Relation Between Cost Driven Green Kaizen and Pharmaceutical Production

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Abstract: *A case study of green kaizen shows how operators and managers can use the Green Performance Map method in a drug manufacturer to engage in environmental improvements on a shopping floor. The method involves defining possibilities for development, an input-output visualizing model (to achieve a common understanding) and a cost saving strategy for intervention prioritizing (to reach strength). This paper would illustrate how operationalization is necessary to change behavior, and illustrates how cost is used to achieve environmental change. The necessary changes are enormous and have begun. In conjunction with new technology exponential development and the overall digitalization, this research find a mode of processing for the producing sector. There are people who say that they are aware of the industrial revolution for the first time in history. There are however significant differences of future manufacturing transition vs. current factories, i.e. brownfield, based upon the preconditions of each company to operate with new Greenfield factories.*

Keywords: *Cost Driven, Change Management, Environmental Improvement, Kaizen, Green Kaizen, Opex, and Lean Sustainability.*

I. INTRODUCTION

With the environmental weather and temperature scenario that is troubling, this research is in a very ordinary situation. They already learn from a recent report by the intergovernmental climate change panel that when it comes to climate change impacts, the gap between holding the global warming at 1.5 ° and 2.0 ° is immense. The emissions of climate gas are caused by eco-friendly problems such as energy and material use, air, soil and water emissions. Approximately 2/10 of global direct emissions and considerable indirect emissions (e.g. electrical and transportation used by the manufacturing system) are apparently part of the global industrial sector as reported [1]. The business is also certainly a part of the solution, though, to make B2B and B2C goods more competitive. The company and all other producers, such as steel, coal, fertilizer, agriculture, food and pharmacy, need to make extensive improvements.

The necessary changes are immense and have begun. Along with new technology-driven accelerated growth and total digitalization, this research see the manufacturing industry becoming a mode of transformation [2], [3]. Some even say that planning an industrial revolution as this research advance, for the first time in history. Nonetheless,

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according to the preconditions of each company's dealing with new green-field plants vs. existing plants, brownfield, there are significant differences in potential production rates. The best available technology (BAT) could be used in the construction of a new factory or e.g. a new production line to produce the most energy efficient and cost efficient solutions using the available digital options. On the other hand, the transformation will rely more on operations excellence (OPEX) and continuous improvements (CI), when an upgrade in an existing plant is based on the ordinary level of annual capital expenditure (CAPEX).

Green lean operational management is probably most cost efficient way for production to improve sustainability [1], [4], [5]. Many fail, however, and it is necessary to explore new efficient mechanisms to trigger and maintain lean and green kaizen in everyday operations. There is a lack of green-lean approaches which practitioners develop and then use as case studies in research. The opposite is more frequently the case, i.e. researchers develop methods that are sometimes tested in industry in real cases. The Green Performance Map (GPM) was used as a framework for designing the green kaizen method used in this research. Originally, in collaboration between industrialists and academy, the authors created the GPM approach (both at that time working in the automotive industry) [6]–[8]. The GPM was applied in participating Sweden automotive manufacturing companies. It was then important to investigate whether it could be successful to implement the method in other industries such as the pharmaceutical manufacturing industry (after called the pharmaceutical industry).

Pharmaceutical production implies specific requirements for quality and cleanliness, operationalized through, for example, cleanrooms and strict constraints and rules for manufacture design. The implementation of a Lean Type CI may be challenging. In the pharmaceutical industry, the quality of climate, time and resources is growing. A high-quality, secure finished product with the use of risk management for identifying potential risks to the end customer demands a sound production practice.

A pilot tested the GPM method in two production lines in a pharmaceutical company was performed in this case. In addition to the emphasis on how the environmental improvements are made at the shop floor level, the cost parameter has been highlighted in order to increase management attention to approve green kaizen resources [1], [9]–[12]. This paper reports on the findings from the pilot and illustrates how environmental policy operationalization is necessary in order to change behavior, contributing to the value of the use of expense in the sense of development as a driver for environmental change.

II. METHODS

This paper is based on a case produced by a corporation in pharmaceutical manufacturing. The corporation has been dealing with lean manufacturing for about fifteen years and have a lean and kaizen production process and organization. Our environmental work is a part of HER when paired with shop-level supporting local SHE coordinators.

