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IMPLEMENTING THE 5S METHOD IN THE PRODUCTION SYSTEM OF DACIA & RENAULT

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Rezumat. *Scopul acestui articol este de a prezenta utilitatea metodei 5S în abordarea problemelor de îmbunătățire continuă a productivității și calității muncii. Sunt prezentați cei 5 pași necesari implementării, tehnici și instrumente adiacente. Sunt indicate soluții implementate în sistemul de producție Dacia & Renault. Prin aceasta, articolul oferă un cadru de lucru practic. Metoda 5S urmează ciclul Deming PDCA, care constituie punctul de pornire al ciclului SDCA, de ameliorare continuă a activităților companiei în vederea obținerii excelenței. Durata de punere în aplicare a metodei depinde de resursele și materialele alocate. Desfășurarea celor 5S se realizează după o schemă "3+2": primii 3S sunt teme de acțiuni concrete și imediate; ultimii 2S fac apel la acțiuni precise de management. Eficacitatea administrării spațiului propriu de lucru în autonomie totală creează confort în mediul de lucru și conferă beneficii personale operaționalilor.*

Abstract. *The aim of this paper is to demonstrate the usefulness of the 5S method in addressing the issues of continuous improvement of productivity and quality of work. There are presented the 5 steps, techniques and the adjacent tools. Solutions implemented in the production system Dacia & Renault are indicated. This article provides a practical framework. The 5S method follows the Deming PDCA cycle which constitutes the starting point of the SDCA cycle of continuous improvement of the company's activities in order to obtain excellence. The implementing time of the method depends on the resources and materials allocated. Deployment of 5S is achieved by a scheme of "3+2": the first 3S are tangible and immediate actions, the last 2S appeal to specific management actions. The efficacy of their own workplace in total autonomy creates comfort in the work environment and gives personal benefits to workers.*

Keywords: 5S method, automotive industry, productivity improvement**,** PDCA & SDCA cycle

1. Introduction

The quality of the process refers to the degree to which a process was implemented and complies with the standards, guides, references documents etc. in order to produce artifacts. To estimate the quality of the process it is taken into account the current state of implementation of quality requirements throughout the

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entire process flow, compared to planned implementation. Process's quality is also measured by the quality of the products obtained from the process [1].

The 5S method is divided into five steps: Seiri - sort, Seiton - set in order, Seiso - shine, Shitsuke - standardize and Seiketsu - sustain (Fig. 1). Implementing them successfully and systematically contributes to achieving and maintaining a workplace optimally organized, with significant operational results: increased productivity, raised quality, lower costs, promotes safety, builds customer confidence, increased factory up-time, and lower repair costs [2]. Also, bookmarking and labeling machinery activities creates a visual guidance system that highlights the environment and helps identify the problems quickly.

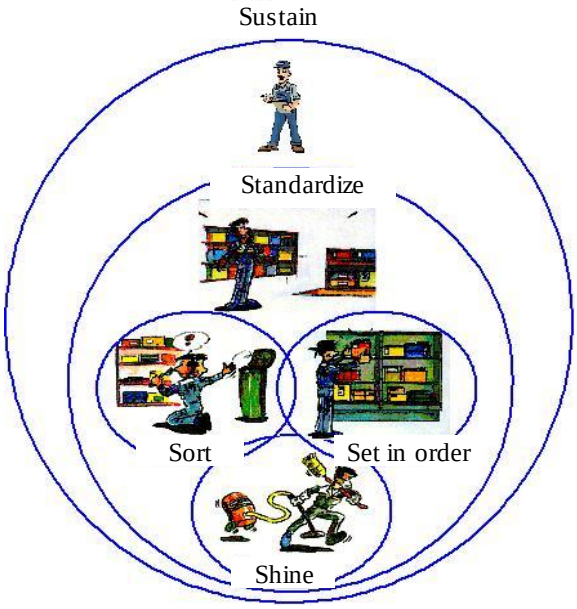

Fig. 1. The 5S method steps: sort, set in order, shine, standardize and sustain.

