Chapter 7
Application of Lean Education in ECAM Lyon for Development Lean Management Training

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7.1 Introduction

ECAM Lyon is a precursor engineering school, in France, in the field of Lean Education. Since 2004, Lean Education became a strategic axis. We launched the Lean Management among education initiatives for our students but also for company employees. These activities around Lean Education helped us to develop strong partnerships with different companies. Our pedagogy is oriented on learning by doing. Our teaching is characterized by real-life situations (in companies) or by situations reconstructed using a platform. Our educational teachings have been enriched by the implementation of research programs. These research topics have focused on issues for the sustainability of the continuous improvement process. We are interested lean manager job. Indeed, we train our learners in an uncertain and complex environment. These simulations set goals to understand the aspects of cognitive and sociologic of lean management. This understanding gives scientific results. These results are subsequently used in the continuous improvement of our educational activities.

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7.2 Lean Education: An Efficient Response for the Development of Responsible and Sustainable Organizations

Faced with the pressure of increasing international competitiveness, companies need to hire expert staff in lean management. Companies need to share best practices for problems solving. Companies are also obliged to quickly spread the lean management principles into teams of workers and managers.

This has been verified with companies of Automotive Cluster of the Rhône Alpes region. Indeed, a survey was conducted among sixty companies about their need to adopt the lean management approach. Over 70 % of them are ready to welcome internships and graduation projects on the topic of lean management.

These companies want to start lean management projects or sustain their development in this area. In conclusion, there is a need to create dedicated training in Lean Management.

From 2004, the report "*A new impulse to the industry in France*" identifies the Lean Management as one of the ways to strengthen industrial competitiveness. This report recommends launching initiatives around training Lean Management to perform with competitiveness.

In 2009, the Ministry of Industry decided to launch a deployment plan for operational excellence in the French industry, called "*Quality Plan and Performance 2010*". The purpose of this plan is to help SMEs to improve their competitiveness through the mastery of continuous improvement program.

This includes a capitalization on the educational experiences of Lean Education. The goal is to allow a better dissemination of these teaching practices in the French Engineering Schools.

ECAM Lyon was selected because of its experience of Lean training deployment. Therefore, the Institute of Operational Excellence was founded in 2009. The aim is to strengthen our skills which allows the transfer to companies' culture.

7.3 Lean Education: A New Approach to Construct New Business Case and Continuous Improvement—The Inputs from the Business Community

To meet this need for French companies, ECAM Lyon made a commitment to implement appropriate responses.

We used a deployment strategy for teaching Lean Management in the form of Kaizen. The goal was to make experiments. These educational experiences must meet different student audiences.

These experiments were established according to scientific principles of PDCA. With the Lean deployment model, our teachings have enabled us to develop educational activities and also to amplify our response within French companies.

Since 2004, we have developed research programs and educational innovations around Lean Management to improve our knowledge to better train French companies.

The consequence has been to develop new partnerships with industry. Our deployment strategy of teaching Lean started in 2004 and was deployed for 6 years. Our strategy was developed with the methodologies: Hoshin Kanri and A3 report.

We formed a team of four professors, teachers and researchers for the development of lean management teaching activities.

7.4 Typologies and Methodologies for Lean Education

Since 2004, ECAM Lyon has developed different types of training to a variety of learner profiles.

7.4.1 The Training of Engineering Students (Lean Education Methodology/Learning Methodology)

First, we developed a new training for students. In 2004, ECAM Lyon has launched awareness training modules (40 h).

The aim was to enable learners to acquire a set of tools and techniques from Lean Manufacturing and therefore to understand the context of companies competitiveness.

In 2006, the investigation results of the "Cluster Automotive Lean Rhône Alpes" identified a growing need for expertise in the Lean approach. ECAM Lyon has increased the number of hours (100 h) to train its students with a reinforcement of problem solving and team management.

We have created educational simulations to improve our teaching of Lean Management. For this, we designed 10 educational games that simulate problem solving and continuous improvement (Jidoka, Pull Flow, standardized work, TWI, PDCA Animation and visual Management, A3 problem solving).

