

## DEVELOPMENT OF THE 5S METHOD IMPLEMENTATION ON THE GROUNDS OF COLLECTED EXPERIENCE

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**Abstract:** The paper contains proposals of improvement concerning implementation of the 5S method. For that purpose there were used some selected techniques of manufacturing management: team work as well as the cause and effect Ishikawa diagram. The analysis of a pilot implementation was done in one of companies located in south–east Poland by a team which consisted of workers involved in that implementation and external experts. The results of analysis were used for the improvement of approach to implementation of the 5S method in the company. Presented methodology as well as obtained results can assist in implementation of the method in other companies.

**Keywords:** manufacturing management, the 5S method, Ishikawa diagram.

### 1. Introduction

The 5S method is one of the main methods for introducing various changes in the organization of manufacturing process. That method should precede other methods used for the management of manufacturing processes. The main idea of the method is an assumption that modern methods of management require creation of suitable working conditions (Pacana, Woźny, 2016, p. 26-31). The objective of the 5S method is improvement of work quality of workers through their better care about keeping necessary order within their workplaces. Its application ought to prepare an organization to introduce more effective methods of management of manufacturing. The methodology of activities associated with implementation of the 5S method is relatively simple and its successful implementation frequently brings in a company real, quantifiable and positive results. Application of activities associated with 5S enables improvement of the organization, systematizing of working setup as well as elevation of activities focused on quality improvement and identification of opponents. It is not only management but first of all a method for an effective learning of discipline, standardization as

well as tending to perfection (Bielecki, 2008; Mikołajczyk, 1983). The fact the 5S method is considered as fundamental factor of the effective management of manufacturing causes that suitable implementation of that method into everyday practice in any enterprise is really justified. However, it not always happens that such suitable implementation of the 5S method into practice takes place. Therefore, in the following there is presented an analysis in a form of a case study of such implementation using selected techniques of management of manufacturing.

## 2. The 5S method

The 5S method, known as a 5S System consists of the following elements (Antypin, 2008, p. 41-47; Pacana, 2016; Waclawik, 2001):

1. Seiri (selection, order, sort or simplify). Selection consists in identifying and separation of all items which are unnecessary within the workplace and removing them. It is a typical stocktaking of a workplace.
2. Seiton (systematization, organization or straighten). Systematics is setting up of locations and limits. The setup concerns locations of storage of things necessary at workplace: tools, transport resources, materials, feedstock, semi-finished products, etc.). That location must be chosen in such a way that each of necessary items obtains its own place and is available in required quantities. At this stage there is developed a well-ordered and well-maintained workplace. It is assumed that finding and catching an item necessary at the current stage of work should take not more than 30 seconds.
3. Seiso (sweep, scrub). The objective of his stage is to clean a workplace. There are removed dirt, dust, chips and other contaminations. Workers are made aware of the negative influence of contaminations and waste on system functioning and on the validity of joining everyday typical organizing actions with checking of efficiency of devices. In order to obtain positive image of a workplace it is necessary that the operator also pays attention to personal cleanliness.
4. Seiketsu (sanitize, tidiness). That stage if implementation of the 5S method consists in determination of everyday standards. It is important to pay attention to stabilization of already implemented behavior and order. The objective of this stage is to obtain repeatability of actions made so far in order to have them done systematically.
5. Shitsuke (self-discipline, sustain). Self-discipline is understood as keeping all introduced standards. Everyday inspections of a workplace and ordering a workplace should become a routine activity each working day. Some defined formal evaluation system e.g., 5S audit, and presentation of results can be helpful in both introducing and keeping a self-discipline.

The 5S method practice transfers to building an environment for harmonious work, which very positively influences the overall company's effectiveness. It is of a fundamental importance for establishing of a system for an effective manufacturing process management and its equipment which becomes an important part of quality management. Combined with the principles of Deming's cycle it allows to introduce, maintain and constantly improve management policies in every aspect of organization's activity ([http://www.lean.org.pl/...](http://www.lean.org.pl/); Sęp, Pacana, 2001).

During implementation of 5S practice a real transition of workers' mentality takes place. Workers become people who manage their workplaces. The 5S method should reduce manufacturing costs and time while increasing profits for the company (Hamrol, Mantura, 2011; Pawlak, 2004. p. 42-46). Therefore, it is very important to properly implement the 5S method in the practice of management.

In the following there are presented the methodology and consecutive stages of introducing the 5S method.

