-149.)

Organisations will move over this efficiency frontier (Figure 2) while trying to maximise flow and resource efficiency.
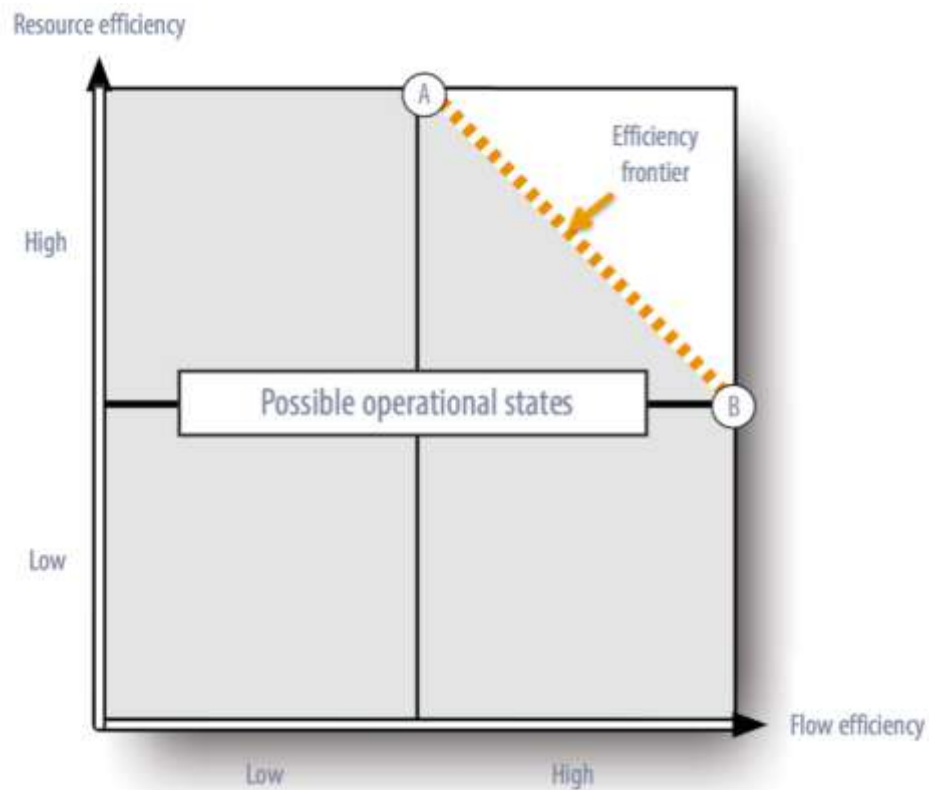
Figure 2   Efficiency matrix with variation restriction (Modig & Ahlström 2013, 149.)

To sum up, organisations will position themselves and move inside the matrix depending on their choice of focus in their corporate strategy, and also keeping in mind their competitive environment and their customer demands. (Modig & Ahlström 2013, 164.)

Finally, inside this approach, Lean is defined as "an operations strategy that prioritises flow efficiency over resource efficiency". (Modig & Ahlström 2013, 166.)

2.2   Five principles of Lean

Womack and Jones present the five Lean principles in their book *The Machine that Changed the World,* and can be briefly listed:

1. Specify value: define what creates value from the customer's point of view.
2. Identify the value stream: identify the steps needed to add value in the value stream.
3. Flow: make products flow through the value stream.
4. Pull: produce only under customer demand.
5. Perfection: eliminate waste whenever possible, striving for perfection. (Grant 2012, 129.)

Below is a description of each of these principles:

1. *Specify value*. This is the critical starting point that Lean organisations have to figure out. The definition of the value has to come from the customer's need and it is only valid for a certain product or service,

which satisfies that specific need, for a certain price, at a certain time. Therefore the dialogue with specific customers is crucial. The way to tackle this inside the organisations is to start from scratch, ignoring existing assets and technologies, and to reformulate their work on a product-line basis with strong, dedicated production teams. (Womack & Jones 2003, 29, 38.)

2. *Identify the value stream*. The value stream is all the concrete steps and actions required to bring a specific product or service through the three critical management tasks of any business, which are:

   – The problem-solving task throughout the whole process (conceptualisation, detailed design and engineering, production launch)
   – The information management task: order taking, detailed scheduling, delivery.
   – The physical transformation task: raw materials to finished product in the hands of the customer. (Womack & Jones 2003, 39.)

   Analysing the entire value stream for each product or service almost always uncovers enormous amounts of waste, alongside three types of actions:
   1. Many steps will be found to unequivocally create value.
   2. Many other steps will be found to create no value but to be forced to keep due to current technologies and production means. This type of waste is called "type one waste".
   3. Many additional steps will be found to create no value and to be immediately removed. This type of waste is called "type two waste". (Womack & Jones 2003, 40.)

3. *Flow*. Once the value and the stream of a product or service are defined in detail, and all the possible wasteful steps are removed, the organisation has to focus on how the product can flow through the value-adding process without interruptions. Batch and queue processes should be eliminated, or progressively decreased, to facilitate the flow of information, products and services. The goal is to have a continuous flow in which waste has been eliminated. (Womack & Jones 2003, 44.)

4. *Pull*. A Lean organisation is capable of creating exactly what the customer wants. Therefore it is possible to let the customer pull the desired product from the organisation, rather than pushing products onto the customer. As a consequence, inventories and over-production are eliminated. (Womack & Jones 2003, 53.)

5. *Perfection*. Once the previous four steps are achieved, it seems that those four principles will run on and on without an end, since after each iteration there is always space for improvement, waste to be removed and value to be more specifically defined by customers. Therefore, this last step equals the continuous improvement that the organisation will be experiencing from that moment on. (Womack & Jones 2003, 26.)

2.3   Waste

Lean looks after the elimination of waste and the increase of speed and flow. For that purpose, its ultimate objective is to remove any kind of waste from all processes. (Goldsby & Martichenko 2005, 31.)

Below are presented the seven types of non-value-adding waste identified by Toyota for any business process plus the eighth one later added:

1. *Overproduction*. The production of items for which there is no demand generates inventory. This excess of inventory brings wastes such as overstaffing, storage and transportation costs.

2. *Waiting (time on hand)*. Workers watching an automated machine, waiting around for the next processing step, tool, supply, part, etc., or even in downtime because of shortage of stock, processing delays, equipment stops, and capacity bottlenecks.

3. *Unnecessary transport or conveyance*. Carrying work in process long distances, having inefficient transport, or moving materials, parts and finished goods into or out of storage or between processes.

4. *Overprocessing or incorrect processing*. Adding unnecessary steps to process the parts. This is a consequence of inefficient tool and product design, which causes unpredicted motion and defects while producing. On the other hand, providing higher-quality products than necessary is also a waste.

5. *Excess inventory*. The excess of raw material, work in process, or finished goods causes longer lead times, obsolescence or damage of stored goods, transportation and storage costs, and overall delay. Not only that, but also other problems are hidden behind this extra inventory, like production imbalances, late deliveries from suppliers, defects, equipment downtime, and long setup times.

6. *Unnecessary movement*. Any extra move or action that employees have to carry out in order to complete their tasks, such as looking, reaching, or piling up parts or any item. Also, walking is considered a waste.

7. *Defects*. This refers to both the production of defective parts and its correction, which are translated in wasteful handling time and effort, and include repair or rework, scrap, replacement production, and inspection.

8. *Unused employee creativity*. Missing out the chance of engaging and listening to the employees' improvement ideas, and not providing them with the opportunities to enhance their knowledge and skills. (Liker 2004, 28-29.)

2.4   Toyota Productive System

The concept of the Toyota Productive System (TPS) appeared way before Lean. It was not until the end of the 1980s that the interest of Western researches in TPS started. John Krafcik first assigned the name "Lean" to label this kind of production in his article "Triumph of the Lean Production System", published in Sloan Management Review. (Modig & Ahlström 2013, 149.)

Taiichi Ohno developed TPS philosophy inside Toyota's company during the nearly sixty years he worked for the corporation. Ohno advocated for productivity through flow as counterpart of economies of scale and large-scale production. (Modig & Ahlström 2013, 148.)

Ohno explained in his book *Toyota Production System: Beyond Large-Scale Production* (1988) that "all we are doing is looking at the time line from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that time line by removing the non-value-added wastes".

TPS has become the basis and example for a lot of enterprises that have wanted to implement the "lean production" movement in their manufacturing businesses in the last two decades.