Fig. 2. Defining the excellence in SPR.

2. The principles of implementing the 5S method in SPR

In a company, the implementation of the 5S method is an agreed approach in order to achieve performance (Fig. 2). The 5S method has a major role in organizational stability. It constitutes a basic step before the implementation of other stages for continuous work improvement: standardized work, Just in Time, organizational culture oriented towards excellence [3].

Through the implementation of the 5S method in the production system Dacia & Renault the following aspects are noticed:

- the 5S are not exclusively devoted to the production activities, but can and should be applied in tertiary sectors;
- the worker, an expert at his workplace, is considered an authority to propose improvements to the effectiveness of the job; the 5S approach allows this involvement;
- the objects will be set in order according to different criteria, particularly according to frequency of use;
- shine (cleanliness) must be continually approached as an opportunity to detect and remove, one after another, the causes of the problems;
- the result of the first 3S consists in obtaining the reference state, which leads to a first level of effectiveness and performance of the workplaces;
- standardize consists in formalizing these reference states and defining activities done regularly to maintain this first level that was reached;
- sustain constitutes the fundamental part of a sustainable 5S approach.

Deployment of 5S by a scheme of "3+2" (fig. 1): the first 3S are tangible and immediate actions, last 2S appeal to specific management actions. Standardize is the base of such managerial actions. Sustain and management of the 5S led to the development of personal practices for continuous improvement. In this approach we agree on what to do, we do what we decided, we control the outcome and we add new improvements to the standard of operation.

3. Achieving the reference state – the determination of km 0

The first phase aims to build the reference state called km zero after a Deming PDCA cycle. After km 0 follows a continuous improvement approach by a PDCA - SDCA cycle (Fig. 3). The time of implementation depends on the effort needed to achieve the targets and can be repeated if it is necessary [4, 8].

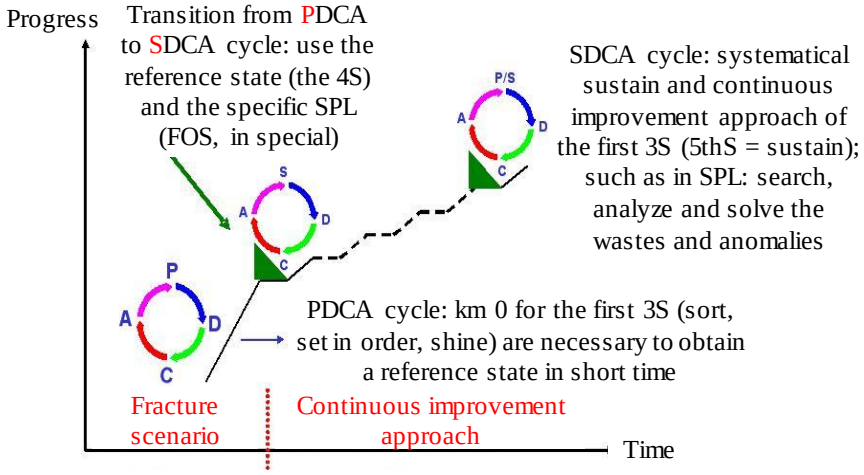

Fig. 3. Implementing the 5S method in accordance with PDCA-SDCA cycle.

3.1. Preparing the site – Plan

- Before you start a 5S project, it is necessary to observe and record the state of facts existing at the given workplace and to establish the goals set of the approach [2, 5].

For this purpose it is identified the cause and effect link between the workplace (in terms of sorting, order, shine) and his performance (accident, ergonomics, operative alerts, wastage etc.). The objectives to be achieved are defined and the associated performance indicators are chosen. They can consist of the existing ones, since the approach is in service of the performance of the workplace.

