The implementation of employee-supportive Lean in four SMEs

This appendix provides a detailed description of the implementation of employee-supportive Lean presented in section 6.3.3. We used an action research approach in which the main researcher fully participated in the implementation of employee-supportive Lean to assure the correct application of Lean tools and the human resource practices.
A.1 General Implementation Scheme

The implementation was developed following the set of Lean practices presented in Figure A.1. In each company, the project team members were two senior industrial engineering students, one company employee, and the main researcher. The structure of the project team is in line with the action research methodology in which the researcher actively participates in the intervention. These four people acted as change agents.

![Diagram of Lean tools](image)

**Figure A.1: Lean tools**

The first month was exclusively dedicated to evaluating the company’s initial situation and training both the general manager and the other managers in employee-supportive Lean. This training had a dual objective: to transmit knowledge and to obtain top management’s approval of the tools to be applied. Next, the launching event was performed. The launching event was developed as a workshop with some training
activities, games, and teamwork. The main objective of the launching event was to deploy the project’s meaning and guidelines (see Figure A.2)

![Figure A.2: Activities performed during the launching event](image)

The implementation of employee-supportive Lean lasted five to six months, and it was accomplished through weekly meetings among the workshop employees, who were grouped into teams according to their functions (i.e., extrusion, printing, sealing). The implementation schedule was designed based on the four main steps of employee-supportive Lean (Organize the workplace, Get to know the customer, Integrate production and sales, and Improve quality). Figure A.3 shows the implementation schedule. The weekly meetings had an agenda of 15 minutes for training, 15 minutes for reviewing the performance indicators, 20 minutes for brainstorming for ideas for improvement, and 15 minutes for planning for improvement activities. At the beginning of the project, the change agents led the meetings, but this responsibility was gradually delegated to key employees in the SMEs.
Employee-supportive Lean was implemented in the four selected SMEs by following the same implementation scheme for each step, as described below.

**Organize the workplace**

The Toyota 5S program was developed during the first two months. The employees were introduced to 5S through training during the weekly meetings. In addition, the weekly meetings resulted in suggestions for improving the 5S level. These suggestions were summarized and provided to top management for implementation. The red tag tactic, which consists of tagging unnecessary elements, was developed to sort out the clutter from workstations and to remove items or equipment that were nonessential for operations. Afterward, a cleaning campaign was conducted by all of the employees. Later, the remaining items were classified, positioned, and identified according to their frequency of use (i.e., frequently used tools were placed close to their point of use). In addition, limit lines and signals were placed to demarcate walkways and equipment. To maintain the 5S initiative, weekly audits were performed by an audit team. Each month, the best area received a nonmonetary award. In addition, the visual management
Get to know the customer

The first activity in this step was the ABC classification, in which the customers were categorized according to their purchase volume. Based on this information, a “client-approach” plan was developed. Together with a supervisor, workshop employees were designated to perform the client-approach activities and to present their colleagues with their findings at the weekly meetings. Based on the information collected from the client-approach activities and a small customer survey, the tools of expectation mapping and job mapping were developed. Owing to the job mapping technique, the workshop employees could understand the customers’ use of products and suggest ideas for improving their processes to fulfill customers’ expectations.

Integrate production and sales

To improve the integration of production and sales, several meetings were arranged with the employees from those functions to understand both needs and points of disagreement. Next, the interaction activities were mapped by using flow diagrams, and based on this map, potential conflict points were identified, and mechanisms for minimizing conflicts were proposed. The key mechanisms for integrating production and sales that were common to the four SMEs were providing technical training for sales agents, ensuring updated information on performance indicators, checking due-date policies, and improving communication.

Improve quality

The first activity involved in this step was an analysis of the seven types of wastes. In this respect, product defects were chosen because at that time, they were the most critical aspect for SMEs. Next, the employees were trained on the seven basic quality tools
emphasized in the cause-effect diagram. In addition, the Failure Mode Effects Analysis (FMEA) technique (MIL-STD-1629A, 1980) was used to identify the root cause of the various quality problems noticed by the customers. Afterward, the statistical quality control system was defined based on the following steps: (a) identify the special causes of variation based on the voice of the clients and the historical analysis of complaints and returns; (b) define the critical points for the process; (c) analyze the measurement system; (d) define the specification limits; (e) perform a capability analysis; and (f) define and use control charts.