Modig & Ahlström (2013) provide an explanation of TPS by its deployment in a four-level pyramid with values, principles, methods, and tools and activities (Figure 3). Each of the levels is described in the following sections.
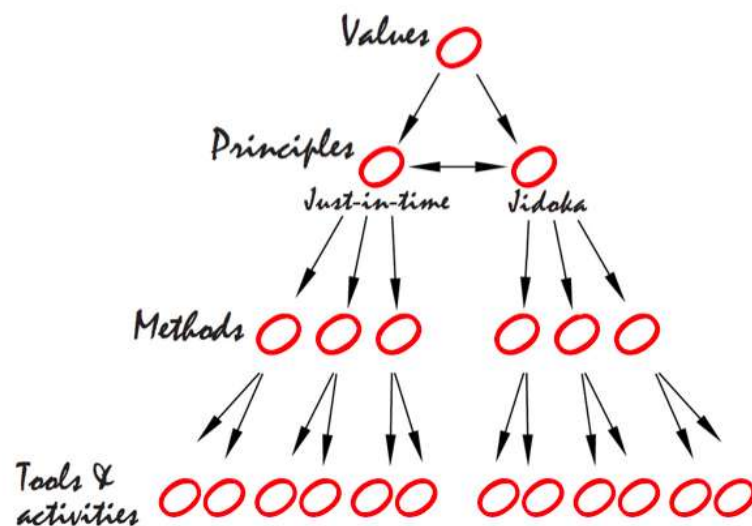

Figure 3   Visual explanation of the Toyota Motor Corporation philosophy by Nishida-san (Modig & Ahlström 2013, 243).

2.4.1 Values

Values define how an organisation should behave, no matter which situation or problem it encounters. They are the basis of the existence of any organisation and they describe the state towards which all actions should be focused for its achievement. In the end, values become the core of an organisation's culture (Modig & Ahlström 2013, 232; 244.)

Toyota's core values are collected inside an internal publication, *The Toyota Way*, released in 2001. This document includes five values that are categorised under two areas:

– Continuous improvement:
  o *Challenge*: they form a long-term vision, face challenges with courage and creativity, towards the realisation of their dreams
  o *Kaizen:* they are constantly seeking to improve their business operations, with special emphasis in innovation and evolution.
  o *Genchi Genbutsu*: they practice genchi genbutsu, which means going to the source of what is happening to find the facts to make correct decisions, build consensus among all bodies involved, and achieve goals at their best speed.

– Respect for people:
  o *Respect*: they respect others, make every effort to understand one another, take responsibility, and do their best to build mutual trust
  o *Teamwork*: they stimulate and support both personal and professional growth, share the opportunities of development, and seek to maximise individual as well as team performance. (Modig & Ahlström 2013, 155-156.)

2.4.2 Principles

Principles define how an organisation should think, how to make decisions and what should be prioritised in order to reach its values. They determine the direction in which the organisation's operations should develop for that purpose.

Toyota's philosophy comprises two principles that complement each other:

– Just-in-Time: delivering exactly what the customer wants, when the customer wants, in the quantity that consumer wants, creating a continuous efficient flow through the whole organisation.
– Jidoka: creating an aware organisation by designing a visible and clear picture of the whole so that anything that happens or disturbs the flow can immediately be identified.

These two principles combined lead Toyota towards a strong customer focus. (Modig & Ahlström 2013, 237; 244-247.)

2.4.3   Methods

Methods define what an organisation should do, standardising how its principles could be accomplished in different situations in the best way possible. In that direction, they give instructions on how to perform different tasks. (Modig & Ahlström 2013, 247.)

Two common methods are:
- Value stream mapping: analyse the existing flow in a process with the task of identifying which are the value-adding activities and which are waste.
- 5S (sorting, structuring, shining, standardising and sustaining): it promotes having the right thing in the right place, meaning having a well-organised workplace, reducing the waste that can easily arise when a worker has to spend time looking for parts, tools, etc. (Modig & Ahlström 2013, 252-253.)

2.4.4   Tools and activities

Tools and activities define what an organisation should specifically have and do respectively, to implement specific methods. (Modig & Ahlström 2013, 243-244.)
One of the most common tools utilised is the *visual planning board.* Its purpose is to make the progress of the processes visible through the display of process and result-oriented metrics or indicators. They allow controlling the status of the flow through the process, so when a deviation is found, it can be handled right away. (Modig & Ahlström 2013, 254.)

2.5   Toyota Way

The Toyota Way gathers the foundational principles of the Toyota culture, which allow TPS to function so effectively. Though they are different, the development of TPS is intimately connected with the evolution and development of the Toyota Way. (Liker 2004, 27.)

In order to completely implement TPS, workers must understand the culture behind it, and here is where the Toyota Way implementation is crucial.
In the Toyota Way, it is the people who are actively making improvement suggestions, resolving issues, and communicating with each other and, in the end, growing together. Therefore the Toyota Way encourages, supports, and demands continuous employee involvement at all levels, from the shop floor to the management. (Liker 2004, 36.)

A summary of the 14 principles that compose the Toyota Way is listed bellow, categorised in four sections: Long Term Philosophy, The Right Process Will Produce the Right Results, Add Value to the Organization by Developing Your People and Partners, and Continuously Solving Root Problems Drives Organizational Learning.

Section I: Long-Term Philosophy

– *Principle 1*. Base management decisions on long-term philosophy, even at the expense of short-term financial goals.
   o Have a philosophical sense of purpose that replaces any short-term decision-making. This mission is the foundation for all the other principles.
   o Generate value for the customer, society, and the economy.
   o Evaluate every function in the company according its capacity to achieve this.
   o Be responsible, acting with self-reliance and trust in your own abilities. Accept responsibility for your conduct and maintain and improve the skills that enable to produce added value.

Section II: The Right Process Will Produce the Right Results

– *Principle 2*. Create continuous process flow to bring problems to the surface.
   o Redesign work processes to achieve high value-added, continuous flow.
   o Create flow to move both material and information fast as well as to link processes and people together so that problems are discovered right away.
   o Make flow evident throughout your organizational culture.

– *Principle 3*. Use "pull" systems to avoid overproduction.
   o Provide your final customers with what they want, when they want it, and in the amount they want.
   o Minimise your work in process and warehousing of inventory by stocking small amounts of each product and frequently restocking based on what the customer actually takes away.

– *Principle 4*. Level out the workload (*heijunka*).
   o Eliminate overburden to people and equipment and eliminate unevenness in the production schedule.
   o Work to level out the workload of all manufacturing and service processes.

– *Principle 5*. Build a culture of stopping to fix problems, to get quality right the first time.
   o Quality for the customer drives your value proposition.
   o Use all the modern quality assurance methods available.
   o Build into your equipment the capability of detecting problems and   stopping itself (Jidoka).
   o Build into your organization support systems to quickly solve problems and put in place countermeasures.
   o Build into your culture the philosophy of stopping or slowing down to get quality right the first time to enhance productivity in the long run.

– *Principle 6*. Standardised tasks are the foundation for continuous improvement and employee empowerment.

- Use stable, repeatable methods everywhere to maintain the predictability, regular timing, and regular output of your processes.
- Capture the accumulated learning about a process by standardising today's best practices. Allow creative and individual expression to improve the standard; then incorporate it into the new standard so that when a person leaves, the next person can be able to learn it.

– *Principle 7*. Use visual control so no problems are hidden.
- Use simple visual indicators to help people determine immediately whether they are in a standard condition or deviating from it.
- Reduce your reports to one piece of paper whenever possible, even for your most important financial decisions.

– *Principle 8*. Use only reliable, thoroughly tested technology that serves your people and processes.
- Use technology to support people, not to replace people.
- New technology is often unreliable and difficult to standardize and therefore endangers "flow."
- Conduct actual tests before adopting new technology in business processes, manufacturing systems, or products.
- Reject or modify technologies that conflict with your culture or that might disrupt stability, reliability, and predictability.
- Nevertheless, encourage your people to consider new technologies when looking into new approaches to work.

Section III: Add Value to the Organization by Developing   Your People and Partners
– *Principle 9*. Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others.
- Grow leaders from within, rather than buying them from outside the organization.
- Do not view the leader's job as simply accomplishing tasks and having good people skills. Leaders must be role models of the company's philosophy and way of doing business.
- A good leader must understand the daily work in great detail so he or she can be the best teacher of your company's philosophy.

– *Principle 10*. Develop exceptional people and teams who follow your company's philosophy.
- Create a strong, stable culture in which company values and beliefs are widely shared and lived out over a period of many years.
- Train individuals and teams to work within the corporate philosophy to achieve exceptional results.
- Use cross-functional teams to improve quality and productivity, and enhance flow by solving difficult technical problems.

        o Make an on going effort to teach individuals how to work together as teams towards common goals.

– *Principle 11*. Respect your extended network of partners and suppliers by challenging them and helping them improve.

        o Challenge your outside business partners to grow and develop. It shows that you value them. Set challenging targets and assist your partners in achieving them.

Section IV: Continuously Solving Root Problems Drives Organizational Learning

– *Principle 12*. Go and see for yourself to thoroughly understand the situation (*genchi genbutsu*).

        o Solve problems and improve processes by going to the source and personally observing and verifying.

        o Think and speak based on personally verified data.