The purpose of these scenarios in the form of practical work is to position our learners in the context of problems—root causes—improvement. Our students are grouped by team where everyone plays a special role (operators, production leader, quality service, method service, production manager). Educational content are reinforced with videos (filmed in companies) to enable our students to learn to observe and identify the sources of progress (Muri, Mura, Muda).

We offer conferences with managers of companies which have implemented the Lean approach. We strongly use learning by error as a training model. This educational model allows our students to effectively learn the PDCA methodology. This approach is very useful because it puts our students in situations in a pragmatic, empirical and scientific implementation of Lean Management principles. The reader will find below examples and illustrations of our pedagogy (Fig. 7.1).

7.4.2 Advanced Training for Students and Employees: Lean Education Methodology/Learning Methodology

In 2007, the need for supporting companies to long term was identified in mastering managerial, behavioral, and cultural dimensions in the sustainability of the Lean system deployment. During this year, we demonstrated that only the mastery of tools and techniques was not sufficient and that the real problem was the business transformation of a managerial and organizational perspective. That is why we created an advanced training: Advanced Master in Lean Management and Continuous Improvement.

Organizational learning by problem-solving is a crucial and essential process to ensure the sustainability of Lean Transformation but which is unfortunately not often taken into account or misunderstood by managers. To our knowledge, there is no research program on the pedagogy of organizational learning in the context of Lean Management which responds to the following important question: "How to increase speed within the processes of problem solving and continuous improvement in organizations?". This question is very interesting because is linked to the nonlinear dynamics of organizations.

The Advanced Master in Lean Management and Continuous Improvement at ECAM Lyon (Graduate School of Engineering) helps provide answers to this important question. A big pedagogical and scientific experiment (20 days) was conducted during this program to measure the level of learning of our candidates in the field of Lean Management through organizational learning. In order to understand the factors that impact the evolution of the learning process of the students, we propose to implement a layout within a platform INEXO (a small hierarchical company with different roles, which will be presented at the conference) with several production lines and the possibility to manufacture real products. This interactive educational immersion allows us to provide responses to the following organizational questions:

What are the determinants for adaptive learning for problem-solving?

How can we explain the reasons for generating organizational transformations?

During the simulation, we created a "simulated" company maturity assessment tool (relationship between operational systems and managerial practices) to help groups of students to measure the maturity of their problem solving and continuous