What we plan is not immediately possible. For this reason it is necessary to perform successive campaigns. The theme of the campaign depends on the nature of production processes and on the most important issues identified after observing the state of facts. It is recommended that all departments of production or services of a tertiary sector to launch simultaneous campaigns on the same theme to take advantage of the dynamics, but also to share best practices.

A photo album with representative photographs can be used as a tool to record the state of facts at the given workplace (Fig. 4). This is done by the person with the highest management rank the areas (compartment) which include the given workplace. Previously, the elementary unit of production was divided into areas of reasonable size (with 3 or 4 workplaces on the areas and mapping is used as a tool) and officials were named for each area.

Fig. 4. Representative photographs for the state of facts existing at the given workplace [8].

- Planning operations for km 0

For this phase a 5S deployment plan is put together, using for example a Gantt chart. Different activities that need to be achieved in order to reach the targets fixed will be placed on the diagram. Some activities will take place out of the production program.

- Providing the resources and materials needed

The inventory of the necessary materials and the foresight of the allocated resources (quantity and skills) are essential for the early sort - set in order - shine activities to be achieved in the most efficient way possible, without wasting time. The official of the area has this task.

- Training and information for workers involved in the 5S approach

For this phase it is required to train a hierarchical structure within a network of senior instructors and to inform the workers involved in the approach.

3.2. Achieving km 0 – Do

- To implement the first S - sort we have to analyze the physical objects (or the information) in every area of responsibility and ask ourselves: do we need this object / this piece of information?

If the answer is yes (no doubt) we move on to the application of the second S (the question is where you order it).
If the answer is no, throw away the respective object. In order to decide on the objects we are undecided, we can apply the methods of labeling or isolation. They are based on the principle of visibly identifying the objects and recording each use in a preset time for observation.

In step Sort we must decide with maximum objectivity the usefulness of each object.

- For the implementation of the second S – set in order we must identify a place for each object.

It is necessary to place the objects in a visible place, dividing them by quality and quantity required. Also, the selection of the place of the objects takes into account criteria such as frequency of use, people safety, the four principles of movement economy etc.

The observation of the workplace is the ideal study support used to obtain information on the use of the objects.

- The third S - shine – the initial cleaning is done to eliminate waste, dust and dirt accumulated over time. Cleaning activities focus both on tangible objects (selected at Sort) and the workplace.

The first results of these actions are often spectacular in sight. Also, initial cleaning is the first opportunity to detect anomalies. Therefore, it has to be done by workers, helped by support functions who contribute with their experience in diagnosing anomalies.

The resources and materials needed for this activity are numerous. After the initial cleaning, a regular cleaning plan should be defined. It will help maintain this initial level of cleanliness with a small amount of effort. This phase belongs to the continuous improvement loop SDCA.

Figure 5 presents the results of the activities from step Do in the area "Turning roughly shaped blocks", UEL "Crank shaft K7" from Dacia & Renault - Romania.

Fig. 5. Representative photographs of activities to achieve the km 0 at given workplace [8]

3.3. Checking the effectiveness of the activities achieved - Check - and determining actions - Act

- Checking the effectiveness of the activities achieved in step "Do" (sort – set in order - shine) in relation to the targets fixed in step "Plan" represent the step "Check" of the PDCA cycle [4, 6].

By achieving the activities previously mentioned the reference state of the workplace is attained: the best state in terms of sorting, ordering and cleaning. Setting this state should be done by workers, depending on their experience and common sense.

Through daily observation of the area subject to the implementation of the 5S method the robustness of the method can be verified: the obtained state must be implemented in daily activities.

If the reference state is reached, pictures will be taken to certify the transition to a continuous improvement loop.

- If the reference state is not reached, the differences must be identified. Complementary activities such as sort - order - shine corresponding to the step Act from PDCA cycle will be planned and carried out.

No need to reach an "ideal" state, but a satisfactory state in report to the fixed targets.