A.2 Implementation Details for Each Company

Company A

Organize the workplace

The first audit graded the initial 5S level at 67%. Owing to the competitive environment created through the audits and nonmonetary awards, the various teams aimed to improve their 5S level. After five weeks, the extrusion team received an award for its excellent performance (86%). The award ceremony was held at the beach (see figure A.4) with all of the employees. On that day, games were played to improve the employees’ motivation and integration. After the 5S award event, the other teams were very motivated to improve. For instance, the printing-area workers made a substantial effort to maintain a clean and organized workplace. Although the printing workers initially claimed that their area was impossible to keep clean and neat owing to the use of ink, after five more weeks that team was the second winner, with an outstanding grade of 97%.
Get to know the customer

At the beginning of the project, the only interaction point between customers and the company was the sales department. Management even forbade production and quality employees from communicating with clients. The first activity developed in this step was the ABC classification of customers. From this activity, three clients were identified as generating 65% of sales. During the project, two visits to customer facilities were scheduled. By using expectation mapping, the SME identified product quality and technical advice as the most important aspects for the majority of the customers that were interviewed. In addition, the SME used the job mapping technique to preserve the quality of the plastic bags delivered to clients.

Integrate production and sales

The principal needs that were agreed upon by both production and sales included the need for technical training for sale agents; the need for updated information on the performance indicators; the need to review policies on delivery periods, employee fines, and the raw materials buying process; the need to create specification sheets for each product; and the need to improve communication. During the employee-supportive Lean project, we organized four technical training sessions for the sales agents regarding printing, raw
materials, processes, and products. In addition, the delivery-time policy was redefined based on market standards and the capability of the production process. Specifically, the policy was changed from six to eight days for non-printed products and from twelve to fourteen days for printed products. The third activity involved improving communication between the two functions. A planning meeting was to be held every two weeks to clarify any questions about orders and due dates. Finally, we proposed to keep the sales department informed about the use of raw materials.

**Improve quality**

Four meetings were held with the workshop employees, who developed their cause-effect diagram and proposed ideas to eliminate quality problems. Based on this information, an action plan was developed and delivered to the plant manager. In parallel with the use of basic quality tools, we worked with the quality coordinator and the plant manager to design the quality control system. The thickness of the film was defined as the critical variable, with specification limits of +/-5%. A capability analysis was then performed with a product that has a high volume of sales in the extrusion process. With the help of Minitab software, we obtained a cp of 0.36, which means that the process was not capable of fulfilling the quality specifications and that it needed to be corrected.

**Company B**

**Organize the workplace**

Together with the 5S technique, some visual control activities were performed (e.g., the establishment of work in process inventory limits). In addition, in the foam area, the employees designed accessories that contributed to the area’s organization and efficiency (e.g., a hook for hanging the packaging materials and saving time while using them). In addition, the maintenance workshop experienced a substantial change: the employees from that area transformed their workshop into a high-level 5S workshop. The first 5S
audit graded the area of plastic bags and the foam area at 64%. However, by the end of the project, both areas had improved significantly, achieving 90% in the plastic bags area and 93% in the foam area.

**Get to know the customer**

The ABC classification of customers showed that the 15% of the clients represented 80% of the plastic-bag sales and that only two clients represented 52% of the foam sales. Four visits to customers were made for the plastic-bag products, and one visit was made for the foam products. Note that none of the visited customers made any complaints about the products.

**Integrate production and sales**

In this step, the sales manager and the production manager worked closely under our guidance. They organized a meeting first with the distribution employees and then with the sales assistant. An action plan was defined based on the suggestions gathered during these meetings. Another result of these meetings was the definition of policies for order placement and delivery dates. In addition, various communication mechanisms, such as the use of electronic communication, the use of weekly meetings between the sales manager and the production manager to discuss the production schedule, the use of a white board in the production area to show the daily production orders, and the use of a white board in the sales department to show the orders waiting for production, were suggested.

**Improve quality**

During the implementation of this step, two quality problems arose. These problems were treated as Kaizen events; thus, the plant manager worked with the employees of the areas involved in the quality problem and performed a deep analysis of the problem by using brainstorming and cause-effect diagrams. An action plan was then developed to prevent
the problem from occurring again. We suggested a procedure to manage both complaints and returns in a constructive manner. Afterward, the quality control system for plastic bags began with the definition of the critical-to-quality variables and an analysis of the measurement system based on the Repeatability and Reproducibility (R&R) technique. The results of the R&R technique showed a high variation caused by employees (p<0.05). Therefore, we suggested training the employees on the measurement procedure to enhance the performance of the measurement instruments. Next, a capability analysis was performed for the two most commonly produced plastic bags. The capability index for the thickness of the plastic bag was 0.68, meaning that the process was not capable of producing according to the specification limits. However, the capability index for the width was 2.21, which means that the process was capable of producing the required width for the product. Based on these results, we suggested some actions to increase the capability of the process with respect to the thickness, such as improving the calibration process and training the employees in supervising their processes. Next, we proposed the use of control charts to monitor the quality of the process according to the different variables.