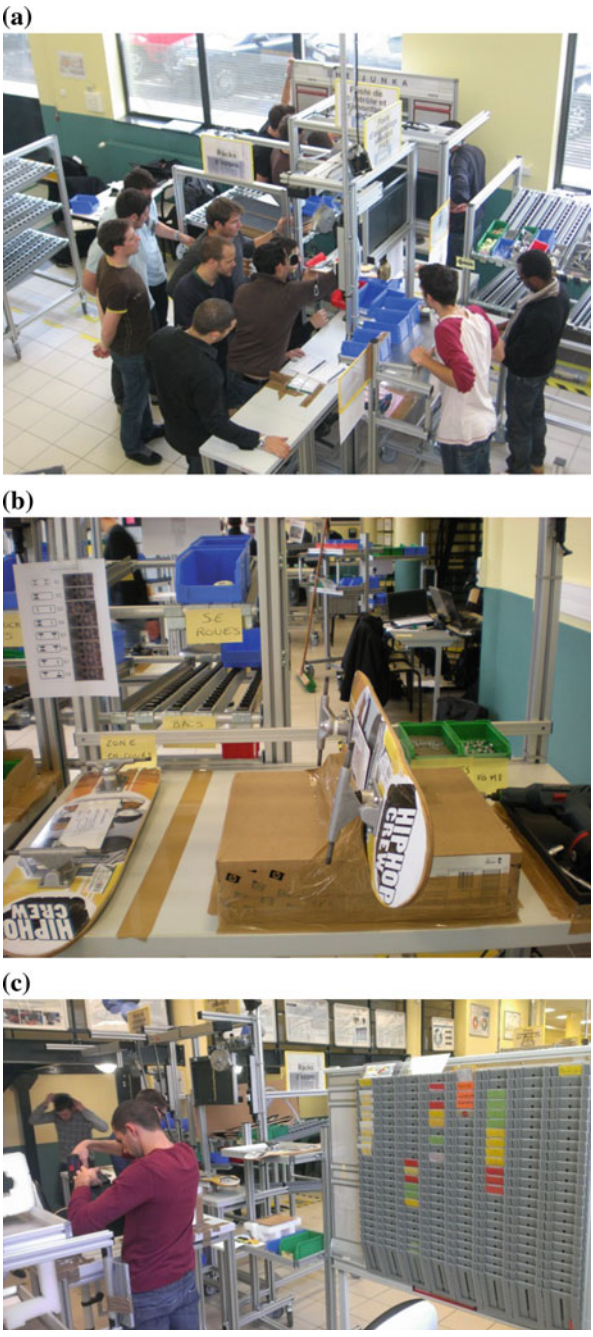

Fig. 7.1 Photos and documents of the pedagogy used: **a** Continuous improvement of an assembly line (TWI + Kaizen team); **b** Design of workstation with the Kaizen approach; **c** Use of Heijunka system to drive the information flow

improvement process (called Problem Solving Value Stream Mapping: PSVSM©). Participants must not only identify the ways to improve the technical aspects of their process, but also understand and master human behavior in the context of organizational learning (continuous improvement of the continuous improvement process: $[CI]^2P©$). The purpose of this interactive and practical simulation is to better understand individual and collective human impacts (social, psychological, cognitive, and behavioral), and organizational impact-induced changes (level and decision-making, accountability, hierarchy, multidisciplinary working groups, deployment of the tools for continuous improvement…) made by the Lean transformation.

To do this, we simulate the roles of the Lean Manager, who must also be the "problem solving chain manager". Another goal is to understand better the obstacles blocking the culture of continuous improvement. It is in fact subject instability in the management of the problem solving process and result in the students' lack of cognitive 'flexibility'.

We propose a new educational model that is based on instructor training. Indeed, for 5 days, our students prepare training and train others students on the basics of Lean Manufacturing. The educational innovation is to put our students in the role of trainers.

As part of this training, we dedicate 15 days of the implementation of animation techniques of visual management principles. Indeed, our students spend 15 days in an "unknown company". They must understand the problems of companies and to train the teams of these companies with problem solving and kaizen animation. This educational activity is an innovating pedagogy that confronts our students in a realistic situation. This pedagogy is an effective way to measure the evolution of student's maturity in mastering key principles of Lean Management. The reader will find below examples and illustrations of our pedagogy (Fig. 7.2).

7.4.3 Continuous Improvement of Lean Management Training that Is Certified and Recognized by the French State

In 2008, in response to the issue of sustainability of continuous improvement efforts, our school has created the CERSYL (Centre for Studies and Research on Lean System). This is an observatory in the framework of the implementation of learning organizations.

In 2010, our training programs have been monitored and gradual changes have been realized to meet the response to company's needs. Since 2007, we focus on a certification that builds skills on the strategic axes, managerial axes and cultural axes. In this context, to improve the recruitment of continuous improvement

Fig. 7.2 Photos and documents used: **a** Team work (worker and student) in a Kaizen activity; **b** Learning through the training of trainers (our students become trainers)

managers and to better support employees (at SMEs and Groups), ECAM Lyon is involved in a registration procedure for this certification in RNCP (Répertoire National des Certifications Professionnelles). This certification "Manager of Continuous Improvement" is designed to validate the skills to supervising animation activities to improve competitiveness in companies. This certification is the culmination of over 10 years of studies, analysis and reflection on the job of Continuous Improvement Manager.

The "Institut Lean France" (ILF) supported by the "Pôle Productique Rhône Alpes" has supported the creation of this certification. ILF is the organization that guarantees the good practices of missions of the continuous improvement manager in France. This training deployment strategy around the Lean Management has allowed us to create a strong network of partners at the companies' level, regional organizations (CCI, DRIRE, CRITT, and THESAME), the automobile platform (PFA), and CARSAT and research laboratories in the field of management science.