– *Principle 13*. Make decisions slowly by consensus, thoroughly considering all options; implement decisions rapidly.

        o *Nemawashi* is the process of discussing problems and potential solutions with all of those affected, to collect their ideas and get agreement on a path forward. This consensus process, though time-consuming, helps broaden the search for solutions, and once a decision is made, the stage is set for rapid implementation.

– *Principle 14*. Become a learning organization through relentless reflection (*hansei*) and continuous improvement (*kaizen*).

        o Once you have established a stable process, use continuous improvement tools to determine the root cause of inefficiencies and apply effective countermeasures.

        o Design processes that require almost no inventory. This will make wasted time and resources visible for all to see.

        o Once waste is exposed, have employees use a continuous improvement process (*kaizen*) to eliminate it.

        o Protect the organizational knowledge base by developing stable personnel, slow promotion, and very careful succession systems.

        o Use *hansei* (reflection) at key milestones and after you finish a project to openly identify all the shortcomings of the project. Develop countermeasures to avoid the same mistakes again.

        o Learn by standardizing the best practices, rather than reinventing the wheel with each new project and each new manager.   (Liker 2004, 37-41.)

2.6   Lean presence and influence around the world

Currently Lean can be found in industries all over the world, both in high-wage (including United States, Canada, Western Europe and Japan) and

low-wage economies (including Mexico, Brazil, China, Poland, Turkey and India).

High-wage economies are interested in applying it to face the migration of high-volume, make-to-finished-goods manufacturing to Mexico, Eastern Europe and China, whereas low-wage economies are striving to maintain their competitiveness and at the same time being able to increase wages and standard of living. (Womack 2005.)

Lean is not only being used in manufacturing factories, but also for service industries and the public sector, for instance, in healthcare, education and maintenance. (Lean Enterprise Institute 2015.) An example for public services is the implementation of Lean in the immigration agency in Sweden, reducing waiting times for the process of asylum applications without using more resources. (McKinsey&Company 2013.)

Additionally, Lean is not a concept restricted to big industries or companies: it can also be implemented to start-ups. In the last years, a lot of literature, such as *The Lean Start-up* by Eric Ries (2011), summits and conferences have taken place to enhance and expand Lean into entrepreneur activities.

3 RESEARCH RESULTS AND IMPLEMENTATION

This chapter describes the various options available to carry out employee training, besides the traditional classroom. The pros and cons of each method are evaluated. Subsequently, recommendations regarding the implementation of these methods for a Lean Training Centre are presented.

3.1 Results

3.1.1 Practical training

One of the first training possibilities that can come to one's mind while thinking about a production environment is practical training. However, other fields outside production also need this hand-on training. Employees need to know how to operate machines, use tools, perform quality revisions, and other tasks connected to their work. Therefore, theoretical knowledge is not enough; practice is mandatory in order to carry out correctly every task.

In-house staff can deliver trainings, as supervisors of employees of a new production line. Also machinery supply companies' personnel can provide trainings.

The first ones can be very effective because it is carried out by a person that has acquired experience on the field and can provide valuable advices from his work. Trainees absorb the knowledge and get to first hand experience on how tasks should be done. Nevertheless, the main problem here is the inconsistency in the instruction that is given and received by different individuals. (Wood Manufacturing Council 2013, 4.) Each em-

ployee can develop different ways of carrying out the same task and therefore will train others on his own technique. This can cause inconsistencies in training because there won't be a standard way of training or performing the task. Moreover, it can lead to major repercussions due to different perceptions in, for example, safety or quality standards. For solving this issue, standard operations and/or training documents should be prepared, published and shared among all workers. (Wood Manufacturing Council 2013, 4.)

Following are two examples of untraditional practical training:

a) Job shadowing: this activity has been used in the last years as educational program where students can learn about a specific profession or position. (Business Dictionary 2015b.) It consist on accompanying an experienced worker during all working hours, seeing and experiencing on first hand what he does, what problems does he encounter, how he solves them, how he interacts with other workers at any level, etc. This provides an opportunity to get a valuable insight of how an everyday workday develops.

b) Job rotation: this activity consists on rotating trainees into different areas inside an organisation, performing different tasks and processes, in order to obtain a picture of how the whole organisation functions. It can be applied among all levels in an organisation, both managers and non-managers, so that every employee inside the organisation knows what is done by the whole enterprise. (Nielson 2010, 6.)

3.1.2   Internet-based training

Internet-based training is known as e-learning and can be defined as "learning conducted via electronic media, typically on the Internet". (Oxford Dictionaries 2015.)
Since high-speed 3G and wireless data networks have been established, access to the Internet through laptops, smartphones and tablets has been more easily accessible. E-learning can be shaped in many ways and can be both passive and interactive. Examples of passive means can be videos of recorded trainings or e-books. Below are described some of the various interactive online tools available for facilitating training:

a) Learning Management Systems

The Learning Management System (LMS) is a computer-based system that enables organisations to register, track and monitor the functions of delivering online training. (Training Industry 2015.)
LMS performs two roles:
1. Content storage (web-based training materials): it can store various forms as HTML pages, presentations with slides, images, PDF documents, videos…
2. Tools offer to monitor learners' training performance, for example, quizzes and tests. Administrators can control the development of

learners by, for instance, restricting the access to the next level of training until a certain score is achieved.

Other common features are forums and chats. Grades and log in tracing are stored so instructors can monitor the evolution and activity of the participants.

The current offer of different LMS is very wide. A good summary and comparison of features available is provided by EduTools and can be found in Appendix 1. (Wood Manufacturing Council 2013, 7-8.)

As an example of how an LMS looks like, Figure 4 displays the homepage of the LMS offered by Latitude Learning.

Figure 4   Example of LMS (Latitute Learning 2015.)

b) **Webinars and Videoconferencing**

A webinar is the abbreviation for Web-based seminar. It consists on a live presentation, lecture, workshop or seminar broadcasted through Internet using video conferencing software. Webinar enables the interaction between presenter and the audience by special features such as real-time questions and answers by chat. (Webopedia 2015.)

The most common type of webinar involves a presenter showing a slide presentation on the web page and talking over the slides. Participants access the webinar logging in through a link. The session is usually recorded and uploaded to the website afterwards to allow participants or people who couldn't attend watch again the webinar. The limitation of webinars

is that they happen at scheduled times and therefore, participants must be present in order to interact and ask questions.

There are many online platforms that provide this service with varying prices according to the included features, number of users and sessions. (Wood Manufacturing Council 2013, 9.)

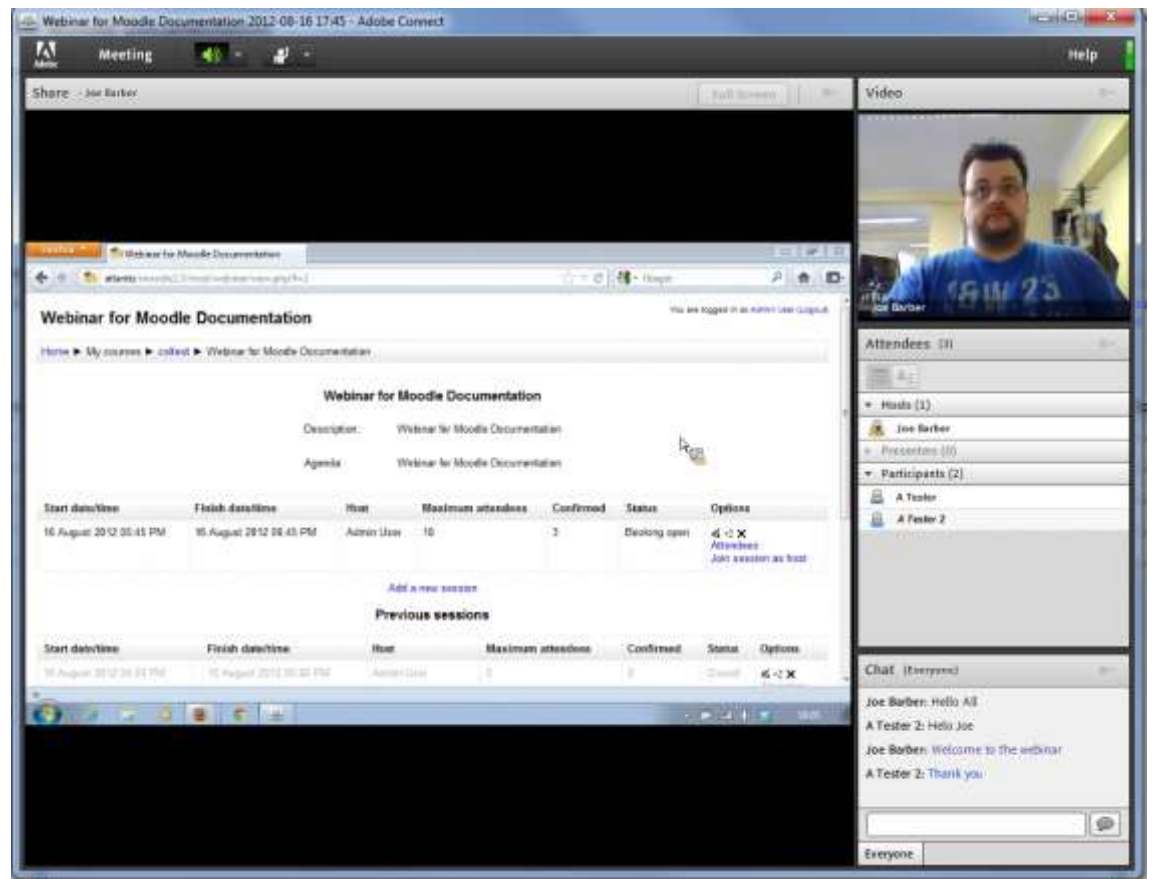Figure 5 displays an example of a webinar from Moodle.

