

LEAN TOOLS TO ELIMINATE LOSSES. TRANSPOSING AUTOMOTIVE APPROACH IN OTHER AREAS

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Abstract

In a competitive environment each company strives to bring higher added value to the customers, while improving the quality of its products and services, diversifying its offer in anticipating demand and streamlining its activity. To achieve market sustainability, companies aim to both map out the progress and use the resources efficiently and economically. During time several methods and tools were developed and used to this end. Lean Management tools implementation has proven to have effects not only in manufacturing sector, but also in healthcare, IT, government, construction, retail and others.

This study presents the steps of implementing the 5S method, highlighting the real impact of Lean tools and the potential to be extended in other activities with at least similar success. Based on case study developed in automotive activity we underlined how these externalities can be economically measured. Moreover, having the automotive example of good practice, we outlined the general framework for adapting the method to other fields of interest, i.e. in companies that provide goods and services for personal healthcare. Designing this framework for improving activity of such essential companies during COVID-19 crisis, we are providing arguments for a market-based approach to social value / social profit creation.

Keywords: *Lean Management, Tools and Methods, Automotive, Medical, Healthcare, Sustainability, 5S tool.*

1. Introduction

As an improvement tool of modern enterprise, the Lean methodology brings advanced management ideas and business processes to companies^{1,2}.

Lean Management (LM) was developed on the foundation of Toyota Production system and has become a need in the automotive industry and not only. Since it generated a wide range of advantages, the LM has rapidly grown in popularity and it started to be implemented in other sectors than manufacturing, too: information technology, government, retail, construction, procurement etc.

Lately Lean methodology evolved, being linked to „innovation“ and „sustainability“ approaches. Not by chance, in order to maintain a sustainable business, organizations need to apply solutions in order to reduce the potential risks posed by industry, the economic and

political environment and the business environment in its complexity. As the external environment is hardly to be significantly influenced by firm's activity, a flexible internal approach is managers' and entrepreneurs' solution.

Sustainability³ and Lean methodology are two interdependent components: on the one hand, through Lean actions and solutions, the sustainability of the organization is ensured, and on the other hand, sustainability provides the needed background for new Lean actions and improvements. There is thus a positive relationship between the two. Recent analyzes have determined multiple determinations between LM, industry 4.0⁴ and the circular economy⁵.

Because Lean is based on identifying and eliminating waste as a continuous process, the business remains efficient and able to adapt to the changing external environment on a long-term basis. Manufacturers have experienced increases in

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¹ Bo Zhang, Zhanwen Niu, and Chaochao Liu, "Lean Tools, Knowledge Management, and Lean Sustainability: The Moderating Effects of Study Conventions," *Sustainability* 12, no. 3 (MDPI 2020): 1-20, <https://doi.org/10.3390/su12030956>.

² Amir Honarpour, Ahmad Jusoh, and Choi Sang Long, "Knowledge management and total quality management: A reciprocal relationship," *International Journal of Quality & Reliability Management*, 34, no. 1 (Emerald 2017): 91-102, <https://doi.org/10.1108/IJQRM-03-2014-0040>.

³ Savindi Caldera, Cheryl Julia Kiran Desha, and Les Dawes, "Exploring the role of lean thinking in sustainable business practice: A systematic literature review," *Journal of Cleaner Production* 167 (Elsevier 2017): 1546-1565, <https://doi.org/10.1016/j.jclepro.2017.05.126>.

⁴ Leonilde Varela, Adriana Araújo, Paulo Ávila, Hélio Castro, and Goran Putnik, "Evaluation of the Relation between Lean Manufacturing, Industry 4.0, and Sustainability," *Sustainability* 11, no. 5 (MDPI 2019): 1439, <https://doi.org/10.3390/su11051439>.

⁵ Simon Peter Nadeem, Jose Arturo Garza-Reyes, Anthony Anosike, and Vikas Kumar, "Coalescing the Lean and Circular Economy," *Proceedings of the International Conference on Industrial Engineering and Operations Management (IEOM Society International 2019)*: 1082-1093, <http://www.ieomsociety.org/ieom2019/papers/279.pdf>.

profitability and customer satisfaction as a result of reducing their lead times, improving product quality and eliminating waste⁶.

