Implementation of the 6S method in an industrial enterprise

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Abstrakt

This paper deals with the application of the 6S method in a selected industrial enterprise, the subject of activity of which is the production, design and development of technical fabrics from synthetic, natural and metallic materials; production of semi-finished products for paper screens. It is an application of the six steps of Separation, Systematization, Purification, Standardization, Self-discipline and Occupational Health and Safety. The analysis of the organization's individual sites revealed deficiencies at three sites in the metal fabrication department and one site in the weaving department of the weave union. The individual steps of the 6S method and the individual actions within these steps are the content of the paper. The proper implementation of the 6S method has led to improvements in the functioning of the individual workplaces in the organisation under study, and the method has become part of the company culture

Keywords: 6S method, waste, kaizen, workplace, process

1. Introduction

The competitive struggle between organizations provides a prerequisite for any organization to move forward, because in this struggle, they look for ways to increase process efficiency, improve productivity and quality, thereby increasing competitiveness at the same time. Every company must reduce as much as possible the waste that is present in every organisation, whether to a greater or lesser extent, and this waste represents everything that does not add value. One of the basic methods by which this can be achieved is the 6S method. With the 6S method, which is actually the Japanese 5S method extended to include safety, we eliminate waste in the workplace, trying to create an organised and, above all, clutter-free workplace where every worker can find the things they need to do their job quickly and easily.

In continuous improvement, we come across the term "kaizen". It includes the improvement of both managers and rank-and-file employees, and involves minimal costs [2].

Kaizen does not mean delegating management responsibility to unprepared workgroups in production, nor does it mean occasional meetings to resolve urgent quality, setup or cost issues [3].

During the work in the production enterprise we often encounter situations when it is necessary to look for tools, tools, jigs, material, machine downtime arises, when workers have to wait, we also encounter disorder and lack of space at the workplace, constant reloading of a large amount of at that time

unnecessary material, with long distances between operations, which causes an increase in the cost of the product, while nothing changes on the product [1]. The term "Lean production" is appropriate here. The main objective is to obtain stable, flexible and standardized production.

2. Method

6S is the 5S method supplemented with security. The goal of 5S is to eliminate waste in the workplace. It is the basis of lean manufacturing and the idea is that after the implementation of 5S (6S), the workplace should be clear, free of unnecessary items, clean, safe, visualised and standardised, so that there is error-free production and no excessive waste [5].
6S - what is it? The number represents the number of steps in the method and the S represents the name of the step in Japanese.

1. Seiri – sorting. Separate necessary and unnecessary items in the workplace and remove the unnecessary ones.
2. Seiton – systematize. Organize all the things left at the workplace after the seizure in a clear way.
3. Seiso – cleaning. Keep machines and working environment clean.
4. Seiketsu: extend the concept of cleanliness to yourself and continuously implement the previous three steps.
5. Shitsuke: build your self-discipline and implement the Five Steps by implementing the Standards.
6. Safety – safety: keep safe at work. [2].