Figure 5   Webinar example. (Moodle 2012).

c) Social Media

Social media usage has boosted in the last years and businesses have started to exploit these means as marketing channels to engage their customers. However, there are some organisations that recently have started looking at the potential of these networks for employee training.

The discussions between training professionals regarding social media have brought up the conclusion that they enable informal learning (employees passing information in non-structured ways) that is more effective because it happens when employees are actively motivated to learn something. Moreover, it is not scheduled so it can happen at any time and it is peer-based, empowering teambuilding among employees. The limitation to these tools is that not all workers use them, normally only the young generations. Therefore, they won't be able to be applied with full efficiency to all workers. (Wood Manufacturing Council 2013, 10-11.)

Internet-based training offers/encounters the following advantages and disadvantages:

Advantages
– Accessibility: training is available in the workplace and at home. – Flexibility: it can be done whenever is convenient to both the learner and the business. – Cost-effectiveness: it eliminates costs related to off-site training, such as travel and accommodation. – Ease and quickness of update: updates can be installed with no need of reprinting materials. – Communication: workers can share experiences and perspectives, contributing to greater problem-solving, increased innovation and teambuilding. (Wood Manufacturing Council 2013, 6.)

Disadvantages
– The e-learning offers in the market are diverse and competitive, with a large number of competing products and systems. This can lead to confusion while trying to chose the most suitable program. – Dropout rates are normally higher than in classroom training. – Applications that require high bandwidth and faster Internet connections, such as video content and videoconferencing, can be difficult to deliver to rural locations that don't use this connection. – Licenses can be expensive. (Wood Manufacturing Council 2013, 7.)

As an example of an online service that provides multiple of these internet-based tools related to Lean is Gemba academy (Gemba Academy LLC, 2009-2015):

This online platform provides Six Sigma and Lean video-based lessons that are appropriate for any kind of organisation, not only for manufacturers.

Their services are available for usage in multiple platforms (PCs, tablets, smartphones) online and there is also the possibility to buy DVDs, hence, it can be used at any time, any day of the year. Moreover, materials are constantly updated and new modules and courses are added. Real professionals in the Lean field deliver the videos in a conversational way and have enough quality to be projected and used for group trainings. The trainings are from 10 to 15 minutes long and documents summarising the lessons are available on PDF. The progression of the participants can be tracked and their learning can be enhanced by interactive quizzes. Some of the topics delivered are Lean basics, Lean leadership, uncover problems and opportunities, waste removal and standardisation, process design and language of Lean.

3.1.3 Collaborative-competitive learning techniques: ACCS methodology

ACCS methodology stands for Autonomous-Collaborative-Competitive learning Seminars. ACCS strives to transform conventional education, passing the centre of attention of the learning process from teachers to stu-

dents, giving the spotlight to these, so that they are able to build their own knowledge while growing other complementary useful skills.

Before explaining the methodology of this integrated technique, the different types of learning styles will be briefly described. (Sanz Angulo 2014a.)

Learning styles

− Autonomous Learning: the student is responsible for his own learning, playing a more active role. This type of learning seeks that the student activates some basic cognitive processes such as, the selection and retention of information, the management and elaboration of new information, its integration all-together, and its application to new learning situations. The consecution of individual objectives is independent from the success of the other students.

− Collaborative Learning: the student takes part of a social "construction" learning process, due to the interaction with other group members, learning more than what he would learn by himself. Through this learning, students develop other skills like reasoning and critical thinking, and also to feel more confident and accepted inside a group. In this type of learning, individual objectives are tied in such way that they can only be achieved if the other members attain theirs'. Some examples of this technique are the case method or problem-based learning.

− Competitive Learning: each student competes against the others to achieve his goals. It can be either between individuals or between teams.

Each of these learning styles have their own benefits and limitations. The ACCS methodology integrates the three learning styles and allows the generation of positive synergies that will enable the training to fulfil the current real needs of society and enterprises. (Sanz Angulo 2014b.)

ACCS Methodology

ACCS learning methodology has the objective of encouraging and motivating the student's learning at the same time as they develop soft skills. For that, the methodology counts with various elements represented in Figure 6. A brief description of the main features can be found afterwards.
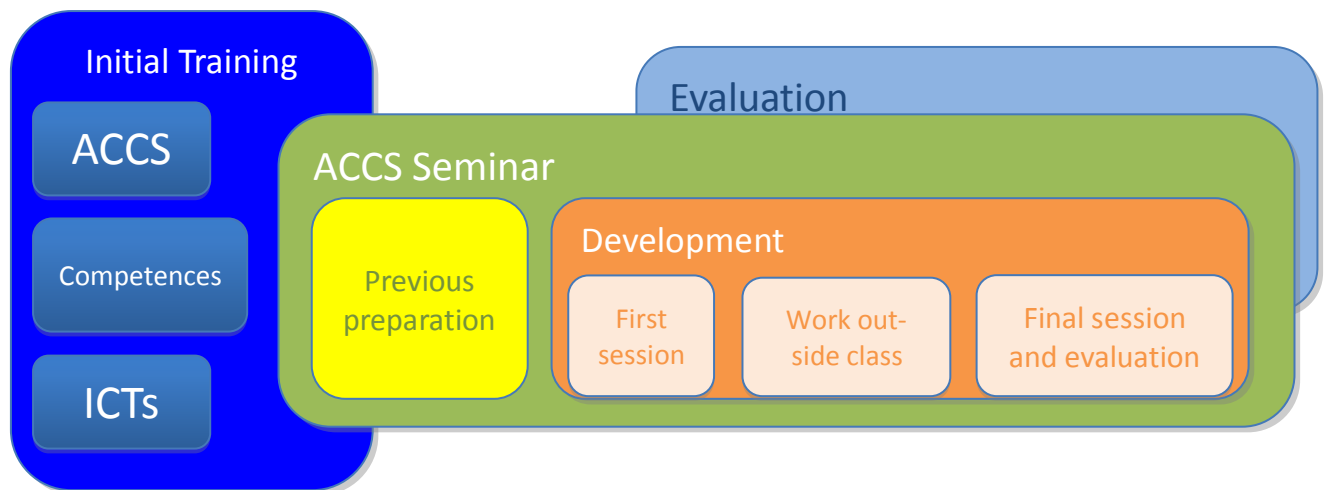
Figure 6   ACCS Methodology (graphical description). (Sanz Angulo 2014).

<u>Initial training</u>:

There are three key elements to tackle in participative seminars, first with the instructors and then with the students themselves in order to have a proper background:

− Methodology: the goals should be clearly established, the steps, roles, teamwork techniques, evaluation mechanisms and criteria, the deadlines, etc.

− Competences: teamwork, leadership, change management, creativity, innovation, ideas presentation, development of critical thinking, etc., should be instructed.

− Digital tools: from the correct use of e-mail to real-time communication and collaboration tools, educational platforms, cloud computing…Basically, the integration of technologies inside the working methods. (Sanz Angulo 2014d.)

<u>Previous preparation</u>:

During this step, three are the key activities that the instructors need to undertake:

1. Search, identification and selection of the most adequate texts and support material (for example, videos, images, leaflets, news, etc.) needed. It is a crucial phase because the success of the learning process depends on it; they should be motivating, as well as up-to-date and close enough to make students desire to participate in the process. In this sense, Internet is a key tool.

2. Define the set of questions that will guide the analysis of the material. They should be presented in an order that will promote the progressive analysis out of the provided information and using the previous knowledge on the topic from the students.

3. Write the problem with the aim that the students will try to discover the "best solution". These problems must be presented in a way that there are multiple valid answers, since the important thing in any case is that students are capable to argue, reason and defend their ideas, al-

ways respecting the others. The students have to provide a solution as a team, while competing with the other teams.

