The Process Model for Shop Floor Management Implementation
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Abstract:
In the early 1990s, the Toyota Production System (TPS) was widely used in industrial industries from various industries to implement lean principles, as well as the development of optimized methods for optimizing products and processes which are refined in the experience. From a practical perspective, the implementation of TPS-elements such as one piece flows, visible standards or U-shaped layouts, easily. In the meantime, most underlying management processes and structures are hidden for the external supervisor. Closing this major gap is the purpose of shop floor management. It provides a structured framework of procedures with defined roles, responsibilities and competencies to maintain and improve efficiency and formalizes. Its fundamental principles are focused on prevention, often making higher judgments and empowering teams, with experts, managers and operators. The purpose of this article is to define the scope of the management of the store, a comprehensive process in reference to the reference model, along with a general structure, to expand its new and modified sub-processes, roles and responsibilities to increase its implementation.

Keywords: Continuous Improvement, Shop floor Management, Lean Management, Toyota Production System

I. INTRODUCTION

Scientific research focuses primarily on lean principles, behaviours and rules rather than describing management processes in more detail [1, 2]. Due to the nature of these rules, their interpretation and implementation is making a major challenge for the practitioners [3] Jeffrey Liker notes in his 4P Lean Enterprise model that most companies are working on “process” layer, which means that they tend to focus on its efforts to reduce waste of seven types, while his philosophy, people and external partners do not adequately addressed (see figure 1 [4]). The concept of store floor efficient management emerged from recognizing the need to solve the problem on site and to contribute to the highest layer of the 4P model. In practice, the problem does not require tracking resolution or display as they were established as the basic procedures to meet the real needs of the floor of the production, but instead of meeting external requirements like reporting to management, in addition, when shoppers are present at the shops for managers. It is necessary to conduct a lack of structures and standards to improve decision-making with implementation often. Therefore, the purpose of SFM described here, as much as possible, individual behaviour and organizational guidelines and the difference between them A systematic, process-oriented to such applications in the industrial approach, takes into account the following literature review practical and current definitions for shop floor management in support of the process-oriented implementation. Suzuki defines shop floor management as practicing the three reals: genba (real place), genbutsu (real thing) and genjitsu (real fact) [5]. First, genba refers to the location where the value is created which can be either the factory floor or a business process in case the final product is a specific service or information. The second focus, genbutsu, requires all associates to understand the nature of problems rather than relying on documented information. Finally, genjitsu implies that the connections between the current problems and their final root causes have been mapped based on valid and consistent data. Thus Suzuki defines shop floor management as a closed loop process to observe the problems on site as well as to understand and eliminate their underlying root causes. Slightly different but with a broader scope, Spear identified four main TPS rules to design, operate and improve process efficiency in 33 Toyota plants through embedded research [6]. While not specifically limited to shop floor management, these rules imply that any improvement has to be performed using a systematic methodology, supported by a qualified coach and executed at the lowest possible level in the organization. A cross-functional rule requires the equipment and process design to meet first time right quality. As a consequence, the organization is able to address continuous, systematic, highly frequent deviations from standards indicating potential risks or current problems. Following Peters definition, SFM consists of recognizing visual deviations from standards and initiating effective countermeasures [7]. In addition to that, he differentiates three maturity levels. The focus on the lowest level is to react quickly to process failures, i.e. the problems have already occurred. A typical example might be the breakdown of a single machine or a section of the production line. The second level emphasizes preventative problem avoidance, i.e. potential sources of risks are systematically monitored and actions are put in place as necessary. On the highest level, deviations from standards have to be closely monitored to prevent the occurrence of problems, implying that root cause and effect is well understood. More advanced levels can only be achieved through a better understanding of system behaviour and standardization of prevention rules and the corresponding action plans. Finally, managing closed loop control systems to reduce variation in production processes constitutes the concept of daily management [8, 9]. In addition to sustaining standards, daily management also focuses on improvement in current conditions as well as managing change points. Because deviations from standards refer to the process output, change point management is instead used to control input parameters when reaching critical thresholds. It thus anticipates severe
impacts on product quality. A strong focus on systematic change point management (CPM) contributes to plan and executes preventative counter measures in a scheduled way with positive impact on process variation and overall efficiency. The brief discussion of the various approaches will be concluded with the formal definition. In general, shop floor management is a precondition for the implementation of lean systems. It defines an organizational framework with standardized processes and activities taking place on the shop floor. Empowered, multi-skilled teams with a profound understanding of system behavior decide and facilitate the sustainable implementation of effective and efficient counter measures. Abnormality control, attainment of change points, deviations from standards, current problems and the continual efficiency improvement along the value stream are the major drivers for activities and counter measures.

Fig. 1. 4P model

Shop Floor Management Process Model

Figure 2 shows the extended SFM process model based on the previous definition. The display of the hexagon has been chosen to express that the elements complement and interface with each other while the six step process illustrates the rigid, cycle-by-cycle structure leading to its implementation.