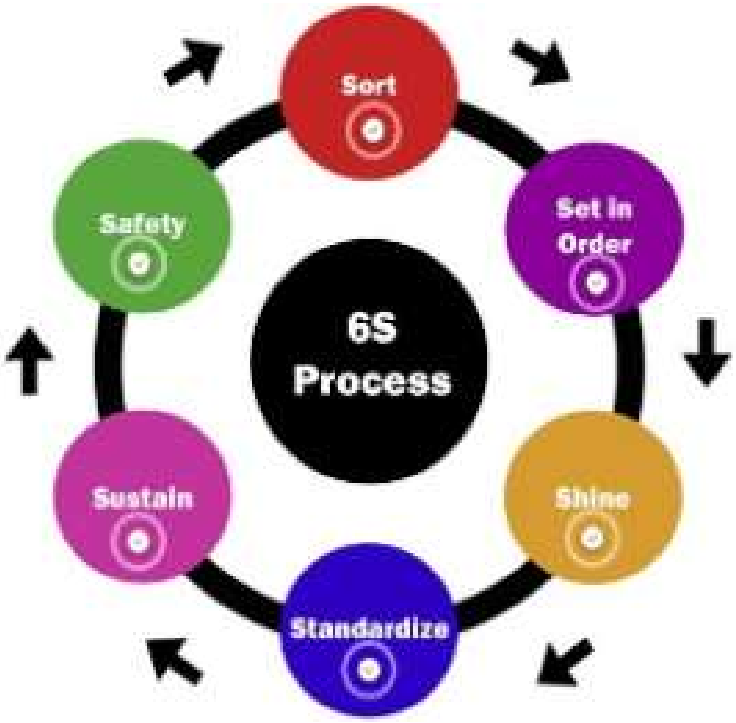

Figure 1. Method 6S [11]

SEIRI – sorting
It is the separation of individual items that are essential to the workplace to perform operations and add value to the product from those that have to be moved and those that have to be removed. This step uses

'red cards' to mark the items, with each item being entered into a job card to determine how the item is to be handled [6].
All items found in the workplace can be rated by a certain frequency of use. Items that are used several times per shift or once per shift shall be retained and placed on the whiteboard or desk. If an item is used once a week or once a month, a decision shall be made to place it in the workshop or near the workstation. If the item is used several times a year or less than once a year, it shall be removed from the workplace and placed in storage.

SEITON – organizing, systematizing, visualizing
Once we have everything sorted, unnecessary items are removed, we organize the items so that we have them "at hand", while it is important to have everything thoroughly labeled and clearly visible. The goal is to always find things in their place when we need them [7].

Map 6S - is a tool that can be used to evaluate the current locations of parts, tools, moulds, jigs, machines and equipment, and to decide on their best location. The use of this map actually involves two maps, namely a 'before' map and an 'after' map, i.e. before and after the introduction of the setup order. [9].

Label strategy - The label strategy uses labels to identify what, where and how much. There are three main types of labels [9]:

- location indicators showing where objects belong
- object pointers showing which specific objects belong in those places
- quantity indicators showing how many of these items belong there.

Coating strategy - is a method for identifying locations on floors and corridors. It is called a "coating strategy" since coating is the most commonly used material. However, we can also use duct tape and cut it to any length. Duct tape is just as clearly visible as paint and has the advantage that it can be easily removed when the layout is changed. The separating lines should be 5-10 cm wide. An example of a colour standard is [9]:

- operating areas are marked in green,
- corridors are marked in bright orange,
- the dividing lines are marked in yellow.

SEISO – cleaning
The workplace is cleaned with all equipment, machines, tools, instruments, preparations to get it in a clean condition. This condition will be further maintained by the workers by regular cleaning." [1]. At the beginning, the workplace is divided into zones (territories, sections) with respect to the activities that are carried out in the workplace. A responsible worker is then assigned to a specific part of the workplace and carries out the cleaning. In this step, it is a deep cleaning in order to give the workplace a clean state. Once the cleaning is complete, the individual parts are photographed clean so that the photos can be used in the workplace standards. In the future, it is important to carry out the cleaning in a systematic, planned manner so that dirt is removed from the workplace on a regular basis. Cleaning requires cleaning aids and equipment, which should be provided by the company for all workplaces [1].

SEIKETSU – standardisation
This principle is about keeping the company continuously and repeatedly tidy and clean. The emphasis is on visual management and standardisation of the 6S method. Innovation and comprehensive visual management are used to achieve and maintain a standardised state [10].

The implementation of standardisation is assisted by a three-step process:

1. decide who is responsible for which activities with respect to maintaining the previous 3S.

2. to prevent the reintegration of maintenance duties in the previous 3S into regular work activities from deteriorating again.
3. check how well the previous 3S are maintained [9].

SHITSUKE – self-discipline
is about ensuring that the improved condition of the workplace does not revert to its original state. This means that all activities in this step will be directed towards compliance with the standards set. Perhaps in Japan, workers adhere to the agreed activities without the need for any control. In our conditions, control is nevertheless necessary. The best control is when workers check with each other (e.g. when taking over a shift). However, in addition to the workers, a check by the foreman is also appropriate and often necessary [8].

