Potential cost reductions driven by management tools at a packaging printer

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Abstract

Amidst the circumstances of sharp global competition in recent years, an increasing number of companies have found interest in lean management in the hope of gaining a substantial competitive edge. It has become evident that the procurement of the most novel production equipment alone would not make a company successful. Beyond state-of-the-art production machinery, another source of advantage in competition can be a value-adding process of manufacturing that focuses on customer demands as a basis of lean management. Experience shows that the competitiveness of companies applying lean management is on the rise because of the smaller costs, more productive labour, shorter lead times and higher quality.

The objective of the research has been to support the introduction of lean management and the use of modern printing technologies by assessing the loss-making constituents of AR Carton Packaging Group's printing processes, offering solutions to mitigate or fully eliminate these impacts, as well as confirming the actual implementation of cost reduction.

In their studies, the author have focused on promoting the introduction of the already initiated lean attitude by bettering the technological processes of printing in order to make perceivable achievements. In this manner, the interrelated projects have reinforced each other, and brought about the foreseen results. The optimal corrective actions have been determined with a step-by-step review of the technological aspects of the printing process.

Keywords: lean management, packaging printing, setup reduction

1. Introduction

The ultimate goal of all business activities is value creation. Value creation is a process that yields a product or service for which a customer is willing to pay. However, in the process of value creation there are activeties not representing any value. Although they are parts of the process, it does not mean that the customer is pleased to expend money on them.

Lean Manufacturing is a philosophy of production that has a focus on rationalizing and optimizing value-adding processes, circumventing and eliminating potential losses. It puts a production system in place that allows the making of high-quality products at moderate costs and with short lead times. The aim is to align the process of production with the expectations of the customer. Consumers tend to demand increasingly better quality, lower prices, short lead times and a broader selection of products. Developed by Toyota, the efficiency of Lean Manufacturing is inherent in the underlying principles its rules, means and philosophy operate in harmony in order to eliminate losses from the processes.

2. Objectives of the research

The fundamental hypothesis of this thesis is that Lean Principles are value-centered, and facilitate the elimination of losses. In our case, a graphic enterprise can considerably improve the efficiency of the printing process (from the customer to the prints) with the application of Lean Manufacturing, promoting an increase in the profit. Our objective is to examine the losses incurred with the printing processes of cardboard packaging materials by the company under review, and investigate how the application of the means of Lean Manufacturing can cut back or fully eliminate the revealed losses. In addition to looking at the printing process, we also want to know what impacts these changes may have on the reduction of costs.

The objective of this thesis has been to support the introduction of lean management and the use of modern printing technologies by assessing the loss-making constituents of AR Carton Packaging Group's printing processes, offering solutions to mitigate or fully eliminate these impacts, as well as confirming the actual implementation of cost reduction, continuing our research job published in last Iarigai conference.

3. Lean printing

In the printing process, the value for a customer is the creation, reproduction of the conceived design, colour, while for the printer the satisfaction of these demands in a cost-efficient manner. For the customer, the essential aspects are the colour, form and deadline of delivery, whereas for the printer the keys to profit lie in the short adjustment time and quick printing of the requested number of useful copies. In the printing process, the Lean Philosophy is embodied in the efficient and inexpensive satisfaction of customer expectations. The specific working process of Lean Manufacturing and the printing technology should work together effectively. It means that Lean proves to be insufficient if the management of the printing technology fails, while without the lean component even the best technology will be less effective. They together provide the best environment for the operation of a competitive printer.

4. Research methods

Procedure and methodological approach:

- analysis of the principles, means of Lean Manufacturing,
- study of the values, losses of the printing process,
- determination of the measures to improve efficiency, actual steps to accomplish the objective
- implementation of the enhancement of efficiency, explanation of results.

The aim of our research is to rely on certain technical processes and printing technologies in combination with the lean methods towards the improvement of the efficiency of the printing process, and thus to reduce costs at AR Carton Packaging Group. As specific aspects of these examinations, those means of lean, operating safety and printing technology have been selected that have the potential to improve the efficiency of the process to the farthest extent, eliminate or minimize losses.