Once all the working material, questions and the problem are defined, it is the moment of working with the students inside the classroom in the seminars. (Sanz Angulo 2014e.)

Seminars:
The activities involved in the ACCS methodology seminars, both inside and outside the classroom, are summarised in the following table:

Table 1   ACCS: description of steps. (Sanz Angulo 2014a.).

First session	Creation of the teams. Assignment of roles. Material presentation for individual analysis. Text analysis inside the team. Presentation of the team's ideas and discussion between teams. Problem display
Personal work (outside the class room)	First analysis of the problem inside the team and assignment of the search-learning topics. Autonomous research of information. Final analysis inside the team.
Final session and evaluation	Presentation of the solutions to the proposed problem. Discussion between teams. Final evaluation.

Duration:
The duration of the different steps depends on multiple factors (time available, number of pupils, etc). The next table displays an example of a possible temporal evolution of the different seminar blocks:

Table 2   Duration of SACC process. (Sanz Angulo 2014b.)

First Session	**2 hours**
Team creation	5 min
Assignment of roles (facilitator, spokesperson, secretary, vocals)	5 min
Material presentation	30 min
Analysis inside the teams	40 min
Presentation of ideas and discussion between teams	35 min
Problem display	5 min
Personal work (Outside the class room)	**4 hours**
First analysis of the problem inside the team and assignment of the search-learning topics.	1 hour
Autonomous research of information.	2 hours
Final analysis inside the team.	1 hour
Final session and evaluation	**2 hours**
Presentation of the solutions to the problem proposed.	1 hour
Discussion between teams.	40 min
Final evaluation.	20 min

However, it is not necessary to carry out all the steps here defined. One advantage of this methodology is that both the duration and number of steps can be adjusted to the needs of the delivered topic. Thus, more simple seminars can be defined, although they won't allow working on all the competences and developing completely the autonomous and competitive learning. (Sanz Angulo 2014f.)

Evaluation:
The final grade obtained by the student is the result of the evaluation of different aspects:

− *Teamwork*: the evaluation is based on the information generated and elaborated in the first session to give a solution to the problem.
− *Individual work*: it contains an objective component, corresponding to the report given to the instructor, and another subjective, according to the participation of the student during the whole process and the assessment of the competences' development.
− *Final examination*: evaluation of the answers provided by the pupil to the final test.
− *Student's self-evaluation*: reflects the opinion and consideration of the student regarding his own achievements, learning and efforts during the whole process.
− *Teacher's assessment of the participation, attitude and competences' development.*

The weight of each of these factors on the final grade is up to the consideration of what is more important by the educational responsible. (Sanz Angulo 2014g.)

Some conclusions about the advantages of the application of ACCS methodology are:

− Development of competences as teamwork, respect, research, critical thinking, and ability to present ideas in a team and being able to defend them.
− Innovative and very dynamic.
− Trainings are not just a knowledge transfer, there is more participation from students, which motivates the instructors.
− Usage of new ICTs as facilitation elements, taking advantage of the continuous technological developments, maintaining the methodology updated.

3.1.4 Integrated training

The previous learning techniques can be combined together in multiple ways, boosting the effectiveness and the benefits provided. In this section, three possible examples are explained.

a) Lean School: Classroom + practical training

Example from "Escuela Lean" in Valladolid, Spain. The information here provided is the combination of the information provided through their website (Escuela Lean - Renault Consulting 2014a.) and a phone interview with Carlos Vallejo-Gago, Senior consultant at Renault Consulting, Responsible and developer of "Escuela Lean Renault Consulting", on 27th March 2015.

Renault Consulting has created the first Lean School in Spain with the mission to respond to the real needs of organisations in terms of Lean transformation and training. Their goal is to shorten the gap between education and professional life and their motto: "Learn Lean by doing".

The school is located in one of the buildings of the School of Industrial Engineering of the University of Valladolid. Its industrial training facilities cover more than 300 m^2 and include different technical and pedagogical means to guarantee the best learning: manual work stations, tools and equipment, semiautomatic machines' simulators, maintenance resources, transportation means, storage and packaging means, computer applications, data collection, training rooms…

The school offers methods that are focused on providing real experience training in order to shape the students to be the change responsibles of their organisations, helping them develop the necessary competences and not only mastering the Lean tools. For that purpose, a "mini factory" was created with real and simulated assembly processes. 5S standardisation tools, workplace improvement, TPM, problem solving, performance improvement, and other Lean tools are integrated by the production of car models. The car models are the result of the combination of all the resources taken into account: quality, time, costs, manpower, etc.

Through various production iterations, students are trained in all the necessary steps to implement Lean: they learn how to do and to control the tools, while learning at the same time how to manage a team and be leaders.

The groups towards which the programs are targeted are:
− Master students who wish to deepen in their Lean studies.
− Professionals with some previous experience who want to implement Lean in their organisations.

School's objectives

The School of Lean's challenge is to present, in a practical and dynamic way, the Lean knowledge and tools that will allow its students to be genuine agents of change inside their Organisations by:
1. Making available the innovative, real and effective pedagogic tools for the change responsible and agents in order to obtain the desired results.
2. Help enterprises in the change towards operational excellence, bestowing change managers and agents all Lean necessary competences.
3. Improve and strengthen Lean's practical education in order to increase Organisations' efficiency.
4. Provide real and fast gains in the Organisations for which its students work.

The participants are lead to manufacture an imaginative product designed under demanding pedagogical requirements.

Though practical exercises and simulations, the students face the typical problems in processes and learn gradually to observe, identify the different wastes, solve the problems and to improve the manufacturing processes.

Methodology

The trainings delivered at the Lean School allow to practice, think over, to exchange impressions and experience best practices on the first hand, through their methodology "Learning by Doing"

The $300m^2$ workshop includes a section that is used as a classroom with a screen and beamer. There is also another separated room that is used for the master programs.

The training modules are built over different workshop layouts, allowing its students to visualise the successive stages of Lean transformation and integrate gradually the operational efficiency principles through practical experience. The subsequent layouts will enable to observe and correct the typical Lean wastes.

Theoretical lectures take from 30 minutes to one hour at the beginning of the day for the professional participants, whereas master students take half of the journey, around four hours. These lectures consist of a PowerPoint presentation, followed by some basic exercises to understand the concepts taught. Afterwards, the students try implementing what they have learnt in the workshop.

For example: when they are taught about Operations' standardisation, they are given some parts, they assembly them and disassemble noting down the actions, time and resources involved. Then they analyse the results and look for the way to optimise them. With that solution, they then apply it in the workshop and evaluate whether it is an improvement or not. Groups are composed of 10 to 15 people, although some exceptional times there are up to 20.

Examination of participants takes place at the end of the programs taking into account two different evaluations:

– Objective examination of theoretical knowledge through multi-response tests, both for master students and professionals.
– Project inside the organisation (only for professionals), which consists on a series of assignments and individual coaching each week in order to solve a specific issue inside the organisation. The project is pre-sented at the end of the program and the final obtained results are as-sessed.

Site visits to Renault premises and other companies are not included in the programs, but they are arranged when possible, with the assistance prefer-ence for Master students. In these site visits, students are able to see which

Lean features have been implemented, to search for possible improvement areas and to interact with operators and managers.

Moreover, the school is working on implementing new technologies to replace the paperwork that is at the moment used in the simulations. In that field, they have a partnership with a small start-up company, Solid Gear, which is developing mobile apps to facilitate and improve Lean related operations, for example, iKaizen, that analyses workstations searching for improvement points. These apps are all gathered under the project "MLean tools". (Solid Gear 2014.)

Training programs offered

Their programs are focused on delivering the whole experience from the production point of view of Lean. Nevertheless, people from other fields are welcome to join and can take fully advantage of the theoretical trainings and office simulations.

In these programs the participants will have to perform a real project in their Organisation that will enable them to implement directly all concepts learnt at the School. Both the undertaken work and obtained results in the intersession seminars will be presented to the trainer and the rest of the participants during the classroom sessions.

Below is the list of the different delivered programs:

− LSBB: Lean Six Sigma Black Belt (Duration: 20 days)
− LSGB: Lean Six Sigma Green Belt (Duration: 10 days)
− LMTL: Lean Manufacturing Team Leaders (Duration: 10 days, 220 hours + coaching)
− LMGT: Lean Manufacturing Gold Training (Duration: 30 days)

Moreover there are specialisation modules:
− STAN: Operations' Standardisation. Genba Kanri (Duration: 4 days)
− MRPL: Problem Solving. A3-QCStory (Duration: 2 days)
− KAIZ: Kaizen (Duration: 2 days)
− TPML: TPM: Total Productive Maintenance (Duration: 2 days)
− JITL: JIT: Advanced Just in Time (Duration: 5 days)
− JITS: Synchronous JIT: Supply Synchronized JIT

Benefits and advantages

− Real environment: practical integration of all the dimensions of Lean in a very close to enterprise environment reality.
− Current Tools: it is supported by the learning of Lean tools on first hand and the transfer of technical competences besides the theoretical concepts.
− Teaching experience: teaching team with a solid acquired experience inside and outside the Renault-Nissan Alliance, in multiple sectors and companies around the world.