The following controls are used by companies to control self-discipline:
- Workers check with each other.
- Checking between shifts.
- Control through the use of a control card (description of the activity carried out).
- By means of regular audits carried out by independent company personnel [1].

SAFETY – safety
In this step, it is important to focus on eliminating the risks of hazards and creating a safe environment to work in. If the workplace has been well organized and cleaned, potential hazards are easily recognized. Not all hazards can be eliminated or their impact on the worker prevented. It is therefore important to establish a standard for safe workplace behaviour. This standard includes how a worker should dress in the workplace (including visitors), what are the principles of workplace behaviour and what are the prohibited activities [8]).

3. Results
The monitored organisation is based in western Slovakia and its subject of activity is the production, construction and development of technical fabrics from synthetic, natural and metallic materials; production of semi-finished products for paper screens.

The organisation has 6 main areas of work focus:
Weaving joints
It is a production department where several sizes of plastic fabrics of different kinds are used to produce the final product - an endless strip connected by weaving. Its use is in the paper industry. All products must be of 100% qualit.
Metal Production Department
It focuses on the production of stainless steel flanges and various welded, rounded products from perforated and perforated sheets of various processing technologies serving the industry.
Technical sieves
In this department, sieves are woven using various technologies for industrial use. It is used in architecture, e.g. as part of the facades of modern buildings.
Service centre
It deals with overhauls of machines under the name of Refiner and PSF worm screws. This centre guarantees a high level of (ANDRITZ) quality combined with increasing progress and the application of modern solutions.
Project Management
The main vision is to achieve the project objectives also taking into account possible constraints such as scope, time, quality and budget. In practice, proper management of these steps requires the development of exceptional technical skills and an appropriate strategy.
Shared Services Centre

Offers services in purchasing, logistics, IT and accounting.
The 6S method will be applied to the Metal Fabrication department, and the original status of the three selected sites can be seen in the figures below.
Figure 2 shows the current state of workplace 12 in the metal fabrication department, where we can see the disorganised state of either the tools needed for the work or the metal templates that are loose on the ground or leaning against a stand with other templates. The arrangement of tools and templates would lead to more clarity and thus to shorter working times, as the worker would not have to laboriously search for the tools, but each tool would have its exact place, which would be marked with a label with its name. As regards the templates, there is also a risk of injury, as these templates have more weight and a worker could be injured if they come loose or trip. It is also possible to see tools and protective equipment laid out on the workbench, and there should be nothing on this. Plastic water bottles, which workers use for refreshments, are placed under the table. These will need to be found in a suitable place, preferably on the work board. There is also an absence of visual signage on the floor of fixed or even moving work equipment. Once the modifications have been made, a standard would be created which would include a photo of the workstation as arranged, together with an indication of the activities for that workstation, and also an indication of the person responsible for carrying out the activities and the person responsible for checking that the standard is being followed.