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The redeveloped GPM method was introduced and tested by the pharmaceutical company in an action-oriented approach. The case study approach involves selected appropriate data collection and analysis techniques. This GPM method was piloted in two production lines, both semi-automated and double-shift, with a similar characteristic for discrete manufacturing. During six months from late 2017 to spring 2018, empirical data have been gathered and reported. Information were obtained by participatory seminars, reports on production lines, team meetings, team and participant interviews, and research analyses. Information were also obtained at project meetings with the managers, supporting roles and contributing development leaders. Energy analysts have developed and compiled energy analysis data on selected manufacturing instruments.

The pilot study was started by the introduction of Green Kaizen to local management experts and CI managers, by a training session, and by an initial pilot and environmental support staff. The pilot used the GPM tool in 5 + 1 steps according to its pre-defined process, thus identifying a number of potential for environmental improvement (step 1). These were given priority (stage 2) and some of the solutions in a KATA-inspired CI have been implemented while others have been examined (stage 3 and 4). The CI coordinators brought the learnings from the first pilot into a steering committee consisting of change managers, responsible for both lean and SHE improvements. As a consequence, desire was shown for a second pilot. In the same phase as in the first pilot scenario, a GPM test has been planned and introduced for a new production line. After the two pilots were completed, the Steering Committee judged them and considered them satisfactory. A long-term plan for standardizing the GPM method to be included in the existing lean toolbox was then developed.

III. EMPIRICAL FINDINGS

In order to improve operational excellence, the case company initiated its lean program during early 2000. Factors such as process development and manufacturing infrastructure construction were initially outlined and lean resources such as 5S, visual control, and lean leadership were normally put in place. Since the early stages of their lean journey, the pilot test's first chosen production lines were a lean front runner with good efficiency, profitability, lead times and cost reduction. Standardization of procedures and reliability of the building process as part of the lean house have been carried out over the years. The importance of including managers and management in developing the job was one of the steps taken in standardizing operating practices. During the next ten years as part of this standardization work, standard operating procedures (SOP) have been developed to ensure reliable production.

The classical PDCA process was used to coordinate CI operations within the organization. Lean changes were mainly driven by the frequent visual control and weekly meetings at the PDCA stage. Uses lean methods such as 5S and Good Manufacturing Practices and TPM have helped towards progress. In general, tools and practices were used as pilots on a wider scale before rolling out. These can typically be included in the Kaizen initiative with regard to environmental improvements. Nonetheless, some respondents said that there had been no substantial attempts in the same way as classic lean kaizen before 2018 in order to highlight ongoing environmental changes. On the other hand, its environmental sustainability had effectively improved by other means and was an important part of its current growth policy. In October 2017 the green Kaizen was released and the pilot was held until June 2018. The first pilot team of eight operators and the team leader was chosen following preparation and establishment of the management committee composed of support functions and line managers. In keeping with the GPM protocol, two workshops were held at a period of one week. The department assessed its expertise for sustainable activities and team-based CI during the first workshop which was addressed further. The team was then split into three smaller groups, each of which three line employees and one mentor defined environmental organizational issues within each segment of the production line. A total of 84 different aspects were identified in about 30 minutes (27 + 17 + 58).

Table 1 offers a description of the aspects in groups.

Table 1. Summarized identified environmental aspects gathered from the input-output model.

Results from the GPM-phase 1
Productive material: One product component (A) sometimes sorted as waste (due to process complexity, not product waste restrictions), and tree types of paper and packaging material, labels and glue.
Energy: Compressed air (also idle) and energy use of machine (operations and idle), lighting, screens, scanners, transporters, lifts, ventilation, heating and moisture control etc.
Water: Only for cleaning.
Process material: Administrational material, high consumption of gloves with packaging. Ethanol and paper tissues, lubricants,
Emissions (air, noise): Heat from some of the machines, noise specifically from one machine, smell from ethanol.
Products: High production volume of the specific product.
Residual material: Different packaging: plastic material paper and cardboard material, component A sorted out; for recycling. A lot of printed material for security combustion and cotton gloves, small amount mixed waste for energy recovery. .
Emissions (water, ground): Water from cleaning is sent to wastewater treatment.

The largest group announced results. Up to Workshop No.2, one week back, the most important ones were identified. The goals were to be strengthened by the department itself and to have a significant improvement potential. Four concerns for review were raised: excessive use of gloves due to work, unnecessary waste of one part due to process difficulty, poor-quality processing equipment that incur energy and job loss in reserve and wasteful packaging on disposable gloves. A review was made in workshop two and the team of 11 people went to the shop to discuss each of the four environmental aspects recommended for data collection in order to quantify the bill. Gloves were used for 60 couples/48 hours (6 work shifts) or 5-6 pairs / operators and rotated on the station that was run by 2-3 alternating people instead of the usual 3 pairs. A deviation from SOP requirements was demonstrated by the measurement and SOP-check. The team has directly improved the saving of nearly 50% gloves through changing behavior.