For the foam workshop, the quality control system similarly began with the definition of the critical-to-quality variable (the width of the foam) and an analysis of the measurement system based on the R&R technique. The results of the R&R showed that the measurement system was reliable. Afterward, a capability analysis was performed for the unique product. In the first round, the capability index was 0.3 because the majority of the samples exceeded the upper specification limit; thus, the plant manager decided to train the employees and explain to them the importance of remaining within the specification limits. After two weeks of training, a capability analysis was performed again, and this time, the capability index reached 1.1. After improving the quality of the
process capable, the use of control charts was proposed to monitor the variability of the process in real time.

**Company C**

**Organize the workplace**

The red-tag strategy and a cleaning campaign were used to identify many useless articles, equipment, and tools, and approximately two tons of useless items were discarded. The initial 5S audit revealed a 5S level of 71%. After four weeks of 5S application, the maintenance team received an award for their excellent performance (78%). The award consisted of a dinner at an elegant restaurant. The second award was given to the warehouse team, which reached 82% in the 5S audit.

**Get to know the customer**

With the help of the ABC classification, 10% of the clients were identified as generating 79% of the sales and only two customers as generating 80% of the returns. Expectation mapping showed that the quality-price relationship is the most important aspect for the majority of the interviewed customers.

**Integrate production and sales**

The principal needs that both departments agreed upon included the need for technical training for sales agents, the need to review policies for delivery periods, and the need to improve communication. In addition, some critical activities and the potential problems were identified (see table A.1). Technical training sessions were performed for the sales agents regarding printing techniques, raw materials, processing techniques, and product specifications. In addition, the due-date policy was redefined based on market standards and the capability of the production process. Finally, a planning meeting was to be held every two weeks to clarify any questions about orders and due dates.
Table A.1: Potential problems between production and sales

<table>
<thead>
<tr>
<th>Activity</th>
<th>Potential problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quotation</td>
<td>Errors in price</td>
</tr>
<tr>
<td></td>
<td>Missing sample or buying order</td>
</tr>
<tr>
<td>Change in dimensions of a product</td>
<td>Errors in communication</td>
</tr>
<tr>
<td>Production planning</td>
<td>Changes in priorities</td>
</tr>
<tr>
<td></td>
<td>Orders without a formal requirement</td>
</tr>
<tr>
<td></td>
<td>Late orders</td>
</tr>
<tr>
<td></td>
<td>Urgent orders</td>
</tr>
</tbody>
</table>

**Improve quality**

The Pareto diagram was applied to the quality problems, and the majority of the problems (64%) were found to be within the extrusion area. In this area, the most repetitive defects were black dots and width variation. In addition, the FMEA technique (MIL-STD-1629A, 1980) was used to determine the causes of and potential solutions to the most relevant problems. The first idea for improvement was to organize a technical training session for the workshop employees regarding the correct operation, preparation, and cleaning of the extruding machines. Another idea was to organize warming-up periods for the extruding machines.

**Company D**

**Organize the workplace**

Owing to the implementation of 5S, four tons of useless materials were identified. The employees actively participated in 5S activities such as a cleaning campaign and a delimitation of working areas (see figure A.5).
The different areas aimed to improve their 5S rates, which began at 48% but had reached 89% by the end of the project. For their effort in implementing 5S, two areas received awards, namely, a dinner at an elegant restaurant with top management (see figure A.6).

Get to know the customer

The ABC classification showed that 21% of the clients generated 80% of sales. Five visits to type-A customers were scheduled. Moreover, the expectations map showed that
quality, warranty, and on-time delivery were the most important aspects for the majority of the interviewed customers.

**Integrate production and sales**

The principal needs that were agreed upon by the production and sales functions included the need for technical training for sales agents, the need to review policies for delivery periods, and the need to improve communication. A technical training session for the sales agents regarding raw materials, processes, and products was also held. Moreover, a shared digital file with updated information about the status of the production orders and the new orders was designed and used to improve communication. Finally, a controlled amount of work in process was established to quickly respond to market changes.

**Improve quality**

At every meeting, the production and maintenance workers analyzed the maintenance problems. The production and maintenance workers began to work together to solve quality problems and to prevent breakdowns. Gradually, the maintenance workers improved their service levels, and the workshop employees understood that machine maintenance was one of their responsibilities. Regarding quality improvement, the focus was on the process with the highest product defect rate (printed plastic packages). Then, FMEA was used to determine the causes of the most relevant problems. The following ideas for improvement were suggested by the workshop employees and subsequently implemented: (a) the definition of a standard for tub colors, (b) a statistical control for the molding process, and (c) a new sampling procedure for the printing process. For the molding process, first, a capability analysis was performed for the plastic film in four different areas (A, B, C, and D). The obtained cp was 1.18 for areas A and B, 1.28 for area C, and 1.34 for area D, which means that the process was capable of producing
according to the specification limits. Next, two control charts were defined: one for the mean and the other for the range of the plastic film width.