In the last decades, Lean tools application has proven an increased impact and has contributed to achieve consistent results in several fields. When focusing on Lean concept, it's important to be aware of the losses which the organization is accumulating and thus eliminate them. Still, applying lean tools is not an easy process. In order to achieve results the management should show perseverance and commitment.

There are several instruments which harness the potential of a company and its people. Lean tools are used to solve specific problems the company faces. Visual management instruments are used to increase productivity and cleanliness at the workplace, Just in Time concept helps decreasing stocks, waste and costs, Andon facilitates communication and problem-solving, and the list may continue.

This paper focuses more on the 5S Method, as a way to increase productivity, save costs and streamline the activity, knowing that, in the current conditions of the ever faster technology transfer in the business environment, the significant comparative advantages are based on the increase of the productivity of the resources;

5S is a basic Lean tool which includes 5 phases:

1. Sort – sort out needed items and remove items which are not needed at the workplace;
2. Set – put in order the items, objects, furniture which are needed, establish a place for each item, designate labels;
3. Shine – clean everything regularly at the workplace to identify possible irregularities;
4. Standardize – establish standard procedures to maintain the achieved results;
5. Sustain – keep following the established procedures, making 5S part of the organizational culture.

5S tool helps to reduce non-value adding time, increase productivity and improve quality⁷, reduce waste and increase process efficiency. The hardest part of the process is to sustain, because in time places tend to clutter again and get back to the initial situation.

As the method has specific and detailed steps to follow, it can be easily implemented in any field.

2. Case study - Hirschmann Lean tools

Hirschmann Automotive is an Austrian company which produces parts for the auto industry and not only. The group has production units in Austria, Czech Republic, Romania, Marroco, China, Mexico, and Germany.

In Romania Hirschmann has 2 production units, situated in Mures County, Transylvania. The activity was established in 2007 and manufactures wiring for parking and battery sensors, wiring for mirrors, automatic gearboxes and motors. 1.950 company's employees out of 5.900 are working in Romania.

The 5S and other Lean tools use is integrated into the production processes and managerial culture, being present simultaneously in all sectors and departments of the enterprise. Hirschmann School offers the new employees a specialized training on the Lean used tools, organizational culture, company's vision and so on.

Hirschmann focuses on eliminating the 8 types of Muda described in the literature as: overproduction, waiting time, transport, extra-processing, inventory, motion, defective products, unused potential.

For eliminating Muda, Hirschmann Automotive Romania uses 2 types of Lean methods:

- Basic methods:
 - 5S method;
 - Improvement ideas management;
 - 7 Muda elimination;
 - Practical methods for solving problems;
 - Process confirmation;
 - Visual management.
- Complex methods:
 - SMED (single minute exchange of die);
 - VSM (value stream mapping);
 - 6 Sigma;
 - TPM (total productive maintenance);
 - TQM (total quality management);
 - Kanban;
 - OPF (one pieces flow).

3. 5S tool implementation and benefits quantification

3.1. Implementing 5S tool in production

For implementing 5S method in the production environment, Hirschmann Romania follows specific successive actions:

1. Select the pilot area for a 5S site;
2. Establishing the team, the members who will participate in the activity;
3. Providing the necessary resources for the development of the site;
4. Training the selected team;
5. Development of the 5S site in Gemba;
6. Closure of actions on site;
7. Achieving the 5S standard;
8. 5S site documentation;
9. Extension of the standard to similar positions;

⁶ Paul Resetarits, "The application of lean management principles to fields other than manufacturing," Proceedings of PICMET '12: Technology Management for Emerging Technologies (IEEE 2012): 1705-1742, <https://ieeexplore.ieee.org/document/6304189>.

⁷ Oleghe Omogbai, and Konstantinos Salonitis, "The Implementation of 5S Lean Tool Using System Dynamics Approach," Procedia CIRP 60 (Elsevier 2017): 380-385, <https://doi.org/10.1016/j.procir.2017.01.057>.

10. Evaluation of 5S level, degree of implementation.

Step 1.

Based on the company's needs, a pilot area for 5S implementation is selected.

Step 2.

For establishing the team, Hirschmann considers selecting 4 to 10 people to participate to the 5S site:

- CIP (Continuous Improvement Project) coordinator in the area - site coordinator;
- workplace operators;
- internal customer;
- the internal supplier;
- process engineer;
- quality engineer;
- segment leader.

Step 3.