1. Selection and determination of the areas of implementation together with managers responsible for those areas. Criteria which can be applied for selection of those areas can be:
  - frequency or probability of making errors by operators on their workplaces (errors which may become reasons of faults or quality variances),
  - costs of faults or quality variances generated at particular workplaces during manufacturing process,
  - costs of demurrages generated by particular workplaces/operations in manufacturing process,
  - costs of retooling particular workplaces or associated with particular operations,
  - values of the OEE (Overall Equipment Effectiveness) indicator associated with particular machines,
  - results of FMEA (Failure Mode and Effects Analysis) for considered process (according to risk evaluation performed for particular workplaces/operations/products),
  - evaluation of professional risk (occupational health and safety) for particular workplaces in considered process.
2. Establishing of implementation team with its leader managing the implementation project.
3. Establishing of partner relations with all participants of project implementation. For the project consisting largely in radical change of many years' operators' habits it becomes essential to gain their support and trust before beginning of all actions ("defrosting" of attitudes, communication of targets, benefits, ranges of responsibility, trainings, motivations).

4. Determination in common with all team so-called “technology roadmap”, i.e. suitable schedule of the project with clearly defined objectives (SMART principle – Simple, Measurable, Achievable, Relevant, Timely defined) and actions.
5. Realization of planned actions and keeping due dates. It is recommended that project schedule should contain:
  - an overview and discussion of results after each important step of considered project with possibility of change of the “technology roadmap” in the case of arising difficulties,
  - documenting and visualization of an advancement state as well as project’s results (information tables, photos, company’s newsletters, intranet, etc.).

Practicing of a 5S principle must be a constant process. The best results are achieved while keeping 5S principles and their development as well as their dissemination within whole company. Only constant and systematic care for order can bring real results and benefits for the company.

## **6. Analysis of the 5S implementation**

At the beginning of implementation of the 5S method in considered company the company’s workers were trained. They were informed about the benefits which the 5S method can bring to the company. Next, according to the methodology presented above, there was made a pilot implementation of the 5S method on a selected workplace. Due to the frequency of faults made in manufacturing process such workplace was one selected locksmith workplace. Comparison of preliminary audit and final audit showed positive result of actions associated with implementation of the 5S method. Having that result it was decided to plan implementation of the 5S method on the successive workplaces. Before proceeding to scheduling the project it becomes important and justified making analysis of the course of the first implementation, in order to omit difficulties which already took place or might take place during the 5S implementation.

The analysis of performed implementation of the 5S method started with brain storming. The objective of the brainstorming was finding the causes which make the implementation of the 5S method difficult. In the brainstorming there took place 8 workers and 2 external experts. Reported proposals were noted and then sorted with consideration to internal substantive relations associated with succeeding elements of the 5S method. Collected information allowed to determine several reasons which can lead to failure at each stage. Ordered results are given in tab. 1.

**Table 1.***Identified causes (experimental and potential) inhibiting implementation of the 5S method*

Stages 5S	No.	Potential causes of slowing 5S implementation	Possible effects for a workplace and the implementation project (in the case of not removing the cause)
Selection	1.	Too many things (necessary) at workplace (after completing a selection stage).	Lack of place for convenient storage of necessary things, difficulties with finding/taking them, problems with cleaning as well as establishing and maintaining order, each succeeding 5S stage time-intensive.
	2.	Unnecessary and rarely used things taking place at a workplace (after completing a selection stage).	Lack of place for convenient storage of necessary things, difficulties with finding/taking them, problems with cleaning as well as establishing and maintaining order, each succeeding 5S stage time-intensive.
	3.	Waste collected at a workplace or very close beyond the place of destination (after completing a selection stage).	Difficulty in moving and transport, risk of accident, disorder, difficulties with finding necessary things, each succeeding 5S stage time-intensive.
	4.	Big failure frequency of a machine.	Request for leaving big number of tools and spare parts for quick removing accidents on a workplace – difficulties with place, systematics, and keeping order. Lack of time for reliable selection due to perturbations and necessity of making production plan up.
	5.	Non-operational tools, tooling and machine parts at a workplace (after completing a selection stage).	Risk of accident, risk of damage of other things, inaccuracy of machining / manufacturing or measuring, risk of making a product incompatible with requirements.
Systematics	6.	Unmarked or impermanently/unreadably marked places for storing things necessary for work.	Long time for searching necessary things, troubles with constant maintenance of order.
	7.	Unmarked or impermanently/unreadably marked places for storing garbage.	Risk of accident, risk of damage of other things.
	8.	Lack of designated place for documentation.	Difficulty with finding suitable documentation, risk of using unsuitable/out of date documentation or work “by heart”, risk of making a product incompatible with requirements.
	9.	Lack of systematics (ergonomics/logic) in location of tools.	Difficulty with quick finding of necessary tool, bigger worker’s fatigue.
	10.	The same tools used by many workers	Lack of necessary tool at a workplace, long time of searching, risk of temporary usage of other tool (type and rate of wear), too big inaccuracy of manufacturing, risk of making a product incompatible with requirements
Cleaning	11.	Lack of means and tools for getting cleanliness at a workplace.	Handicapped/longer cleaning or lack of possibility of cleaning, using temporary measures and tools, risk concerning violation of occupational safety and health, possibility of damaging a machine, tool or tooling, lack of willingness for the following 5S stages.
	12.	Periodic or permanent lack of means and tools for maintaining cleanliness at a workplace.	Handicapped/longer cleaning or lack of cleaning, using temporary measures and tools, risk concerning violation of occupational safety and health, possibility of damaging a machine, tool or tooling, demotivation and resistance of workers, negative results of the last stage of the 5S.