5. Establishment of orderly work conditions, effective base material flow

In order to make the working environment of the printing presses more orderly and safer, 5S was applied. The objective was to establish an efficient, safe and high-standard work environment. Whatever was not needed for the performance of daily tasks in the printing press was sorted out and removed. After this process of selection, it was re-considered whether such materials and devices had been retained in the work area that were integral parts of daily work, and if their quantities had indeed been effectively cut back. For the required tools, expedient storage places were accurately defined and created, while other objects were stored in an easily recognizable arrangement. As a fundamental rule, objects, base materials that were necessary for adjustment or production were placed so that they should become accessible in the quickest and shortest way.

Figure 1:
Surroundings of the KBA Rapida 142 sheet-fed offset press

Figure 1 demonstrates the working environment of the KBA Rapida 142 sheet-fed offset printing press. Following the completion of the 5S process, only the necessary tools remained in the work area, in ergonomic, visually recognizable arrangement.

The established system was designed to sustain and develop the existing work environment. With the use of a questionnaire, the surroundings of the printing press are now reviewed on a monthly basis. The questions are scored in order to quantify the existing conditions, whether they are perceived as improvement and/or regression.

Beside the work environment of the printing press, the 5S method was also applied to the base material flow of the manufacturing process. The existing material flow was assessed and visualized as shown in *Figure 2*.

Figure 2: Unoptimized material flow

Having reviewed the given material flow for print carriers, we had to admit that neither the location of the in-process inventories, nor the place of the roll warehouse was optimal. The movement of print carriers demanded considerable time and energies due to the considerable distances. The base materials were not available where they were actually needed.

Owing to the new arrangement, the distance between the printing press and in-process inventories was reduced from 100 meters to 20 meters.

Therefore, the base material can now be carried to the printing press in a shorter while, with smaller loss from the operators' time. The achieved time saving can be utilized to perform other operations on the printing press.

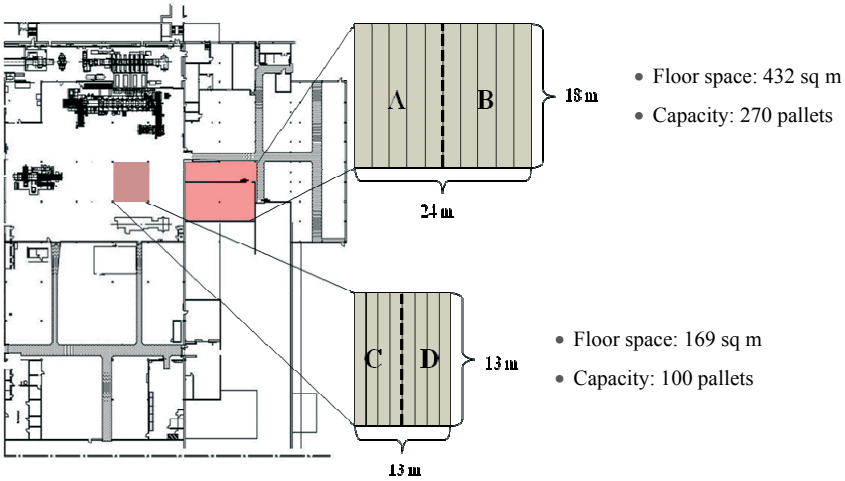

Figure 3: Optimized material flow

6. Improvement of the reliability of the printing press

As within the plant no sufficient expertise is available, the maintenance and servicing of the KBA Rapida 142 sheet-fed offset printing press were outsourced to the supplier of the printing press. In detailed consultations and negotiations, the terms and conditions of maintenance and repair servicing activities were defined and set forth in the form of a contract. The partner program implemented in the framework of the given con-tract was aimed at reducing the time losses arising from machine failures, and guaranteeing an appropriate level of operating safety. The contract consisted of three modules. The first module was designed to ensure the monthly servicing of problems with the machines to maintain the initial conditions of the equipment, and sustain the perfect operation of all the functions of the printing press. The second module allowed remote servicing all around the clock. The last module covered the assessment of the prevailing conditions of the machines on a half-yearly basis. The printing press was not set to be inspected solely for mechanical problems, but diagnostic test printing was required to be executed. The defined checks included the printing characteristics, reproduction capabilities of the press, as well.

7. Colour calibration of the printing press

The aim of the colour calibration process was to define, and then standardize the technological parameters of the devices used in the printing process (sheet-fed offset printing press, subcontracted colour proofing) on the basis of the test prints. The parameters determined in the course of test printing (CIE L*a*b*colour space, tone value increase) were examined on the basis of the target values set by Standard ISO 12647-2. After the drying of the prints, the tone value increase of the printing press was determined from the average of the measurement results of several prints. On the basis of the measured values, the tone value projected on the form was modified so that in the course of printing the tone value increased by the printing press in the print should comply with the value specified in Standard ISO 12647-2.