The company ensures the following resources:

- Printing of 40-50 pieces of 5S Red tags;
- adhesive tape for gluing the red tags;
- blue, red and green markers;
- Flip chart;
- red and white strip for marking the area;
- standard information label Site pilot area 5S.

Step 4.

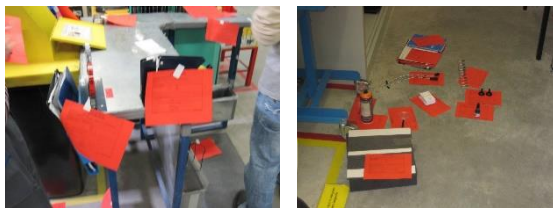
The course material and Best practices in production are presented and trained for 1-1,5 hours.

Step 5.

The implementation of 5S method starts. The Flipchart is filled in with data: Site location, site date, site purpose, participants (team), team expectations.

Sorting implies the identification of unnecessary objects, problem areas, sources of dirt and hard-to-reach areas with red tags. Unnecessary objects are removed from the area and written on the Flip-chart.

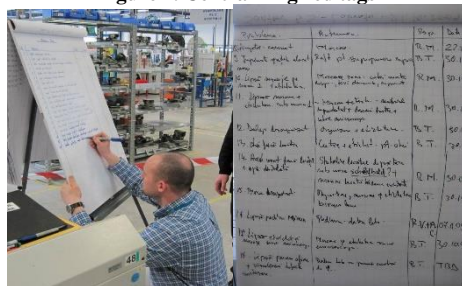
Figure 1. Red tags on unnecessary objects



Source: Hirschmann Automotive Romania

All red tickets are centralized in an Action Plan.

Figure 2. Centralizing red tags



Source: Hirschmann Automotive Romania

The remaining things are put in order, then the space is cleaned to shine. Cleaning is done together with the whole team, so during this time the following necessary things are identified to achieve the standard of cleanliness and 5S:

- Sources of mess;
- Hard to reach areas;
- Required cleaning time;
- Materials needed for cleaning.

To standardize the achieved results, a standard form is used within Hirschmann company, which shows and describes all the objects present at the workplace, but also details the daily and weekly cleaning program in tabular form (see figure 4).

Figure 3. 5S Standard

5S Standard						
Date	Description	Automatic bandage	Zone	SG01		
Revision	Created by		Responsible	Operator		
What to do!						
S1 (Sort)	S2 (Systematize)	S3 (Shine)	S4 (Standardize)	S5 (Sustain)		
Make sure all unnecessary things are properly removed and identified	Make sure all things are identified and are in the correct location	Make sure the area is clean and all things are clean	Make sure this standard is current and placed in the designated location	Make sure this area looks the same as in the image below		
DAILY CLEANING PROGRAM						
No.	Location	Activity	Responsible	Cleaning tools	Time	Frequency
1	Floor	cleaning	operator	broom	2 min	Z
2	Machine	cleaning	operator	Clean and cloth	3 min	Z
WEEKLY CLEANING PROGRAM						
No.	Location	Activity	Responsible	Cleaning tools	Time	Frequency
1	Floor	cleaning	operator	mop	3 min	U
2	Machine	cleaning	operator	Clean and cloth	5 min	U
3	Lamp	curatate	operator	Clean and cloth	1 min	U
4	Chair	curatate	operator	Clean and cloth	3 min	U
5	Gutter wires	curatate	operator	Clean and cloth	3 min	U

Source: Hirschmann Automotive Romania

3.2. Benefits of 5S tool use

The main effects of continuously using 5S tool are well-known: increased power of concentration, increased labor productivity, improved quality of products and services, clean and productive work environment, improved maintenance and safety, cost reduction, increasing of effectiveness and efficiency in the processes, discipline and better engagement at workplace, improved sense of responsibility and teamwork, better equipment reliability, as well as reduced waste: less space for storage and wasted labor

time, reduced production and set-up times etc^{8,9}. But then how do we quantify the benefits in economic terms? It is important to know that the achieved results can be measured also as performance indicators. Four main KPI-s (Key Performance Indicators) will be used to measure the impact 5S implementation had in Automatic Bandage process.