cont. table 1

Cleanliness	13.	Lack of worker's competence/awareness/motivation/time for cleaning/cleaning (for 5S).	Lack of cleaning up or rough cleaning up, simulation of cleaning, waste of working time, demotivation of other workers (also at other workplaces), lack of willingness to implementation of the following 5S stages.
	14.	Lack of specific responsibility or inconsistently defined responsibility for executing cleaning of workplace maintained by several operators.	Lack of cleaning of a workplace, lack of willingness for the following 5S stages.
	15.	Lack of standard/instruction/schedule of cleaning/doing cleaning-up or schedules/standards/instructions out of date/unreadable/unclear for a worker.	Lack of systematic cleaning of a workplace, decline of workers motivation, demotivation example for other workplaces (being before implementation/during implementation/after implementation of the 5S) negative results of the last 5S stage.
	16.	Standards/instructions/schedules of cleaning/doing cleaning-up by worker imposing new duties requiring additional time not falling in working shift.	Lack of systematic cleaning of a workplace, rough cleaning, putting forward a motion concerning overtime, delays in starting the following shift, arrearage in manufacturing plans.
	17.	Big frequency of a machine failure.	Lack of cleaning up of a workplace or only rough cleaning up a workplace due to unavailability of a workplace/machine or succeeding re-soiling caused by machine failure. Lack of time for realization of cleaning schedule, necessity of additional out of schedule cleaning of a machine after its failure extending planned standard methods, risk of violation of occupational safety and health.
	18.	Lack of worker's competence/awareness/motivation/for handling tasks associated with maintaining cleanliness at a workplace. Potential source reasons: lack of training/ineffective trainings of workers at the stage of implementation of the 5S, poor communication of an implementation team with workers.	Lack of cleaning, unsystematic or occasional cleaning in the cases of dramatic difficulties with keeping cleanliness/disorder, resistance of workers, simulation of cleaning, simulation of cleaning, waste of working time, demotivation example for other workplaces (being before implementation/during implementation/after implementation of the 5S) negative results of the last 5S stage.
Self-discipline	19.	Poor communication worker – middle level of supervision (leader, master, foreman).	Lack of feedback information concerning 5S functioning/ideas for its development, lack of encouragement of workers to improve methods/standards, discouragement and resistance of workers, demotivation, lack of continuity in maintaining cleanliness of a workplace, negative effects of the last 5S stage.
	20.	Methods and/or periods of cleaning/ordering a workplace very awkward/labor consuming for a worker.	Demotivation of workers, unsystematic and rough cleaning, creating by workers their own unapproved methods – danger of violation of occupational safety and health, simulation of cleaning, simulation of cleaning, waste of working time, demotivation example for other workplaces (being before implementation/during implementation/after implementation of the 5S) negative results of the last 5S stage.

cont. table 1

	21.	Lack of presentation/ visualization/communication concerning the process of implementation and obtained results of 5S in a company.	Diminishing of motivation and understanding by workers of the 5S targets, perception of 5S only as formal requirement taking time necessary for entire realization of manufacturing plan, difficulties in current implementation of the 5S and its future implementation on succeeding workplaces.
	22.	Lack of system actions in order to supervise and develop of 5S (reviews/grading/audits/competition/awards).	Return to former practices, loss of long-term benefits, need for rebuilding trust and motivation, more difficult implementation of the 5S on succeeding workplaces.