Fig. 2. Hexagon of shop floor management

The tools next to the elements have to be interpreted as enablers of the process. Changing the perspective from a tool-oriented implementation view, e.g. the introduction of standard work combination sheets or 5S standards, to the process perspective helps team and management to understand their “real” contribution to efficiency improvement. Thus the benefit of SFM relies not on the presence of tools but rather on their consistent, process-driven application. Although there is no contradiction between the proposed model and Peters’ concept, three major differences must be acknowledged. First, the elements change point management and efficiency improvement have been added. Managing change points systematically emphasizes prevention and thus reduces effort required for reactive problem solving. The objective of efficiency improvement is to break down changed external or internal conditions in a standardized way into realistic targets on the operational level by looking holistically at performance (man, machine, organization). The second difference is the change in mind from an element or even tool implementation perspective to a process orientation as stated above. Finally, systematic, best-practice transfer is an integral part of SFM. It ensures knowledge exchange across teams, increases efficiency in problem solving and leads to a focus on prevention rather than on reacting to problems in the long term. An overview of the nine basic functions of visual management is given in [10]. The authors point out that visualization enables organizations to effectively communicate, focus teams on common goals and facilitate decision making on the shop floor. For implementation purposes, shop floor displays and t-card systems are simple but effective tools. This concept does not specify methods for problem solving... Nevertheless as a general condition, a systematic approach based on reliable standards, for example, 8D, Kepner-Tregoe, Six Sigma, is mandatory to avoid trial-and-error problem solving and leads to significant better results [11, 12]. Depending on the market environment and product specifications, industry guidelines have to be adopted [13]. In addition to the problem solving approach itself, a suitable escalation process has to be defined and aligned with the management levels of the organization. Finally communication refers to standardized and scheduled exchange of information within the team.

II. ABNORMALITY CONTROL

The objective of this sub process is to enhance the ability to see and correct abnormalities in the short-term that can contribute to poor quality and customer complaints. Based on project experience and scientific research, the importance of abnormality control is often understated [14, 15]. The perception of many western managers is that 5S – sort, set in order, shine, standardize and sustain – simply describe basic housekeeping elements rather than a means for managing continuous improvement [16]. Thus implementing stable 5S initially relies upon a strong belief in its importance since the relationship between poor 5S status and its impact on key performance metrics is not directly transparent. This approach thus requires establishment of abnormality control as a consistent process within the shop floor management concept. Finally the process scope should not only encompass 5S, but also incorporate safety related and equipment abnormalities. Some practitioners call this combination of 5S levels and safety the 6S concept.
Figure 3 displays the continuous process to start and stabilize abnormality control. In the first step, a common understanding of each of the 5S levels has to be developed within the shop floor management team. In addition to that, abnormalities have to be analysed in a holistic way rather than scattered around the production cell. In addition to observations on the shop floor, external data in terms of process parameters should be taken into account for example, applied pressure or temperatures of a moulding press. Sources for this kind of data could be shop floor data based on manufacturing execution (MES) systems. In the second step, the textbook consolidates these findings and describes their target situation (see figure 4.) Each abnormality found is classified (5S, safety, equipment), assessed regarding its possible nonconformity and assigned to a shop floor team member to be solved. Once completed, the problem-solving steps and responsible team member must be tracked in the third step. As abnormality control is considered a continuous process, existing check sheets are updated incorporating new or modified standards and their check frequencies. Step 4 encompasses the regular monitoring and documentation of the implementation status with visual tracking sheets in the production area. The abnormality control process cycle is concluded with presentation of findings and best-practice solutions to other shop floor management teams before restarting the same activity in a different cell. The conduction of these events is based on a continuous schedule.

Change Point Management
In general, issues regarding product quality are the result of a change. In its introduction, the Toyota handbook for CPM links quality problems with the corresponding nature of a change [17]. According to that, about half of all issues stem from so called programmed changes such as new part numbers, product models or new production process introductions. Considering that these changes are managed by other major business units prior to start of production and thus not primarily owned by the shop floor – for example the product development process - other quality issues that erupt can be considered systemic. Their main drivers are setup and changeover processes, operator changes and abnormal conditions in terms of machine or tool malfunction. Therefore, CPM always starts with a holistic analysis of potential change points (see figure 5.) Change points in each of the four categories have to be discussed regarding root causes impacted by man, machine, material and methods using Ishikawa diagrams. Past experiences, current problems and future potential risks have to be taken into account in this brainstorming stage. While the challenge for planned changes is to minimize disruption of current production, the focus of the second and third category is to define suitable reaction rules for personnel facing clearly described abnormal situations. Finally, visualization is the key to manage gradual changes. Upper and lower control limits combined with real-time process data, for example, sharpness of tools, indicate whether change points have been approached or already reached. Six Sigma tools can be used to model the system behavior in case process data cannot be directly measured.
Once the analysis is complete, standard reaction rules have to be agreed upon and described in abnormality reaction rule displays, (see figure 6.) They connect the change points on the left with the corresponding escalation levels to the right, commencing with the operator at the machine and moving up the chain to the operations manager. They describe specific actions to be taken according to the competencies of each role. The levels have to be aligned to other escalation processes such as layered process audits. The standard agenda on each level starts off with an evaluation and assist phase to agree on the same problem and root cause understanding, followed by recording and reporting the change point event. The record history facilitates internal or external tracking specifications and also helps to understand in detail the impact of the change point to the process output. If the directly initiated counter measure has been effective, regular operations will be resumed and an escalation to the subsequent level is not required. To ensure a quick response and information tracking, standard lead times can be defined for each level after automatically being forwarded to the next layer. Nevertheless this automated flow must not be designed too aggressively, ending up potentially with either too much detail on higher escalation levels or overloading the process. Even with a highly skilled and trained workforce, these displays serve as a guideline and check list of necessary actions. They are not a substitute for more detailed process descriptions such as quality control plans. Finally, they illustrate standard reaction rules to outside observers and thus explicitly describe the dynamic behavior of the production system.