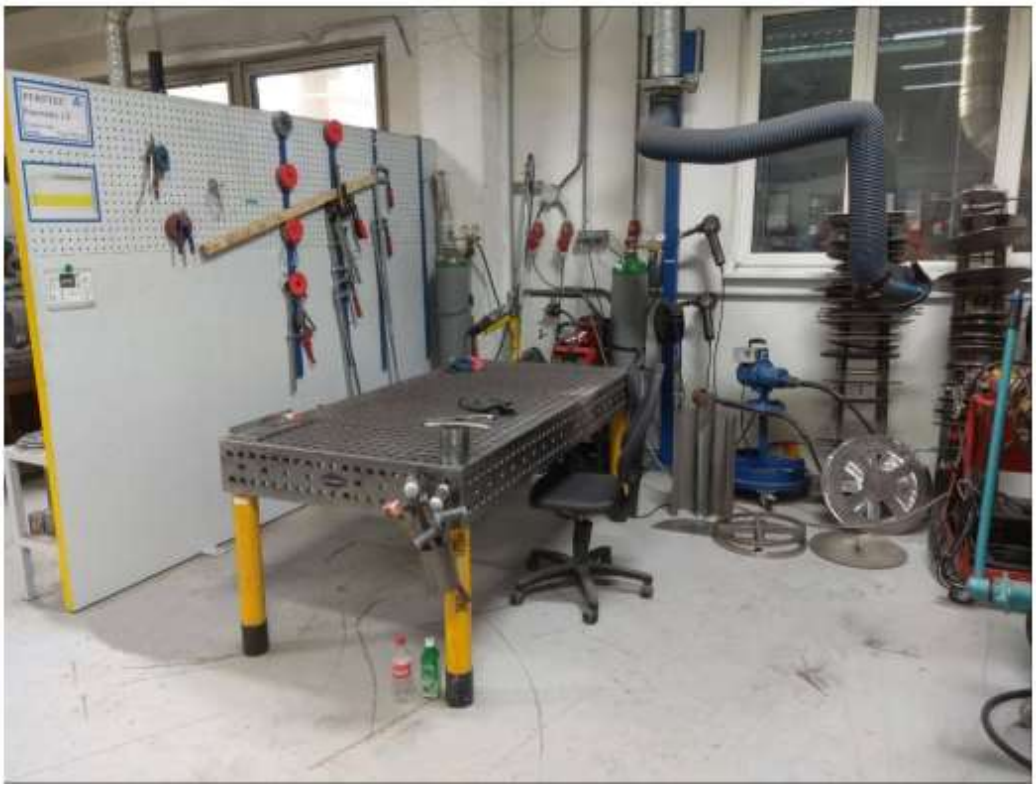

Figure 2. Workstation No. 12 in the metal fabrication department [4]

Figure 3 documents the state of workstation 9, where it is also possible to observe a certain work chaos caused by the disorganization of the work tools, whether on the storage board or on the workbench, where there are various work tools that should have their precise and marked place. There are visual markings on the floor, but some are still missing. The drill bit storage is not in a good location as the path to the paper towels, the bin and also the air hose is blocked. There is a loose work apron in this storage area, which should be hung in an easily accessible place so that the employee has immediate

access to it, but also so that it does not get in the way. A work board provides ample space for displaying work aids, and this would be an effective use of this. Power tools should be as close as possible to an electrical outlet to allow immediate use when needed. A mobile trolley or container could be placed where the pallet is placed to collect the ferrous waste that is generated at the site. It would also be useful to establish a standard for this site once the modifications have been made.

Figure 3. Workstation No. 9 in the metal fabrication department [4]

The last selected workstation in the metal fabrication department is workstation 20, shown in Figure 4, where a storage rack with storage boxes is located. At a glance, one can already see the work chaos caused by the lack of signage. There is also loose documentation, which can become degraded in this way. It would be advisable to create some working space for this documentation. In the lower shelf there is a soiled rag that belongs in the bin. There are protective work equipment - gloves - in various places on the shelf, which have their place, but due to indiscipline on the part of the workers, they have found their way to these places. This discipline should be worked on, preferably by training the workers in the 6S method.

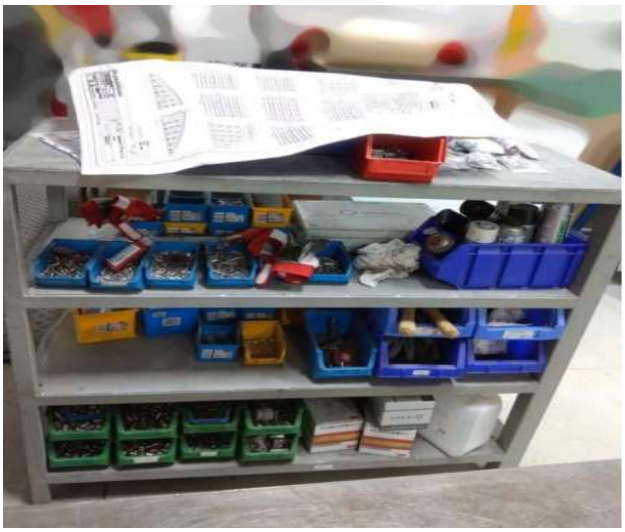

Figure 4. Workstation No. 20 in the metal fabrication department [4]

Introduction of the 6S method on workplace12

In the first step, unnecessary tools were selected, completely freeing up space on the workbench. In the future, it is advantageous to use the so-called red cards, which are pinned to a specific tool (object), where the way of dealing with specific tools (objects) is indicated, i.e. whether the item should be removed, kept, moved, reduced in number, or another way of dealing with the tools (objects). The red card has also been realistically created.