Workers suggested, in result of performed brainstorm, twenty two reasons leading to implementation difficulties. In the next step the team selected, using multiple voting approach, two biggest implementation difficulties. They were: lack of competence/lack of worker's competence/awareness/motivation/for handling tasks associated with maintaining cleanliness at workplace (within the range of 5S) linked with lack of trainings and big frequency of a machine failure.

Ordering of factors inhibiting the implementation of 5S and taking into account identified causes leading to the occurrence of those inhibitory factors allowed to develop the Ishikawa diagram. That cause and effect diagram is shown in Fig. 1. Standard 5M structure (Management, method, Man, Materials, Machine) used in the Ishikawa diagram was replaced with the following elements of the 5S method. On the basis of the developed diagram the team indicated one element – cleanliness – which causes the biggest difficulties in implementation of the 5S method because of the biggest number of causes associated with that element.

In order to find such type of potential causes which may lead to failure of 5S implementation project there was also done standard analysis based on the cause and effect Ishikawa diagram containing sorted factors which can influence and even lead to failure of implementing the 5S principle in relation to the 5M method. Grouped causes are given in Fig. 2.

After making analysis of the Ishikawa diagram, focused on causes grouped with respect to 5M, there was observed that the number of causes in particular branches of the Ishikawa diagram associated with a man is the biggest. It means that the most numerous defined causes were originated by a man. Thus, the role of human capital in improving any process in organization is fundamental. It can be stated that it is the most important factor influencing success of any project. From the point of view of the number of causes associated with particular branches of the Ishikawa diagram it can also be indicated that both environment and the methodology of performed actions also significantly influence success of implementation of the 5S method.

## 7. Conclusions

The 5S method is most frequently applied in companies in order to develop manufacturing organization. Its implementation and especially keeping standards associated with the method are usually neglected in manufacturing practice. However, the 5S method is a foundation for improving manufacturing processes. Therefore, it becomes very important to implement it properly. It is recommended to make pilot implementation of the method on a selected workplace. Next, after the analysis of performed implementation on a pilot workplace the 5S method should be implemented on the following workplaces with respect to conclusions drawn from the results obtained on pilot workplace.

The paper presents the result of analysis of pilot implementation of the 5S method on a locksmith's workplace in one of Subcarpathian companies which manufactures steel structures. Performed analysis allowed to determine two biggest implementation difficulties (Fig. 1 and Fig. 2).