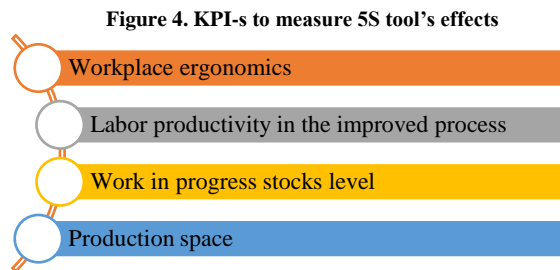


Figure 4. KPI-s to measure 5S tool's effects

A. Workplace ergonomics KPI

Ergonomics is especially important at the workplace not only for comfort, but also for increasing productivity, minimise risk of injury or accidents.

When measuring the ergonomomy KPI, Hirschmann Automotive Romania uses a Motion Economy Chart. The main objective is to ensure to the operators a workspace where the tools are at 2-second distance, can be easily reached at a stretch of hand. Time is measured at a workplace and specific analysis are performed to optimize it.

For example, in Pre-assembly area, at the Automatic Bandaging process a Motion Economy Chart was developed and a 5S site was implemented. 73 issues were identified at the workplace, all of them were classified based on the type of issue. Analysing the occurrences of identified issues, a Pareto analysis was performed (figure 5).

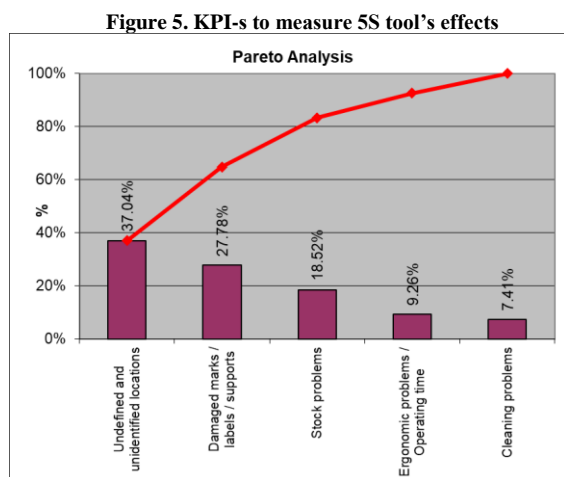


Figure 5. KPI-s to measure 5S tool's effects

Source: Hirschmann Automotive Romania

The analysis helped to establish 76 actions, 97% of which were implemented at the Automatic Bandaging workplace. Time was measured again and results were introduced in the Motion Economy Chart (please see figure 6).

Improved results in terms of workplace ergonomics can be seen, comparing the green area of the Motion Economy Chart with the red area.

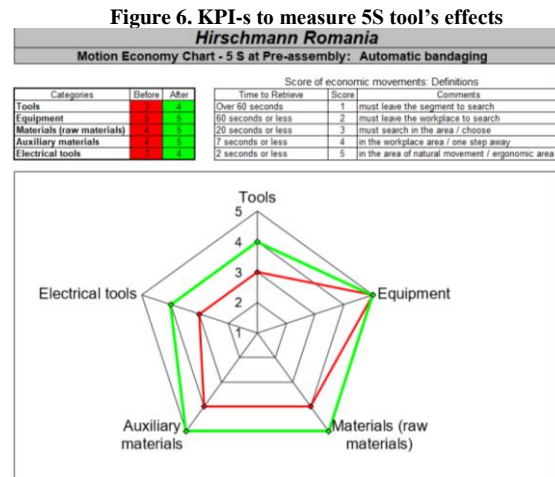


Figure 6. KPI-s to measure 5S tool's effects

Source: Hirschmann Automotive Romania

B. Labor productivity in the improved process KPI

The workplace was optimized as a result of the 5S tool implementation and the analysis performed. By standardizing the objects places (raw materials, tools, etc.) used in the assembly process, it was possible to reduce the Cycle Time from 13 seconds to 10 seconds, i.e. an increase of 23% of productivity. This gain of 3 seconds, transformed into hours, multiplied by the number of products/year and by the cost rate/hour result a gain of 1.856 euro/year. Please consider that this gain is yearly, so the sooner the improvement is introduced, the bigger the cummulated save is.

C. Work in progress stocks level KPI

For the interphase stocks, a minimum and maximum value was introduced. This helped reaching a better control of the material flow and the reduction from 5 boxes to 2 boxes of the stock, i.e. by 60%, meaning 53 euros per year. Several similar actions were introduced in the factory (see examples in the figure 7), which helped to decrease work in progress stocks level.