In the second step, we created a new tool storage system on the workbench, labeling each tool with its exact location on the board to prevent confusion or misplacement of tools. We moved the bottle holder from the side of the table, which was used to store the hammers, to the workbench, where it will be used exclusively for storing drinking water bottles, and we also found a place for the hammers on the workbench. The tools were arranged on the workbench in such a way as to make it as easy as possible to get to them at a glance. We also used a painting strategy where we used colour markings on the ground for fixed or moving objects.

In the third step, we continuously cleaned all the tools, instruments and components so that we had an organized and clean workplace. At this point, a 'checklist' was created".

In the fourth step, photo documentation was taken to create a final standard that would allow the workers to know exactly what the workplace should look like, so they could leave it in that condition after working hours. The standard is placed in a prominent position on the notice board.

As a fifth step, it was proposed to carry out an audit at least once a month, with each audit being accompanied by an „Audit 6S - Questionnaire".

On point 6 - "Visual safety standards" have been created describing the types of protection needed in the workplace, together with a photo of a properly dressed worker.

Workstation 12 after the introduction of the 6S method can be seen in Figure 5.

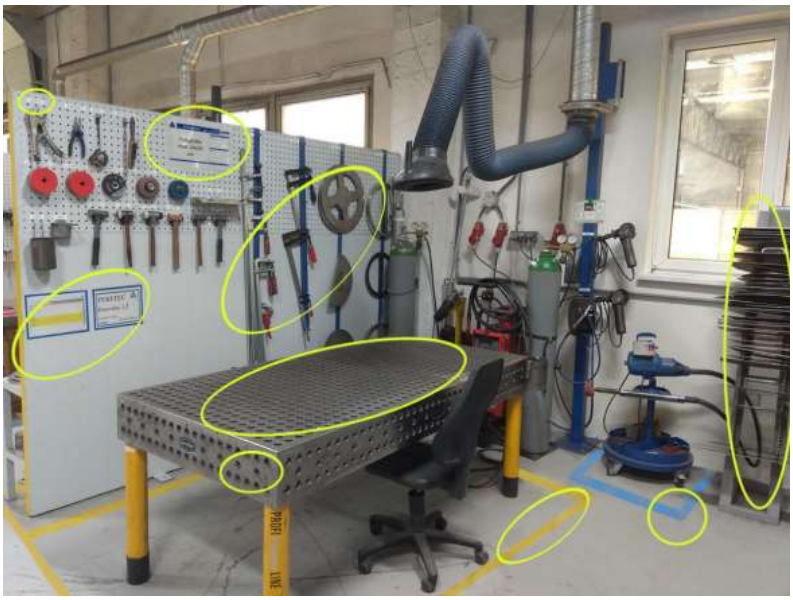

Figure 5. Workstation 5 in the metal fabrication department after application of 6S [4]

Introduction of the 6S method on workplace 9

The drill stand was the first to be moved in front of the tool table, and we created a blue marking on the ground for it to be stored, thus creating space for the air hose needed for this workstation, as it is used to power air tools such as the air grinder or air drill. We completely cleared the workbench of loose tools, which we used to make the workstations. We also redesigned the tool storage system on the workbench, where we used a label system to make the workplace more organized and reduce the time it takes for workers to find the tools, instruments, or tools they need. Where the pallet was loose, we

placed a trolley for the scrap metal that is generated at the workplace. We cleaned up all the dirty items and photographed the workplace. It will be necessary to place a "Control Card" at the workplace, where the workers themselves will continue the third point of the method and record their activities in this card. In the fourth step, a photo documentation was made to create a final standard, which would allow the workers to know exactly how the workplace should look and to leave it in that condition after working hours. The standard is placed in a prominent position on the notice board. We also propose to place a 'Visual Safety Standard' in a prominent place in the workplace, which will also list the protective equipment workers must have in the workplace. Workplace 9 after the introduction of the 6S method can be seen in the figure below 6.