Calibration was also performed for the subcontracted proofing, i.e. the inkjet printer. The effectiveness of calibration was verified by making the test print again.

In addition to instrumental evaluation, prints were subjected to visual checks, because the majority of customers would judge the colour spectrums of printed products in the same way. The prints of the plates that had been scanned with the settings originating from the process calibrations were compared with the similarly calibrated, subcontracted colour proofs, and eventually it was concluded that the calibration was successful.

In the course of digital pre-processing, appropriate colour separations could be made for printing. The two work processes became harmonized, and - as a very important aspect - mutually verifiable. The roots of problems now proved to be distinguishable, and the efficiency of the process bettered. The settings of printing became unambiguous, individual, occasional adjustments in the machine room could be avoided, reproducibility hugely improved.

8. Summary of results

In our studies, we have focused on promoting the introduction of the already initiated lean attitude by improving the technological processes of printing in order to make perceivable achievements. In this manner, the interrelated projects have reinforced each other, and brought about the foreseen results. The optimal corrective actions have been determined with a step-by-step review of the technological aspects of the printing process. The performance indicators suggest whether changes have taken an appropriate direction. The tasks described in association with the objective of the research have been executed in three groups.

The 5S practices that have already been introduced to the operations concerned have been perfected on the KBA Rapida 142 printing press. In line with the expectations, as a result of the optimization of the material flow the idle time of the printing press has been considerably reduced.

By adapting new maintenance practices, the operating safety of the printing press has been enhanced. A maintenance system applying a more efficient strategy has been set up to make the manufacturer of the printing press responsible for sustaining the required technical conditions of the machine. With the use of this developed system, maintenance planning has become feasible, while frequent machine failures can be avoided.

By reconciling printing press and prepress processes, a major step has been taken towards the acceleration of machine changeover. By completing the calibration process, the number of cancelled prints to be adjusted has been decreased by 39%, while the desired design colours can be implemented more quickly.

With the application of the SMED device, the time demand of machine changeovers could be cut. In practice, the solution was implemented on the KBA Rapida 142 printing press. The time demand of changeovers dropped by 45% when the standard operating procedures were introduced.

The results of the actual implementation of the measures taken for the improvement of productivity as described in the discussion part of the research are demonstrated in *Table 1*. The table shows the performance indicators of the KBA Rapida 142 printing press before and after the adaptation of the corrective measures.

Table 1: Performance indicators of KBA 142 sheet-fed offset printing press in 2009 and 2012

Performance indicators	Production figures in 2009	Production figures in 2012
Operating time (hours p.a.)	3913	5057
Setup time (hours p.a.)	717	1126
Idle time (hours p.a.)	1764	1187
Production time (hours p.a.)	1432	2762
Idle time (%)	43.8	23.4
Average setup time (h)	1.39	0.64
Number of setups	515	1754
Average number of make ready (sheets/job)	277	169
Number of make ready (sheets p.a.)	142,597	296,426
Number of waste sheets during the printing (p.a.)	477,182	198,015
Total number of waste sheets (sheets p.a.)	619,779	494,596
Total number of waste sheets (%)	4.5	1.8
Average printing speed (sheets/h)	9100	9920
Average number of print runs	25,308	15,614
Number of prints (sheets p.a.)	*13,654,621*	*27,890,000*

It can be claimed that the primarily examined key performance indicators have been substantially improved by the corrective measures. On the other hand, it can be also confirmed that the enhancement of production efficiency is accompanied by cost reduction. The average duration of idle times has fallen from 43.8% to 23.4%. This newly recovered, additional time offers free capacity for the manufacturing of further products, real and profitability operations.

8. Conclusions

The handling of the means of lean management and the development of the processes of printing technology with a common approach has clearly visible and measurable outcomes. In consequence, it can be claimed that the application of lean methods with proper view of industrial characteristics, i.e. "lean printing" is a truly useful tool. Without a thorough knowledge of the technology, the means of lean management may be successfully applicable, though cannot be vehicles of a breakthrough.

The ways of practical use described in my thesis unequivocally underline this statement. Both cost reduction and the enhancement of production efficiency can be continued. It is a never-ending process. There will always be new losses occurring, and they can eliminated from the process to drive further improvement.

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