**Efficiency Improvement**

In addition to maintaining existing standards, SFM has to provide a consistent approach and methodology to facilitate sustainable efficiency improvement. External conditions and performance targets are may continuously change and the TPS also specifies on-going waste reduction [18]. The following standardized five step process satisfies these exogenous and endogenous specifications. The first step is defining the current needs and focusing on improvement. This can be either driven by modified external conditions, for example, strategic decisions such as increased product volume requested by the customer or internal product transfers. The main performance indicators should be influenced by those who have to be prepared and downgraded goals. After the guidelines of TPS, ensuring quality balance, lead time, productivity and security related goals. In terms of additional constraints, general conditions should also be defined. The second stage analyses the current performance of the output cell or line in depth. To do this, you have to understand the boundaries of the production sector using the schematic layout of the device. Prior to starting a detailed study, standard operator movements should be seen and mapped. The resources should be analysed in a representative time period in the context of the current production (article and quantity) and operator staffing (shift or allocated hours). Assistant resources like set up associates should also be taken into account and, if necessary, be allocated in the appropriate production area using the appropriate key factors. After this stage, detailed time study is done on non-standard activities (changes, machine breakdown, etc.) as well as focus on standard work. For both types of analysis, the accuracy of time measurement units depends on the choice of the supervisor and the degree of current standardization. For standard work analysis purposes, the figure outlines a possible guideline for obtaining the correct expansion for 7 measurement units. In general, their choice should be based on the ability to distinguish those actions which add value and that are the result of the waste. The same concept can be applied to benchmark similar machines against each other at a process stage level. is. To open or close a press, vertical or horizontal movements, the precise timing or pressure phase can be compared with similar devices and the original causes can be identified for deviation. As a last step, a virtual good-practice machine cycle should be determined on the basis of the shortest time for each process stage. The final results of standard work analysis are documented with standard work combination sheets (SWCCs) as well as standard work layout (SWL). In addition, to understand the intent of working material studies (WCS) for a long time, it is to achieve deeper performance, usually on the basis of three-innings operation on a 24-hour basis. During this period, each associate in the area under consideration is celebrated separately without interruption. WCs also include non-standard work such as changes to change activities, change processes, or answer to machine failures. In the third process stage, there are three main functions of the production index: Firstly, it consolidates current performance data and therefore determines the base line for efficiency improvement. Secondly, it works as a model to break overall efficiency goals for the specific performance parameters of the production cell as shown in Fig. 8. For example, decrease in cycle time, increase in overall equipment efficiency or scrap reduction contributes positively to top-down productivity target of +20 percent; third, before setting the final goal, it separates with each other Is able to compare the scenarios. Line items 1 to 5 usually include external conditions such as shift patterns and production quantities. Items 6 to 8 represent the current resource consumption (personnel, machine and equipment), while line item 9 and 10 reflect the major results of previous study. The productive time ratio (11) represents the percentage of time spent with the production of parts and constitutes the first major performance parameters. This ratio also tracks the present efficiency level of the cell by measuring associate productivity in terms of pieces. After defining the baseline, the production target is applied to achieve the sub target. To do this, external conditions that are not subject to change in quantity of production and scrap rate, have been kept constant. Here's a challenging top goal of more than 25 operator efficiency improvements has been extended. The production index is now the vehicle to indicate the correct lever and receives the corresponding sub target: the integration of an additional machine in the operator cycle (item 7), the more efficient use of instrument holes (line 8) and the increase of +3 percent If the productive time ratio (item 11) is achieved, then efficiency in these livers increases by 36 percent (item 13).

**III. Conclusion**

So far, limited research has been done about the SFM approach and its procedures being clearly prepared. The information presented in this article will help to overcome this difference. By discussing related scientific research, the formal definition of SFM has been extended to represent the foundation for the developed model. The process model is designed to prevent abnormalities, to ensure highly reactive decision making and continuous efficiency improvement. Further detail has been described in detail due to its innovation, abnormality control, change point management and efficiency improvements. It is important to understand this approach as a consistent guide rather than a catalogue of tools for implementation. The involved colleagues will not experience the experience of only a sharp learning process but will also be a high motivation as a team. After this approach, organizations will benefit from
making more stable processes and coalition decisions rather than solving the reactive problems.

IV. REFERENCES


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