–   Competences' increase: leadership, change management and team-work, among others.
–   Practical experience: the students will acquire the necessary abilities to deal with the challenges of this increasingly global and competitive environment through the participation in real projects.

b) Workshop

A workshop can be defined as a "training class or seminar in which the participants work individually and/or in groups to solve actual work re-lated tasks to gain hands-on experience". (Business Dictionary 2015b.)

There are many different kinds of workshops, although they all share some common features:
–   Short length (45 minutes to some days);
–   Designed to teach practical skills to be implemented in the partici-pants' work or daily lives;
–   Small groups (6-15 participants);
–   Normally for people in the same working area, or even working to-gether;
–   Workshop facilitators' are experienced in the topic delivered;
–   More than one facilitator can conduct the workshop;
–   Important interaction facilitator-participant;
–   Participation of the participants is crucial;
–   Discussions on the topic are held;
–   Self-contained: they are planned as a stand-alone explanation, without further need on studying or reading other projects afterwards.

Workshops can be useful to carry out in diverse circumstances, such as initial training, to teach and prepare the workers for the change when a new technique or method is going to be introduced, or for the continuous improvement and development of the workers' skills.

Advantages:
–   Enhancing brainstorming, interactive learning, building relationships, and problem solving;
–   Can de implemented for all levels of workers;
–   Any kind of working environments, not only manufacturing;
–   Short period of time: does not take a lot of time off from the partici-pants working hours
–   Hands-on skills: participants can try new methods in an environment where failure is not going to ruin their work
–   Platform for sharing ideas and feedback
 (Community Tool Box 2015.)

c) Blended Learning: Classroom + Online tools

Blended learning is the combination of live classroom lessons followed by online activities. This kind of integrated training is one of the most com-mon used ones. The online tools described in 3.1.2. should be selected ac-

cording to their suitability and fulfilment of the needs and characteristics of the trained audience.

To encourage learning outside of the classroom, for instance, assignments with instructions and links can be posted on an LMS to be completed for the next class, after a group activity there can be online discussions about the outcomes, and also an open forum can be opened to resolve doubts.

The activities and tools used for blending should be periodically changed, in order to keep up the attention and interest of the participants (Nielson 2010, 10-11.)

3.2 Implementation recommendations

Based on the research and findings of this research project, this section provides some guidelines for implementing effective integrated training programs for a Lean training centre.

At the request of Fadeno Oy, the implementation focuses only on manufacturing and service, and seeks to respond to what the customers would demand for training in their organisations. In addition, all levels of workers in the organisation should be considered as participants of the training courses.

As seen above, for training to be more effective, a combination of more than one tool is recommended. Classroom lessons, practical instructions or online games by themselves are not enough to completely train a person to perform his/her work. Not only will all background and experimental aspects not be entirely delivered, but also the stimulation of the employees is lower and therefore his/her motivation towards the job.

The main issue regarding the training of Lean inside an organisation derives from an ignorance or lack of culture on why things are done as they are. This is a problem that affects all the levels inside an enterprise, for example, the shop floor/office workers who just perform operational tasks in a standardised way, without knowing the meaning in conducting them in a certain way; and the managers, who are busy with meetings with other managers, keeping track of key performance indicators, but not seeing the whole picture as they should.

Firstly, for the instruction of Lean philosophy, a lecture can be delivered at the very beginning of the training program. This lecture can be carried out as a workshop or ACCS in order to make it more dynamic and to involve the participants. As a concluding exercise at the workshop, the employees can be divided into mixed groups (managers, shop floor, office, etc.) and be given a problem to solve. In this way, they will listen and understand the different points of view around the same topic from each of the different backgrounds.

For those employees who are not able to physically attend the workshop, the solution is to follow it via a live screening webinar, with a possibility

to ask questions through chat from the instructor, although the participants will not be able to carry out the workshop's practical exercises. Therefore they should be more active in the follow up exercises. In addition, for those who cannot even attend the workshop online, it will be recorded and available afterwards. The instructor can then answer their inquiries through email.

After this introductory workshop, each person can return back to his/her position and continue with online quizzes or simulations, in a Learning Management System, to retain the information just received. These follow-up exercises should not take too long, 15 to 30 minutes is the ideal. The reason for this is to not interfere in excess with participants' working tasks and also for not making it too tiresome and discouraging to follow.

As an incentive for doing the follow-up exercises, a competition among all the participants can take place. Each time an exercise is completed with a score of a minimum 80%, that person will get a point reward. The person with the most points at the end of the week wins a prize that should be attractive enough to keep the employees competing. It can be a free breakfast the next Monday for example.

To integrate other online tools, there can be a possibility to earn extra points. A simple way for doing so could be integrating the social media. This can be done in the following way: each worker has a Twitter account, for example. Each time an exercise is successfully finished, a pop-up window will appear asking if the participant wants to share his/her results in social media, with the different social media buttons to choose from. Choosing Twitter, there will be a default sentence as "I just successfully passed exercise number 7 in my online Lean training! @CompanyName" that the worker can just post like it is, or erase and write his/her own customised message, saying how he/she feels or asking if somebody else has achieved the same level. This way, the other workers will see how their colleagues are going forward in the training and can be engaged to try to keep up their speed. Moreover, the company and person in charge of the training can follow the progress and award extra points to the most original message each day.

Secondly, in order to give all the levels of employees an overview of the operations in the organisation as a whole, job shadowing and job rotations could be implemented. Job shadowing should be carried out first, to get a first impression of how a day of another worker looks like and to get familiar with the concepts and tasks executed in that position. In this way, when the turn of rotating to different positions comes, the trainee will not be a complete stranger with them and will feel more comfortable in that environment. In this manner, workers from all the levels will be capable to experience in their own skin how the different features of Lean are being developed at each particular level, and get the big picture in their head of all the operations in the organisation.

During this second phase, the LMS can still be used and the competition continued to enhance each day's training. To make the competition even

more appealing, a prize for the best score each month and a prize for the best global score at the end of the training program can be awarded. Employees will be stimulated to continue and do not give up against their colleagues while having an incentive of winning prizes at the end of the course.

Finally, communication between different departments inside an organisation is crucial for it to work well and to avoid undesirable mistakes because of misunderstandings. Therefore, it would be suitable to have meetings at the end of each week to share how everything has evolved during the week. These meetings should not take too long, between 30 minutes and 1 hour should be appropriate. Each employee can briefly state his/her progress, what challenges he/she has faced, his/her achievements and his/her impressions from the tasks performed that week. The listeners can also comment whether they had the same perceptions or had experienced this otherwise. Of course, if the trained group is large, people can be divided into smaller groups so everyone has the chance to share their experiences.

To make the atmosphere more welcoming for sharing, drinks and something to eat, such as coffee or tea and some biscuits, can be offered, so that the activity develops in a more relaxed way. Thereby, employees are teambuilding without even noticing; bonding with their fellow colleagues, and a feeling of belonging to the organisation is grown. At the end of the training program, all workers will know each other and what they do, and thus the working environment inside the organisation will be improved.

All the steps inside the training must be adapted to the needs of the customer organisation. For instance, if a worker is freshly-hired, the organisation might not object that he/she is trained full time, and does not start working right away, since he/she does not have any experience in the company yet. On the contrary, if a worker is a long-time employee with responsibilities, he/she might not be able to afford spending one week or even a whole day devoted to training, however much the benefits training will bring. Therefore, the training program for this last worker must be divided into shorter sessions and exercises with both working and training. Consequently, a training program's length will vary accordingly.

Content-wise, also the operations of the organisation must be taken into account. If all the workers are being trained at the same time, job rotation cannot happen the same day for every employee, because they are not in their main position and do not know how to handle all the situations and perform perfectly in this new position. Therefore, the company's operations will be negatively affected, which was not the desired situation.

To conclude, in the implementation phase of a training plan, the most important element that should be considered above others is the customer organisation's needs and characteristics. The different methods and tools to be included into the training will be chosen by their suitability correspondingly.

4   CONCLUSION

The elaboration and implementation of any training plan is a laborious task in which many different elements should be taken into account in order for the plan to be a success. At the moment the number of methods and tools offered is wide and varied. Therefore, a selection of these or a combination of these has to be decided upon based on customer organisations situation, their specific requirements and the audience targeted.

The continuous progress in the fields of new technology will definitely help to further develop and update the current tools, and this will bring new innovative training tools to the market that we cannot even imagine right now.