D. Production space KPI

Due to the optimization of the workstation and the reduction of the interphase stock, it was possible to reduce the space used from 15.6 sqm to 12.3 sqm, i.e. a reduction of 21%, meaning 165 euros per year. Even

⁸ Cristina Veres, Liviu Marian, Sorina Moica, and Karam Al-Akel, "Case study concerning 5S method impact in an automotive company," Procedia Manufacturing 22 (Elsevier 2018): 900-905, <https://doi.org/10.1016/j.promfg.2018.03.127>.

⁹ Vipulkumar Patel, Hemant Thakkar, "Review on Implementation of 5S in Various Organization," International Journal of Engineering Research and Applications 4 no.3 vs. 1 (IJERA 2014): 774-779, <https://core.ac.uk/download/pdf/26989504.pdf>.

though the amount is not big, several improvements in different areas of the factory increment the saved space.

*Small improvements * Many repeats = Major Impact*



4. Transposing automotive experience into medical environment

The described 5S approach can be transposed into other fields, such as healthcare, government, IT, retail and others to improve productivity and quality of products and services.

Adapting 5S method in healthcare, for example, should consider the specific medical environment and conditions. As in any other field, health system has several wastes, too.

The 8 Muda in the medical field are different from the 8 Muda in automotive. See table 1 for some specific examples of wastes.

Table 1. Examples of 8 Muda in healthcare

Types of MUDA	Examples in healthcare
Defects	misdiagnosis, incorrect administration of treatment, labels on the wrong tube, mixed analysis
Waiting time	patients waiting for consultation / hospitalization or discharge/ test results / doctor's stamp; waiting for beds, equipment, information, operating rooms; Blockage of the computer system; time spent searching for a missing scalpel in the surgical kit; any interruptions or blockages
Inventory	inventory for 50 weeks; medications that may expire; too many consumables; pre-printed forms; any medicine, solution, furniture, object in too large quantities
Over-production	discharging all patients at 12 a.m., processing of all blood tests at 10:00 in the laboratory, ordering medications that the patient doesn't need
Transport	Unnecessary movement of patients, samples, equipment or materials; remote locations
Extra-processing	Extra work, which the patient does not need; requesting and performing unnecessary diagnostic procedures; excessive bureaucracy; forms with information never used; surgery instead of an equally effective medical alternative
Motion	Travel 20 meters to the printer or to take analysis results; accompanying a patient for a NMR; long distance between locations
Unused potential	Loss of ideas, skills, improvements and learning opportunities through lack of involvement, listening and support of employees; putting pressure on people to hide problems

Implementing 5S means following the same 5 steps as in automotive field (follow section 3.1). In hospitals or clinics, Gemba means the place where medical care is offered. The teams are formed of the doctors, nurses, managers and other employees who are involved in creating value for the customers. Patients are the customers in healthcare.

There are several top hospitals and clinics in the world which monitors KPI's.

Applying the described in this paper KPI-s, we should not subestimate the importance of ergonomics in a surgery unit, emergency unit, histopathology laboratory, neonatology, cardiology unit, radioactive laboratory in nuclear medicine, and so on. Seconds matter as we are no longer operating with technical equipment or raw materials, but with human lives. We have seen how the ergonomics of a space can be measured and improved.

Labor productivity is very useful in crowded environment, which cumulate large waiting lists and queues, as well as in the emergency unit, where each minute matters more than elsewhere.

In the actual pandemic situation saving and optimizing space can allow a bigger number of patients to be treated at the same time, a bigger number of drugs to be stored and a more efficient use of equipment to be achieved.

Work in progress stocks level can be also decreased in the medical environment, using the same

approach of streamlining spaces by finding solution to store the same equipment in less space. A medical unit can establish a specific number of drugs to be stored in a particular space, to avoid disorder and time waste.

Figure 8. Before and after examples



Source: www.youtube.com¹⁰

A simple labelling of boxes helps saving time to search drugs or equipment, making the workplace more “visual”.

5. Conclusions

The presented case study highlighted the externalities of using LM, especially the 5S method and the potential to expand the application in other fields of activity. 5S Tool is an appropriate choice to start introducing excellency in health care as the basis for redefining the measurement of quality in health services. In the actual pandemic crisis, when hospitals are facing a very large number of patients, 5S brings simplicity, focus, reduces stress and increases significant KPI-s: Workplace ergonomics, Labor productivity in the improved process, Work in progress and Adding-value space.