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Due to the process complexity within the automated manufacturing equipment, the next priority was a plastic component. Rejected (dropped) components were sent to recycle on a specific point of the track, although the output was not altered. The fast fix was to feed the materials manually into the manufacturing line while ensuring no leakage. The medium-term solution avoided 100% of the discarded content at the time. Hence the fact that a large amount was sent previously for recycled products (plus the Right-First-Time (RTM)) figure could also be stopped. The remedy was, however, to change the SOP and the operations staff. In some more pages, the approach had scale-up options.

The third dimension was a production facility with a long unplanted stop time (not a bottleneck), 3.9 hours of unplanned recorded stop time (stops > 5 minutes) in addition to shift period. Furthermore, the stops produced energy standby and wasted packaging, which due to labeling problems had to be sent into secret combustion. The team then conducted a time stop review and requested an energy assessment. Later, it was found that the machines used 70-80% of the standby capacity.

IV. CONCLUSIONS

The pilot showed a realistic and functional way of using and applying a green kaizen system originally developed by and for the automobile industry in order to bring sustainability techniques into practice in a pharmaceutically producing company. New green technologies can not only boost environmental sustainability. It is clear that there are a lot of improvements that can be achieved by changing the behavior, see figure. 1

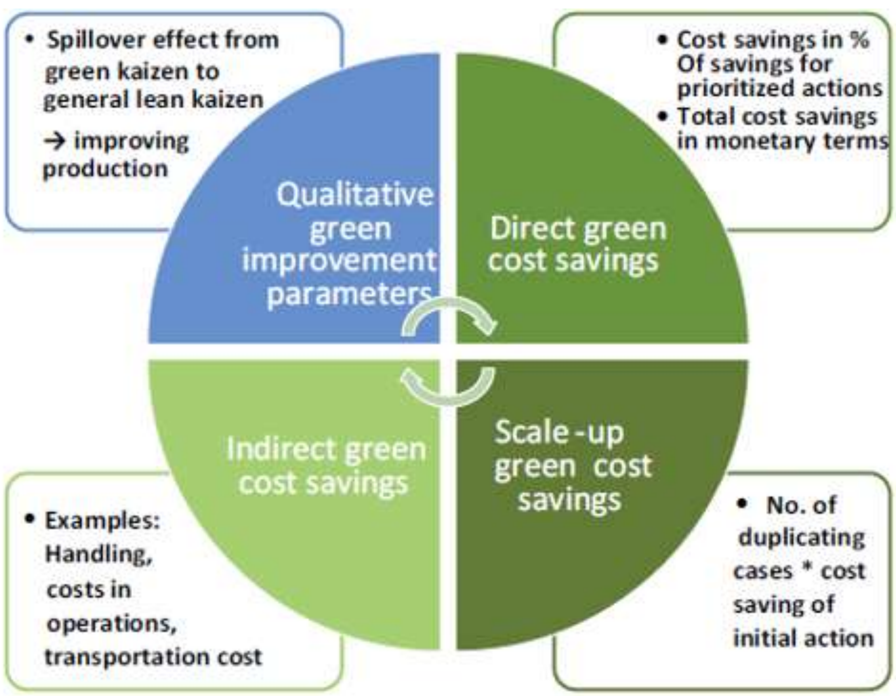

Fig. 1. A model illustrating four cost saving categories of making environmental improvements.

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The aim is to create a positive green circle of improvement: (a) create practical environmental improvements in the shop, resulting in (b) cost savings and (c) sharing best practice and scale successful cost saving solutions, gradually building (d) a sustainable organization with increased green competence and commitment and (e) integrating green-kaizen tools in the end.

Fig. 2. The goal is to create the positive improvement circle.

It has proved to be an effectively applied strategy to accelerate the rate of change when it comes to sustainable changes in development where green cost savings are used both on the store level to give priority to defined enhancement strategies and on the management side to gain engagement and dedication. Therefore, it is desirable to assume that the expense should be worth the economic benefits in terms of business cases of planned ecological improvements. Particularly important when the identified cost savings have a scale-up impact. In addition to this, green upgrades could challenge existing production standards (and SOPs) that could lead to even wider positive effects on the pharmaceutical industry.

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