Table 7.1 Results of lean education at ECAM Lyon since 2012

Students trained	758
Employees trained	243
Partnerships	10
Research topics	7
Industrial contracts	23

The Table 7.1 below summarizes the integration of Lean Education in acquiring new business and the impact on the business community (number of learners trained, number of partnerships created, research topics and industrial contracts).

The impact of the training program is to better train our students to the issue of business competitiveness. For this, your training meets the needs of company's changing (recruitment of future employees and improving the skills of their employees). Thanks to Lean Management, our school has become a reference in France in terms of teaching and research on performance of continuous improvement in different companies. We have signed agreements with companies (Manitowoc, Bosch, PSA, Volvo, Ugivis, Faurecia, Joint Technique, and Remy Barrere) and public organizations (Thésame, ILF, and CARSAT). Also through this program, we were able to develop research around learning organizations and organizational learning (CERSYL). It must be added that this program allows (through research developments) to raise the teachers skills in sociological problems of Lean Management implementation.

7.5 Lean Education: A Means for Development of the Student's Employability and Employees Skills

7.5.1 Research Chair for Students and Employees

In order to develop the employability of our students and employees in an uncertain and complex organizational environment, we have developed a research chair: "Companies Dynamics and processing skills using the Lean Education". This research chair is supported by the Center for Study and Research of Lean System (CERSYL: founded in April 2008) with companies and partner organizations.

The originality of CERSYL revolves around a scientific culture based on human science, management science and engineering sciences. This multidisciplinary approach allows the embracing all aspects of the transmission, practice and dissemination of Lean in companies. CERSYL uses his ability to imagine new managerial models of the Future for the benefit of french companies and future generations of lean management practitioners.

Research should focus on two closely interrelated issues (Fig. 7.3):

- Action-research;
- multidisciplinary research.

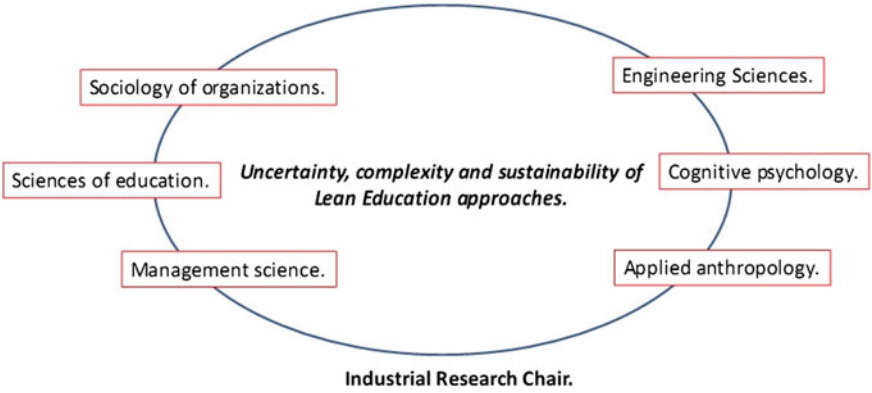

Fig. 7.3 Interdisiplinary research chair

7.5.2 The Employability of Students

The Institute for Operational Excellence (INEXO—2009) and the Center for Study on Lean System (CERSYL—2008) were developed to study in depth the Skills of developments of Lean Manager Job. These two structures have a tool of pedagogical management and a monitoring system for the development of employment and training.

The monitoring system has the following objectives:

- to analyze operational and managerial practices in companies which develop lean management (publications and surveys);
- to create partnerships for the dissemination of good practices of lean management;
- to examine the conditions of adequacy in employment/training (survey annually renewed);
- to anticipate the evolution of the profession of continuous improvement manager in SMEs;
- to publish scientific articles on the sociology of the continuous improvement manager (technology transfer);
- to develop new teaching practices and training engineering responding to economic change (Platform and educational games).