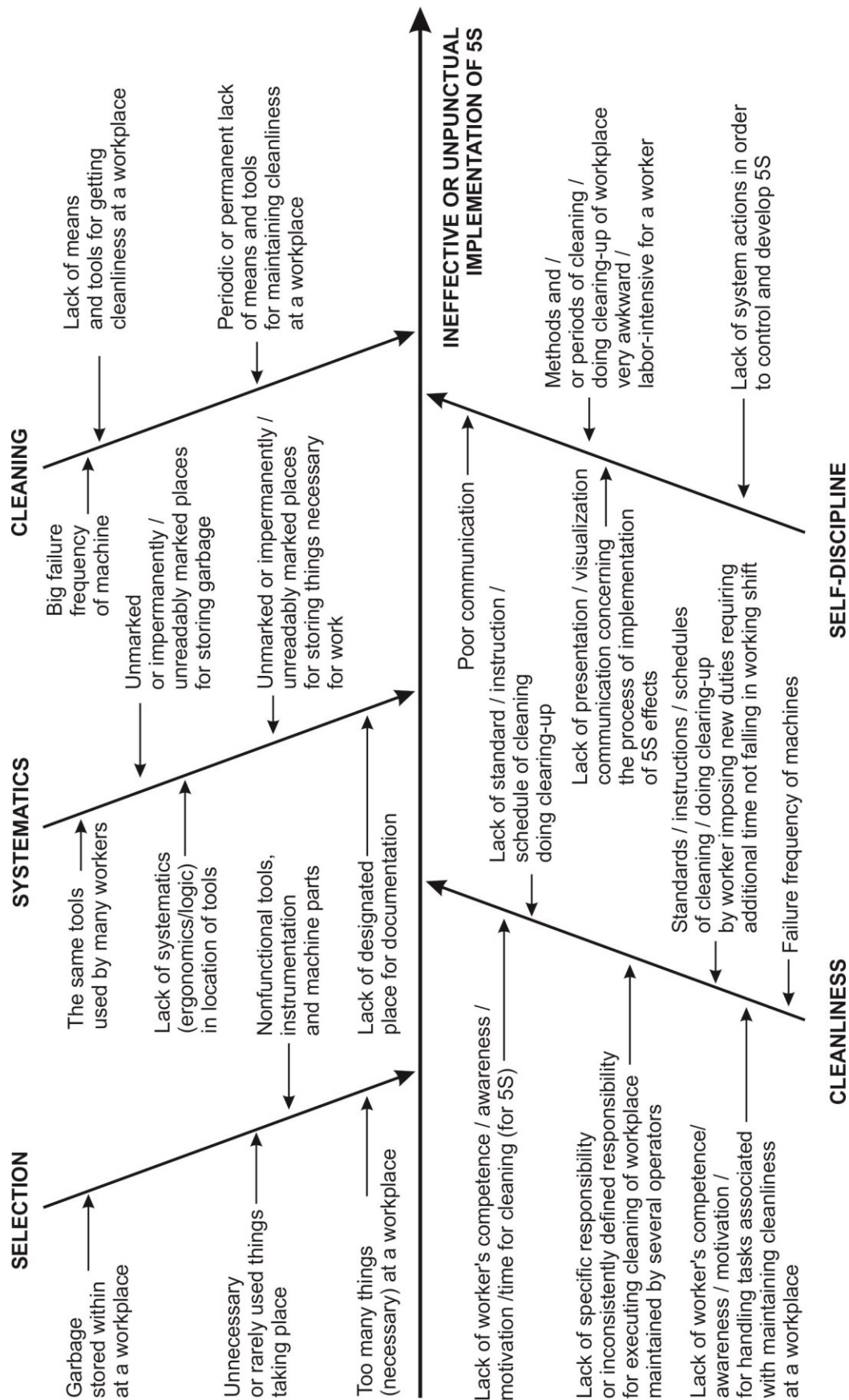
The most significant difficulties in the process of implementing the 5S method were:

- lack of workers' awareness in the area of the 5S method advantages, linked with absence of trainings,
- troubles with machines which cause increased demand for various tools stored at a workplace.