Why is it necessary to apply the 5S method in the health system? There are several reasons:

1. Nowadays the medical system is facing an excessive waste. Staff travel significant distances daily,

patients wait tens of minutes or even hours in line to be consulted, we face an excessive bureaucracy that forces us to fill in dozens of forms, and so on.

2. Patient satisfaction is strongly influenced by the services provided by medical staff. In addition to patient satisfaction, it is important to increase employee satisfaction. Thus, we must first make sure that we offer our employees optimal working conditions, simplifying and making their work easier.

3. The quality of the health system needs to improve. Only excellence in the medical field is the way to achieve top results.

4. The medical field is constantly evolving and as a result, the staff, the professionals must be continuously adapted to the changes that take place, to improve.

5. The efficiency of routine activities leads to significant improvements, which are imperative in conditions of increasing demand for health care services.

6. Efficient medical management systems are successfully applied and show remarkable results in the top hospitals, being important models and examples of best practice for clinics, hospitals, pharmacies, medical offices, medical departments, etc.

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References

- Zhang, Bo, Zhanwen Niu, and Chaochao Liu. “Lean Tools, Knowledge Management, and Lean Sustainability: The Moderating Effects of Study Conventions.”, *Sustainability* 12, no. 3 (MDPI 2020): 1-20, <https://doi.org/10.3390/su12030956>;
- Honarpour, Amir, Ahmad Jusoh, and Choi Sang Long. “Knowledge management and total quality management: A reciprocal relationship”. *International Journal of Quality & Reliability Management*, 34, no. 1 (Emerald 2017): 91-102. <https://doi.org/10.1108/IJQRM-03-2014-0040>;
- Savindi Caldera, Cheryl Julia Kiran Desha, and Les Dawes. “Exploring the role of lean thinking in sustainable business practice: A systematic literature review”. *Journal of Cleaner Production* 167 (Elsevier 2017): 1546-1565. <https://doi.org/10.1016/j.jclepro.2017.05.126>;
- Varela, Leonilde, Adriana Araújo, Paulo Ávila, Hélio Castro, and Goran Putnik. “Evaluation of the Relation between Lean Manufacturing, Industry 4.0, and Sustainability.” *Sustainability* 11, no. 5 (MDPI 2019): 1439. <https://doi.org/10.3390/su11051439>;
- Nadeem, Simon Peter, Jose Arturo Garza-Reyes, Anthony Anosike, and Vikas Kumar. “Coalescing the Lean and Circular Economy.” *Proceedings of the International Conference on Industrial Engineering and Operations Management (IEOM Society International 2019)*: 1082-1093. <http://www.ieomsociety.org/ieom2019/papers/279.pdf>;

¹⁰ “Lean 5S in MSICU,” Youtube, accessed April 1, 2021, <https://www.youtube.com/watch?v=aMkXICM1-98&t=258s>.

- Resetarits, Paul. "The application of lean management principles to fields other than manufacturing." Proceedings of PICMET '12: Technology Management for Emerging Technologies (IEEE 2012): 1705-1742. <https://ieeexplore.ieee.org/document/6304189>;
- Omogbai, Oleghe, and Konstantinos Salonitis. "The Implementation of 5S Lean Tool Using System Dynamics Approach." *Procedia CIRP* 60 (Elsevier 2017): 380-385. <https://doi.org/10.1016/j.procir.2017.01.057>;
- Veres, Cristina, Liviu Marian, Sorina Moica, and Karam Al-Akel. "Case study concerning 5S method impact in an automotive company." *Procedia Manufacturing* 22 (Elsevier 2018): 900-905. <https://doi.org/10.1016/j.promfg.2018.03.127>;
- Vipulkumar Patel, Hemant Thakkar, "Review on Implementation of 5S in Various Organization," *International Journal of Engineering Research and Applications* 4 no.3 vrs. 1 (IJERA 2014): 774-779, <https://core.ac.uk/download/pdf/26989504.pdf>;
- Youtube, „Lean 5S in MSICU.” Accessed Aprilie 1, 2021. <https://www.youtube.com/watch?v=aMkXICM1-98&t=258s>.