The main tasks of the CERSYL are:

- to capitalize the initiatives on the Lean at the international level
- to design innovations and know-how around Lean Management
- to train the future generations to dissemination, practice and sustainability of Lean

- to develop researches based on industrial issues in sustainability practice
- to study the conditions of practice diffusion on the maturity of companies
- to innovate for better dissemination and Lean adaptation at different hierarchical levels in organizations
- to anticipate and manage new educational engineering.

Evaluation of training is conducted within the development council. The development council's role is to enable participants to obtain a high level of knowledge and expertise in the area of continuous improvement. The development council will ensure the quality of training to meet the requirements of companies. The development board is the guarantor of the relationship between science, education and industry. Each development council member brings their advice, both scientifically and pedagogically. The means of action are:

- the scientific expertise;
- the monitoring and management improvement actions;
- the determination of the communication strategy;
- the consolidation of relations with industrial partners;
- the adaptation of training with the scientific advances.

The development council has established and has operated a training assessment procedure whose performance indicators are:

- number of candidates;
- number of selected participants;
- number of participants employed after training;
- number of partner companies;
- number of companies for internships;
- QoS level (number of satisfied participants and number of satisfied companies);
- courses level;
- level of the case studies and projects;
- level of training from good practices;
- industrial satisfaction level;
- scientific quality of training.

These indicators make proposals to improve training.

An alumni association following the certification was built from the beginning of the creation of the training. This association organizes various events in order to follow holders who have completed this certification. The first event is the sponsorship between the holders of the year (n) and alumni of the year (n−1) upon graduation. This sponsorship is held every year around the month of November. The purpose of this sponsorship is to connect graduate students in building work days around the development of the certification.

These workshop days are held every 4 months with a maximum of graduate students (December, March and July). The objectives of these working days are:

- Presentation of the career paths of students graduating classes (n−2) and (n−3) to map the career development
- Upgrading of knowledge on key elements provided during the certification with the training experts
- Visit businesses which have hired graduate students to analyze continuous improvement projects completed.

The goals of the workshops are to understand the changing needs of companies that hire our graduate's students. It is also permit to translate the thematic development axes and change pedagogy. A survey is sent for capitalizing on the experience feedback (positions held, wages, type of organization) graduate students.

Finally, we organize a conference every year (in May) with the theme of lean manager skills which last two days. Participants are graduate students, business leaders as well as experts working in our training. The aim of this conference is to understand the changing needs of companies to develop effective and innovative solutions.

By tracking our graduate students (sponsorship, workshop days and conference), we analyze macroscopically changing the needs in training new students to prepare medium-term developments of certification. For example, we identified the need to strengthen the "Organizational Coaching competence" for driving change in companies. These axes of change allow us to take into account the needs of new skills.

The annual conference allows us to understand the new methods, practices or tools provided by existing companies (through senior experts). This allows us to integrate them into the certification program (examples: TWI practice, VSM of problem solving and strategic A3). The system for monitoring student graduates allows us to develop educational axes of about 30 %.

7.5.3 The Development of Employee's Skills

Within the Research Chair, we have implemented a program to better understand human impacts (social, psychological, cognitive, and behavioral) and organizational impacts caused by changes (level and decision making, hierarchy, multidisciplinary working groups, deployment of continuous improvement tools…). Therefore, we focus more deeply on the skills of Lean Manager or Agent of change. We believe they must have a role of "manager of problem solving chain" (agent of the transformation of problem solving process). Another objective is to better understand the obstacles from the variability of the management of problem solving process and a lack of "flexibility" cognitive agents of change. Finally, cultures are specific to different types of situations; we focus on the correlations between culture (national, companies and personnel). These cultural patterns influence the learning culture of continuous improvement.

We propose to formalize best practices animation. They are carried out using a modeling approach on the mechanisms of interaction between managerial tools, change management and organizational learning (capacity models of visual management systems).

We propose an approach of observation and evaluation of cognitive activity during problem solving approaches (Kaizen workshop). This is to identify the sources of progress in the ability to solve problems of the actors within companies (strengthening activities of Kaizen Teian type).