4. Continuous improvement phase (cycle SDCA)

Once the reference state is attained, in order not to fall back to the state before, we should immediately place a hold under Deming's wheel PDCA (fig. 3). Therefore, we leave the PDCA loop (and its successive iterations) that led us to the reference state to enter in the logic of continuous improvement according to SDCA cycle.

The first step consists in formalizing the reference state obtained at km 0 which must be maintained in the future, and then improved.

The second step consists in defining the set of activities needed to maintain the reference state previously formalized. Depending on the complexity, each of these regular activities will require changes in the mode of operation or the existing procedures. For example, FOS will be written for these sectors involved in SPL approach. They are an aid in managing the 5S method and aim to obtain a reflex behavior.

The third step is to define the means to signal anomalies (relative to the reference state).

4.1. The 4th S - Standardize

- Standardization starts by formalizing and displaying the reference state of workplaces as a result of the first 3S (Fig. 6).

Based on these reference states we must define sorting-ordering-cleaning activities needed to maintain these states. Activities are determined by the official of the area in collaboration with the workers from the area. The skills and

knowledge needed by the workers to achieve them must be recorded. You can use the following tools: 5S plan, operating procedures, life rules.

Reference state 5S								
Area			N	1	2	3	4	5
Workshop	Date of change							
	Points changed							
Operation	Checked by	Workshop master						
		UEL master						
								

Fig. 6. An example of the reference state of the given workplace [8]

We must define a means of detecting the differences from the reference states, to which we associate a means of animation, such as anomalies labels (Fig. 7).

Blue - anomalies that can be solved by UEL
Red - anomalies that can be resolved outside UEL
For anomaly prioritization use a dot sticker:
red = anomaly related to the objective or security problem
yellow = anomaly with risk to the target of the approach
green = anomaly with no effect on the target

Fig. 7. Anomalies labels [8]

4.2. The 5th S - Sustain

The target of 5S management consists in assigning the workplaces to the workers in order to make them responsible for improving their given workplace.

Hierarchy management of the areas plays a fundamental role in implementation of the 5S method and continuous improvement. It must be involved personally in the approach and demonstrate rigor, reactivity and exemplarity.

Reference states are formalized, the 5S plan and standards resulted are established and from now on the SDCA continuous improvement cycle (Table 1) must be put into operation.

Table 1. Extract from the macro planning for the implementation of the 5S method in UEL "Crank shaft K7" [8]

			Year	2013					
			Month	Oct.		Nov.		Dec.	
			Week	41	42	45	46	49	50
Define km 0	Step 1: Initial cleaning	Plan	Starting the project	*					
			Performing a state of facts of the current situation (photo album "Before")	*					
			Defining objectives and indicators	*					
			Defining sectors and assigning officials	*					
			Planning sequences km 0	*					
			Defining resources and tools	*					
			Informing all the participants		*				
Transition from SDCA to PDCA cycle: achieving the objectives that define the reference state									
Continuous improvement approach	Step 3: formalizing	Standardize	Formalizing "reference state"		*				
			Defining the 5S plan		*				
			Planning activities necessary to maintain the reference state		*				
			Standardization / defining and action plan		*				
			Define how anomalies are detected		*				
	Step 4: doing continuously	Sustain	„Do”						
			Informing the staff about 5S standards			*			
			Applying and imposing the defined standards			*	*	*	*
			Detecting anomalies			*	*	*	*
			„Act”						
			As a result of the identified deviations, root causes of anomalies and non-efficiency of the standards are analyzed			*	*	*	*
						*	*	*	*
			Implementing the solutions			*	*	*	*
			Upgrading standards			*	*	*	*
			Identifying the paths of progress						*

By complying to and applying the rules previously determined in the 5S approach, anomaly detection will be obtained more easily if these activities will be defined and managed by the workers involved. The efficacy of the total autonomy creates comfort in the work environment and gives personal benefits to the workers [2, 7].

The audit is used as a tool for reaching the fixed target. It provides factual information which will serve as input for the analysis of the causes of differences from standards and to identify the paths of improvement.