The concept of a Lean training centre considered for this thesis was very broad due to the fact that the centre does not yet exist and it is for the moment an idea for future the enlargement of the operations of Fadeno Oy. In the event that this project is carried out, the implementation recommendations presented here could be more accurately defined and shaped matching the specific requirements of such a Lean training centre and hence be customised to meet the real needs of the company.

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Table 1
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FIGURES

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Figure 4
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Figure 5
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Appendix 1

"Course Management System" Features and Criteria. (EduTools 2013)

Communication Tools		
Discussion Forum	Discussion forum is a threaded online text conversation between participants.	• Students can enable or disable posts to be sent to their email. • Students can receive posts by email as daily digests of subject lines or whole posts. • Students can subscribe to forum RSS feeds. • A spell-checker is available for student and instructor responses.
Discussion Management	Discussion Management includes all of the accessing and scheduling associated with running a discussion forum.	• Instructors can allow students to create discussion groups. • Instructors can set up moderated discussions where all posts are screened. • Posts may be peer reviewed by other students. • Instructors can view statistical summaries of discussions displaying participation which can be used to generate grades. • Discussions can be shared across courses, departments, or any institutional unit.
File Exchange	File exchange tools allow learners to upload files from their local computers and share these files with instructors or other students in an online course. Note: File attachments to messages are part of Internal Email and Discussion Forums.	• Students can submit assignments using drop boxes. • Students can share the contents of their personal folders with other students. • Administrators can define disk space limitations for each user.
Internal Email	Internal email is electronic mail that can be read or sent from inside an online course.	• Students can use the built-in email functionality to email individuals or groups. • Students can use a searchable address book. • Instructors can email the entire class at once at a single address or alias.

		• Students can elect to forward their mail to an external address.
Online Journal/Notes	Online Notes/Journal enable students to make notes in a personal or private journal. Students can share personal journal entries with their instructor or other students but cannot share private journal entries.	• Students can attach notes to any page. • Students can combine their notes with the course content to create a printable study guide.
Real-time Chat	Real-time chat is a conversation between people over the Internet that involves exchanging messages back and forth at virtually the same time.	• The chat tool supports a limited number of simultaneous rooms. • The chat tool supports unlimited simultaneous group discussions. • Students can create new rooms. • Instructors may moderate chats and suspend students from the chat rooms. • The chat tool supports a structured way for students to ask questions and instructors to provide answers. • The system creates archive logs for all chat rooms.
Whiteboard	Whiteboard tools include an electronic version of a dry-erase board used by instructors and learners in a virtual classroom (also called a smartboard or electronic whiteboard) and other synchronous services such as application sharing, group browsing, and chatting.	• The whiteboard supports image and PowerPoint uploading. • The whiteboard supports mathematical symbols. • The software supports graphing, polling, and instructor moderation. • The software supports group web browsing. • The software supports application desktop sharing. • The software can archive a recording of whiteboard sessions for future viewing. • The software supports two-way voice chat.
Productivity Tools		
Bookmarks	Bookmarks allow students to easily return to important pages within their course or outside their course on the web. In some cases bookmarks are for an individual students private use, and in others can be	• Students can share their bookmarks. • Students can create bookmarks in a private folder. • Students can bookmark any content material in a course.

	shared with an instructor or amongst a group.	
Calendar/Progress Review	Calendar/Progress Review tools enable students to document their plans for a course and the associated assignments in a course.	• Instructors and students can post events in the online course calendar. • Instructors can post announcements to a course announcement page. • Students have a personal home page that lists all courses in which the student is enrolled, new email and all course and system-wide events from their personal calendar. • Students can view their grades on completed assignments, total points possible, course grade, and compare their grades against the class performance. • Students can subscribe to RSS feeds to be notified of changes to materials.
Searching Within Course	Searching within a course is a tool that allows users to find course material based on key words.	• Students can search all course content. • Students can search all discussion threads. • Students can search chat or virtual classroom session recordings.
Work Offline/Synchronize	Work offline/synchronize is a set of tools that enable students to work offline in their online course and for their work to be synchronized into the course the next time they log-in. Sometimes students can download course content to their local computers and work offline.	• Students can compile and download the content for an entire course into a format that can be printed or stored locally. • Instructors can publish course content on a CD-ROM that can be linked to dynamically from within the online course or viewed offline. • Students can download course content and discussion group content with a PDA.
Orientation/Help	Orientation/Help tools are designed to help students learn how to use the course management system. Typically, these tools are self-paced tutorials, user manuals, and email or telephone helpdesk support.	• Students can access context sensitive help for any tool. • The system includes online tutorials for students that help students learn how to use the system.
Student Involvement Tools		

Group Work	Group Work is the capacity to organize a class into groups and provide group work space that enables the instructor to assign specific tasks or projects.	• Instructors can assign students to groups. • The system can randomly create groups of a certain size or a set number of groups. • Students can self-select groups. • Each group can have its own discussion forum. • Each group can have its own chat or whiteboard. • Each group can be given group-specific assignments or activities. • Groups may be private or instructors can monitor groups.
Community Networking	Community Networking tools allow students to create social ties, study groups, clubs, or collaborative teams without instructor intervention.	• Students can create online clubs, interest, and study groups at the system level. • Students from different courses can interact in system-wide chat rooms or discussion forums.
Student Portfolios	Student Portfolios are areas where students can showcase their work in a course, display their personal photo, and list demographic information.	• Students can create a personal home page in each course. • Students can use their personal home page to selectively display their course work. • Students can export their personal home page.
Administration Tools		
Authentication	Authentication is a procedure that works like a lock and key by providing access to software by a user who enters the appropriate user name (login) and password. Authentication also refers to the procedure by which user names and passwords are created and maintained.	• Administrators can allow guest access to all courses. • The system can authenticate against an external LDAP server. • The system can authenticate using the Kerberos protocol. • The system supports Shibboleth. • The system supports the Central Authentication Service (CAS). • The system can authenticate against IMAP, POP3 or secure NNTP. • Administrators can set up fail-through authentication against a secondary source (e.g. the system's own database) in the event that the primary source (e.g. LDAP server) fails. • The system can support multiple organizational units and

		virtual hosts within a server configuration.
Course Authorization	Course authorization tools are used to assign specific access privileges to course content and tools based on specific user roles, e.g. students, instructors, teaching assistants. For example, students can view pages and instructors can author pages.	• The system supports restricting access based on roles and roles can also be customized by the service provider. • Administrators can create an unlimited number of custom organizational units and roles with specific access privileges to course content and tools. • Administrators can distribute the permissions and roles across multiple institutions or departments hosted in the server environment. • Instructors or students may be assigned different roles in different courses.
Registration Integration	Registration tools are used to add students to and drop students from an online course. Administrators and/or instructors use registration tools but students also use them when self-registration is available. Students can also be added to or dropped from the course.	• Instructors can add students to their courses manually or allow students to self-register. • Administrators can batch add students to the system using a delimited text file. • Administrators can transfer student information bidirectionally between the system and an SIS using delimited text files. • Administrators can transfer student information bidirectionally between the system and an SIS using IMS Enterprise Specification v1.1 XML files via web services. • The software supports data interchange with student information systems through an event-driven API. • The software supports integration with SCT Banner, SCT Luminis, Datatel, PeopleSoft 8 or customized integration with other SIS or portal systems. • The software is compliant with the IMS Enterprise Specification for Student Data.
Hosted Services	Hosted Services means that the product provider offers the course management system on a server at their location so the institution does not provide any hardware.	• The product provider offers a hosted solution. • The product provider offers **only** a hosted solution. • Hosting and support services from Commercial Affiliates.

Course Delivery Tools		
Test Types	Test types indicate which types of questions the software supports.	• Multiple choice • Multiple answer • Matching • Ordering • Jumbled sentence • Calculated • Fill-in the blank • Short answer • Survey questions • Essay • Questions can contain other media elements (images, videos, audio) • Custom question types can be defined.
Automated Testing Management	Automated testing management includes the control of when and where tests may be taken and under what conditions.	• The system can randomize the questions and answers. • Instructors can create self-assessments. • Instructors can set a time limit on a test. • Instructors can permit multiple attempts. • The students are allowed to review past attempts of a quiz. • The system supports a MathML editor for the inclusion of mathematical formulas in both questions and answers. • Instructors can specify whether correct results are shown as feedback. • The system supports proctored tests. • The system supports Remote Quiz Protocol which allows questions to be rendered and scored externally to the system via standards-based web services.
Automated Testing Support	Automated testing support includes system services for importing and exporting tests and test banks as well as statistical analysis of test results.	• Instructors can create personal test banks. • Instructors can create system wide test banks. • Questions can be imported from external test banks that support QTI.