We have also developed a mapping of learning of cultures of continuous improvement. This mapping can identify correlations with corporate cultures and business (building organizational activities of continuous improvement).

In order to develop the skills of employees (including managers and leaders) we propose a mapping of Lean Manager Skill fields under difficult work situations, uncertain and praxeological (learning to learn). For this, we used the TWI model (Training within industry) developed for the supervisor competencies. This model is suitable for lean manager function. It consists of 3 professional areas: Job Method, Job Relations and Job Instruction.

- Job Method: being able to teach people to engage in problem-solving process;
- Job Relationship: being able to identify sources of stress for employees and to take action to eliminate these sources of stress;
- Job Instruction: be able to support management teams in the development of the culture of continuous improvement.

This competency framework is derived from the organizational learning and learning organization to assist employees in their mission to be lean manager.

Employees are trained to be future experts in problems solving of competitiveness. The contents of the training accompany our candidates to be change agents and animators of the Lean approach. The key principles taught bring to our students the following skills:

- Development of continuous improvement strategy. They learn to drive change in companies with implementation policy of continuous improvement. Our teaching philosophy allows them to learn to coordinate transformation projects and provides solutions to the competitiveness problem. Learning by solving problems within our training gives them the key elements for understanding the business strategy dynamic.
- Coordination of projects for continuous improvement. They learn to identify the mechanism of progress and quantify their limits. Our training content allows them to define the implementation of progress operations. Our training philosophy advises them in the definition of the rules and the standards work to improve. They also learn to define the indicators to measure progress.
- Accompaniment teams for problem-solving. They learn to train people through the principles of animation. To do this, our teaching philosophy guides to

Table 7.2 Activities developed and skills

Activity 1: Develop a strategy of continuous improvement deployment	
Task: Identification of competitiveness problem Conduct research to understand the current situation of the organization Conduct of factual analyses of the root causes Design of countermeasures to address the root causes Targets development for improvement	Content: History of performance and industrial strategy Business and performance Economic strategy, growth and development Value and value management Value stream management (VSM) Punctual Kaizen, flow Kaizen, Kaizen system Strategic A3 Value-added direct (VAD) and Activity-based costing/management (ABC/ABM) The observation of value chains, wastes, variability and overloads mental/physical Techniques and observation tools Analysis of value chains and identification of the root causes Techniques and analytical tools/Tests of hypotheses and experimentation
Skills: Diagnose the performance of a product licensing process or service Define the axes of priority progress contributing to the strategic objectives of the company Propose the levers or actions most relevant improvements	
Activity 2: Coordinate continuous improvement projects	
Tasks: Creation of action plans Development of plans for monitoring with planned results Discussion of plans for monitoring with all affected parties Obtaining approval for the implementation of the actions Implementation actions	Content: Working standard and standardized work Performance indicators Stability of the processes and visual management Planning and visual scheduling (Heinjunka) Construction of the quality in the process (Jidoka) Flexibility of organizations (SMED) Just in time (Kanban, Pull Flow)
Skills: Pilot actions for improvement of the performance of process Measure the performance of the process Detect and implement corrective actions	
Activity 3: Accompany the teams to problems solving	
Tasks: Evaluation of the results Standardization to ensure results Stabilization standards Improvement standards Continuing education at problems solving	Content: Training within industry (Job training and job relationship) On job training (field training activities) Gemba walk, indicators and visual management control Individual and collective behavior, changes in enterprises A3 report, problem solving (QRQC, red bin, PDCA) Information systems and Lean Actors, roles and responsibilities Participatory projects and teamwork Health and performance
Skills: Prepare teams for the methods and tools of Lean improvements Enhance the results obtained and the actions implemented Standardize best practices	

change management methods in order to make people to be actors in the process. Our vision of Lean Management accompanies them to become real strength of proposal. Our pedagogical approach helps them to be animators and actors of change.

The following table Table 7.2. presents the Lean Manager activities with its missions and the content of our training.