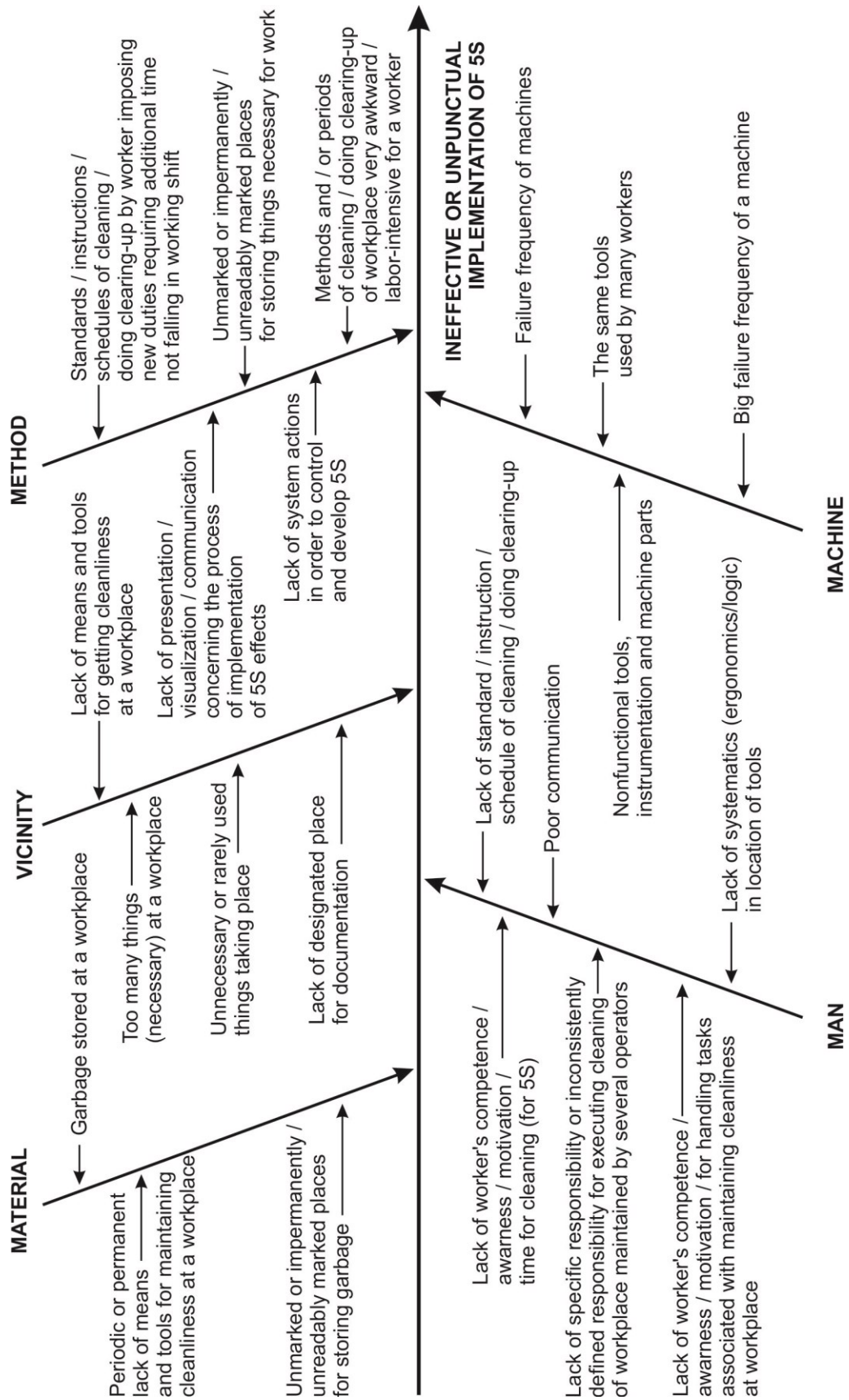
After that analysis there were introduced cyclic (one time per week) short trainings (app. 20 min.) performed at a workplace by supervisors. Those trainings preceded implementation of 5S on particular workplace. During those trainings supervisors showed their workers the necessity of using the developed 5S. Moreover, there were initiated various actions focused on introducing Total Productive Maintenance (TPM) system in order to diminish failure frequency of machines. Application of analyses contributed to making a decision concerning preparation of training presentation for workers including visualization of the 5S effects in considered company.

It may be expected that the described analysis and the following conclusions will make possible for companies to implement the 5S method better than before. That can contribute in turn to better organization of manufacturing processes and in result – better effectiveness of a company.





**Figure 1.** Cause and effect diagram illustrating causes in the process of implementation of 5S practices with consideration of the stage of the method.



**Figure 2.** Cause and effect diagram illustrating causes in the process of implementation of 5S practices with consideration of the 5M.

## Bibliography

1. Antypin, P. (2008). Opracowanie oraz wdrożenie systemu 5S w firmie motoryzacyjnej. *Problemy Jakości*, 40, 2, 41-47.
2. Bielecki, M. (2008). Wykorzystanie wybranych technik i narzędzi TQM do wdrożenia praktyk 5S. *Logistyka*, 2.
3. <http://www.lean.org.pl/lm.html?id=3>, 10.02.2009.
4. Hamrol, A., Mantura, W. (2011). *Zarządzanie jakością. Teoria i praktyka*. Warszawa: PWN.
5. Mikołajczyk, Z. (1983). *Metody doskonalenia organizacji procesów i stanowisk pracy: interpretacja systemowa*. Instytut Wydawniczy Związków Zawodowych.
6. Pacana, A. (2016). *Metoda 5S*. Częstochowa: Oficyna Wydawnicza Stowarzyszenia Menedżerów Jakości i Produkcji.
7. Pacana, A., Woźny, A. (2016). Draft questions of 5S pre-audit with regard to health and safety standards for tires retreating plant. *Production Engineering Archives*, 13(4). Częstochowa, 26-31.
8. Pawlak, R. (2004). O praktykach 5S ponownie. *Problemy Jakości*, 36, 4, 42-46.
9. Sęp, J., Pacana, A. (2001). *Metody i narzędzia zarządzania jakością*. Rzeszów: Oficyna Wydawnicza Politechniki Rzeszowskiej.
10. Waclawik, Ł. (2001). Metoda 5. *Ekonomiczna Organizacja Przedsiębiorstwa*, 5.