Figure 6. Workstation No. 9 in the metal fabrication department after application of 6S [4]

Introduction of the 6S method on workplace 20

The storage rack had to be cleaned and washed, and the material in the storage boxes had to be sorted according to importance and also according to the purpose of use. After sorting, we organized the boxes in the rack and then labeled them for clarity. At the very top we created a place for the documentation that is needed during the work. A visualisation of workstation 20 in the metalworking department can be seen in Figure 7.

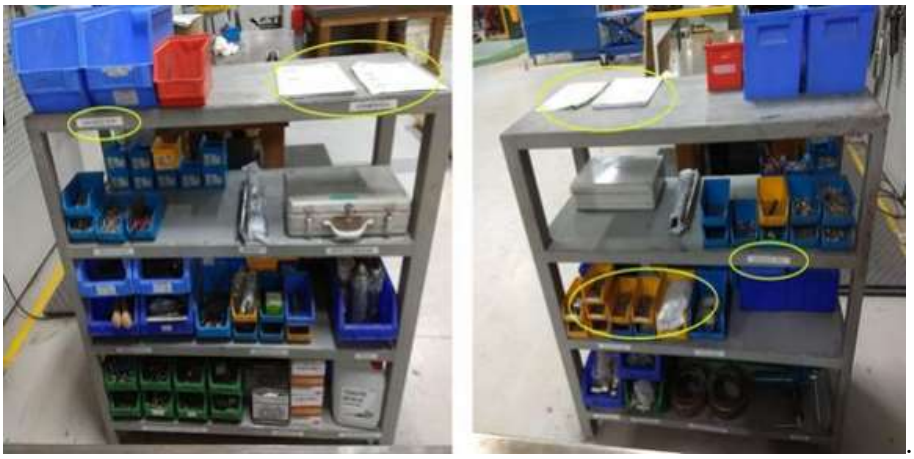

Figure 7. Workstation 20 in the metal fabrication department after application of 6S [4]

4.Discussion

When deciding where to apply the 6S method, certain sections or workplaces in the organisation were selected where problems with the workplace layout were visible at first glance, not least due to the indiscipline of the workers, which reduced work efficiency and thus increased task times. At the outset, criteria were always established by which work items were assessed, and all necessary and unnecessary tools were selected. Unnecessary tools were relocated to an appropriate position or were discarded altogether. Necessary tools were arranged as conveniently as possible so that each item was within reach of the workers. For the purpose of this sorting, a so-called red card was designed. A label was then created for each item so that the used item could be returned to its original place after work, saving time for the workers and also avoiding unwanted clutter in the workplace. Once the workplace was organised, it was possible to create a draft workplace standard, which serves as a template for a well-organised workplace, on which the responsibilities of workers for specific activities in the workplace are delineated. It is these standards that are the 'picture' of how a particular workplace should be properly organised. When these standards are followed, there should be no risk of disorder and, although it takes time to check the activities listed in the standard, ultimately time and therefore money will be saved directly in the production process, as workers do not have to extend the time allocated to work tasks by searching for 'lost' tools that they need. Also, by adhering to the above standards, imminent accidents that can cause injury to workers are eliminated. Since even after the introduction of the 6S method, there are problems of indiscipline among workers, it has been proposed that regular audits of the 6S method be carried out to ensure compliance with the standards thus proposed, and a '6S audit questionnaire' has been developed to monitor compliance. This is a set of questions focused on individual workplaces, where for each question we determine whether the area is met or not, and thus points are assigned, so that we can determine after the audit to what percentage the steps of the 6S method are being met, and for the best rating "very good" we have determined a range of 90-100%. This is the area that would be ideal when assessing the current status of the 6S method in the workplace. Safety audits are carried out in the workplace and we suggest that these are carried out at regular intervals, at least once a month.

5.Conclusion

In every manufacturing company, whether larger or smaller, there are shortcomings that need to be minimized or eliminated, whether to make work more efficient, save money or simply to improve the quality of working conditions. The introduction of the 6S method is a process that has not ended here and is still ongoing, as there is still room for improvement. The 6S method can also be complemented or extended to e.g. 7S, i.e. ecology and environment.

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