		• The system provides test analysis data.
Online Marking Tools	Online marking tools enable instructors and assistants to evaluated and mark student work while online.	• Instructors can choose to mark each student on all questions or to mark each question on all students. • Instructors can choose to evaluate student responses anonymously. • Instructors can enable students to rate and comment on submissions of other students.
Online Gradebook	Online gradebook includes supports for keeping track of student progress and work online in support of assigning course grades.	• When an instructor adds an assignment to the course, the software automatically adds it to the gradebook. • Instructors can add grades for offline assignments. • Instructors can add details to the gradebook in custom columns. • Instructors can export the scores in the gradebook to an external spreadsheet. • Instructors can create a course grading scale that can employ either percents, letter grades, or pass/fail metrics.
Course Management	Course management tools allow instructors to control the progression of an online class through the course material.	• Instructors can selectively release assignments, assessments, and announcements based on specific start and stop dates. • Instructors can release materials based on a single criteria (date, grade, etc.) or instructors can use Boolean expressions to identify multiple selective release criteria. • Instructors can set up specific course content that is released on a specific date and must be completed by students before they continue with the course. • Instructors can link discussions to specific dates or course events. • Instructors can personalize access to specific course materials based on group membership. • Instructors can personalize access to specific course materials based on previous course activity. • Instructors can personalize access to specific course materials based on student performance.

Student Tracking	Student Tracking is the ability to track the usage of course materials by students, and to perform additional analysis and reporting both of aggregate and individual usage.	• Instructors can track the frequency and duration of student access to individual course components. • Instructors can get reports showing the time and date and frequency students as an aggregated group accessed course content. • Instructors can get reports showing the number of times, time, date, frequency and IP address of each student who accessed course content, discussion forums, course assessments, and assignments. • Instructors can review the navigation record of each student. • Usage statistics can be aggregated across courses or across the institution.
Content Development Tools		
Accessibility Compliance	Accessibility compliance means meeting the standards that allow people with disabilities to access information online. For example, the blind use a device called a screen reader to read the screen but Web pages need to be designed so that screen readers can navigate it easily.	• The product provider self-reports that the software complies with Section 508 of the US Rehabilitation Act. • The product provider self-reports that the software complies with the WAI WCAG 1.0 Level A guidelines. • The product provider self-reports that the software complies with the WAI WCAG 1.0 AA guidelines. • The product provider self-reports that the software complies with the WAI WCAG 1.0 AAA guidelines.
Content Sharing/Reuse	The product provider self-reports that the software complies with the WAI WCAG 1.0 AAA guidelines.	• Instructors can share content with other instructors and students through a central learning objects repository. • The repository can be system-wide or for individual organizational units. • Tools are available to enable version tracking and linking to specific versions as well as the creation and management of workflows for collaborative content creation and review. • The repository supports IEEE LOM and metadata application profiles such as, Dublin Core, Cancore, and custom profiles. • For any content in the repository, users can view reports

		displaying every course in the system that is currently using the selected item.
Course Templates	Course templates are tools that help instructors create the initial structure for an online course.	• The software provides support for template-based course creation. • The system provides course design wizards that provide step-by-step guides that take faculty and course designers through the completion of common course tasks, such as setting up the course homepage, syllabus, organizer pages, content modules, discussion. • Course content may be uploaded through WebDAV. • Course templates may contain selective release criteria and custom gradebook columns that persist with each new course instance. • The system allows administrators to use an existing course or a pre-defined template as a basis for a new course.
Customized Look and Feel	Customized Look and Feel is the ability to change the graphics and how a course looks. This also includes the ability to institutionally brand courses.	• The system provides default course look and feel templates. • Instructors can change the navigation icons and color schemes for a course. • Instructors can change the order and name of menu items for a course. • Institutions can create their own look and feel templates across the entire system, including their own institutional logos, headers, and footers. • The system can support multiple institutions, departments, schools or other organizational units on a single installation where each unit can apply its own look and feel templates as well as institutional images, headers and footers.
Instructional Design Tools	Instructional design tools help instructors creating learning sequences, for example, with lesson templates or wizards.	• Instructors can organize learning objects, course tools, and content into learning sequences that are reusable. • Instructors can create linear learning sequences organized hierarchically by course, lesson, and topic. • Instructors can reuse courses as templates for future lessons.

Instructional Standards Compliance	Instructional standards compliance concerns how well a product conforms to standards for sharing instructional materials with other online learning systems and other factors that may affect the decision whether to switch from this product to another.	• AICC • IMS Content Packaging 1.1.3 • IMS Content Packaging 1.1.4 • IMS QTI 1.2.1 • IMS QTI 2.0 • IMS Enterprise 1.1 • IMS Metadata 1.2.2 • IMS Metadata 1.3 • Microsoft LRN • SCORM 1.2 • SCORM 1.3
Hardware/Software		
Client Browser Required	Client Browser Required is the type and version number of the Web browser (e.g. Internet Explorer 3.0, Netscape 4.0) that works effectively with the course management system.	Open Text Description
Database Requirements	Database Requirements are technical specifications for the database management software (e.g. Oracle or SQL) required by the course management system.	• The system supports Oracle. • The system supports MS SQL Server. • The system supports MySQL. • The system supports PostGreSQL. • The application requires only one database and can coexist with tables from other applications.
UNIX Server	Unix Server means the course management system runs on a server using some variant of the Unix operating system. The Unix Server feature includes general information about hardware requirements such as disk space, memory (RAM), and CPU speed and model.	• A Unix version is available.
Windows Server	Windows Server means the course management system runs on a server that uses	• A Windows version is available.

	some version of the Microsoft Windows operating system.	
CompanyDetails/Licensing		
Company Profile	The company profile includes public information about the company or organization that provides the course management software.	Open Text Description
Costs / Licensing	Costs include information on licenses and other startup expenses.	Open Text Description
Open Source	Open Source means the software is delivered with the source code and the license agreement gives the licensee the right to modify and redistribute the software.	• The software is distributed under one of the OSI-approved licenses.
Optional Extras	Optional extras are features or extras added to the product that may or may not add to the cost.	Open Text Description

LMGT: Lean Manufacturing Gold Training Program (Escuela Lean - Renault Consulting 2014b):

Introductory Module (3 days):
- Presentation of the selected intersession work zones
- Knowledge of the Factory-School's current situation
- 1st Production
- The principles of Lean Manufacturing and the 7 wastes

Hoshin Kanri Module (2 days):
- The New Production Systems
- Goals and Actions deployment
- Autonomous Work Units administration (Organisation and Management)

Intersession assignment: Analysis of the 7 wastes in an Enterprise + individualised coaching

Genba Kanri Module (3,5 days):
- *Intersession assignments review (0,5 days)*
- Workstation Standardisation
- Balancing
- Training, competences and polyvalence management
- Technical skill or ability development
- Workplace organisation. The 5S and the visual management
- Time establishing methods and Ergonomy
- 2nd Production

Intersession assignment: Creation of Standard Operation's Records and Reference States with Visual Management in the Enterprise + individualised coaching

Quality Control Module – I (4,5 days):
- *Intersession assignments' review (0,5 day)*

- Problem Solving animation dynamic
- Job Observation: observation of the respect and improvement of the 4Ms standard
- The 5 whys
- 3rd Production
- Customer protection: pokayokes and protections' analysis
- 4th Production

Intersection assignment: 5 whys in enterprise + individualised coaching

Quality Control – II (3,5 days):
- *Intersession assignments' review (0,5 day)*
- Basic quality tools
- In-depth problem analysis methodology (A3-QCStory)
- 5th Production
- *OBJECTIVE EVALUATION*

Intersession assignment: Start A3-QCStory (project "Lean Manufacturing Gold Training") + individualised coaching

Production Means Command Module (3 days)
- *Intersession assignments' review (0,5 day)*
- Diversity increase
- 6th Production: discontinuous flow with PUSH production
- Value Stream Mapping – I (VSM)
- The pillars of Total Productive Maintenance
- TOC and the improvement strategy of OEE (Overall Equipment Effectiveness)

Intersession assignment: Strategy to eliminate the production leaks in the Enterprise + individualised coaching

Flows' Command Module (JIT) – I (4,5 days):
- *Intersession assignments' review (0,5 day)*
- Introduction to JIT
- VSM – II

- PULL Production
- 7th Production: discontinuous flow with KANBAN
- SMED – Single Minute Exchange of Dies
- Kaizen in the workstation
- 8th Production: one piece flow

Intersession assignment: VSM in the Enterprise + individualized coaching

Flow Command Module (JIT) – II (3 days):
- *Intersession assignments' review (0,5 day)*
- Logistical flows and synchronised supply (picking, kitting, sequenced)
- 9th Production: one piece flow synchronised

Lean Transformation Module (1 day):
- Change agent
- Diagnosis tools of the productive system
- *OBJECTIVE EVALUATION*

QCStory Presentation + Lean Implementation Plan (0,5 day)