Previous steps have allowed us to measure the implementation of the fixed standards. If the results observed are not as expected (namely reference states and fixed targets) it is agreed to begin a thorough and rigorous analysis. This should lead us to the root causes of non-performance.

Depending on the anomalies, identifying the root cause should lead us to a solution in our standards: development of the reference state, modifying the 5S plan, improving operating modes, training and so on, which leads naturally to the implementation of a new SDCA cycle of continuous improvement.

If the results are as expected it means that the time has come to redefine the targets and to move on to another 5S campaign.

Conclusions

The 5S method is divided into five steps: Seiri - sort, Seiton - set in order, Seiso - shine, Shitsuke - standardize and Seiketsu - sustain. These must be implemented successfully and systematically.

Among the gains obtained on the UEL "Crank shaft K7" production line from Dacia & Renault, after applying the 5S method we can include the following:

- well-organized workplaces - all that was not useful has disappeared from the workplaces; everything which is useful was arranged, marked and labeled. For example, on inspection tables, each control means is well-established, each shovel and bare scrap have their place, for new or used tools, for cabinets parts, parts for carts interoperational stocks etc. Due to this fact a total area of 17 square meters was gained, which made the production line more "airy".
- waste generated by searching for stuff, expectations, disorder, scrap was eliminated - the result is the disappearance of the present state of nervousness among the workers of the production line due to the difficult searches for different things. There were many cases of disagreements between workers because some of them accused the others for the disappearance of certain things. Now there is perfect harmony between workers on the production line.

- increased labor productivity - due to workers working without stress, together with the fact that the time used for adjusting equipment and response time after a failure was greatly decreased, it was obtained a 50 pieces higher production (from 710 pieces / day to 760 pieces/day);
- improved work safety - before starting the 5S site, the ICS indicator was 76%; at the end of the 5S site, the security audit conducted went up to 83%;
- basis for standardized labor - during the 5S site were created reference states and plans to maintain the cleanliness which, although ongoing changes will incur there will be standards to be observed by all workers in the production line, even by the new employees. The latter, after consulting reference states they will understand that everything has a well-established place and that they are contributors to the maintenance of the reference state.
- improved quality - this 5S site led to a decrease in scrap parts. So indicator RU ppm dropped from 13740 to 11987. This indicator shows the situation with scrap parts products on manufacturing line based on the number of finished parts, reported to a million pieces.

$$\text{RU ppm} = \frac{\text{scrap parts}}{\text{finite compliant spare parts} + \text{scum}} \times 1000000 \quad (1)$$

- quick problems identification (visual management) - because all things have a well-defined place in the reference states, it makes any drift from the normal to be identified and corrected immediately. Thus, during the audit 5S or OPL, done by the head of UEL, an eventual change from normality is highlighted in the audit grids; it is then developed an action plan that will lead to the immediate elimination of the problem encountered and the maintenance of normal.
- Eliminated the workplaces listed in yellow (an ergonomics gain) - because everything was arranged so that the travel of workers was reduced to a minimum, the three workplaces which were listed in yellow from an ergonomically point of view (FSSE method) went up to green. In this moment all workplaces in the production line of crank shafts K7 are listed in green (FSSE method).
- a basis for any improvement program: lean, six sigma, kiazen.

Managing the own work area lies in the responsibility of each worker.

The efficacy of the total autonomy creates comfort in the work environment and gives personal benefits to the workers.

Abbreviations

5S – seiri-seiton-seiso-seiketsu-shitsuke

SPR – production system Dacia & Renault

PDCA – plan-do-check-act

SDCA – standardize-do-check-act

FOS – standard operating sheet

SPL – standardized production at the workplace

UEL – elementary unit of production

ICS – indicator of conformity and security

RU ppm – scrap parts per million

OPL – organization of the workplace

FSSE – simplified sheet of safety and ergonomics

R E F E R E N C E S

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