

Game for a LEAN Methods Training (5S, Visual Management and Standardization of Work)

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Abstract: The aim of this study is to minutely describe a game designed for training car industry employees. The game's subject of focus is the area of Lean methods, specifically the 5S method, visualization and standardization. While playing, employees encounter problems with quality, mistaking materials or not utilizing supplies during the process. Players are repeatedly informed that these problems are an illustration of what they face daily during the working process. The game helps them to see 5S as a regular way of thinking, not as the management's tool to lower wages or force employees to do the clean-up as is commonly and mistakenly believed. At the end of the game, the employees are presented with the increase in performances in individual rounds. This is achieved by a diagram and a chart representing the financial side of the production process, especially with regards to costs. Finally, the study's conclusion summarizes the results of past trainings which were attended by more than 500 employees from all levels of the company.

Key words: Lean, game, training, 5S, education, management

INTRODUCTION

The aim of this study is to present readers with the methodology of a game designed for educating adults on the basic LEAN methods 5S, standardization of research and visualization.

For more than 4 years, the game has been successfully used by a company doing business in the car industry and has been finished by over 500 employees including members of the senior management. In the study's conclusion, the researcher shortly addresses the results of observing groups of players, comparing their respective approaches to the game or the performance of particular groups and individuals from various research teams throughout the entire company, from the management to production workers.

MATERIALS AND METHODS

Short explanation of LEAN methods: The word "Lean" signifies a never-ending process of improvement also known as Kaizen. Lean processes are free of needless wasting or activities with no additional value for which a customer would be willing to pay.

The game deals primarily with the 5S methodology, though it, also, contains elements of visualisation and standardization of research which are closely related to the 5S methodology.

The 5S are five steps leading to the standardization of workplace, the first one of which being "Sort". During this stage, it's necessary to separate out everything that isn't needed for everyday research. The second step is "Straighten" all remaining things are sorted out and assigned a permanent place and their placement is clearly visualized. The third step is "Shine" or a clean-up which stresses the need to keep the workplace clean and regularly clean it up. The fourth S is "Standardize" all previous steps are incorporated into in-house manuals and procedures. The last S is "Sustain". Although, it might seem that this is the easiest measure in reality it's the most important one because if the implementation doesn't require that the 5S rules are observed, the company might easily find itself back at the stage before 5S was even introduced. Many people mistakenly believe that 5S is merely a clean-up initiative, perhaps because a clean research area is one outcome. The primary purpose of the first S in 5S is to clear the clouds which involves eliminating the waste of motion from moving things and the waste of looking for tools and materials (Jeffrey and Meier, 2006). If the above-mentioned steps are supplemented by further areas, most commonly "Safety", "Security" or "Surrounding", then the 5S method can also be known as 5+1S, 6S or 8S.

Standardization of research standardization of research makes it easier to identify wasting, a basic

prerequisite for writing time-lapse studies. Standardization facilitates the detection of process errors. Due to an easy standardization of research, training employees is much simpler and faster.

Visualisation compared to standardization, visualisation is more general and meant primarily to provide information to employees and management but also to people visiting the company. Combined with standardisation, it helps to formulate the workplace code of conduct and organizes the movement of employees or materials (maps of flows, defining workplace boundaries, marking workplaces, etc.) (Jeffrey and Meier, 2006).

Jidoka automatic quality control. If any abnormality occurs during the process, either an employee or a machine immediately stops the process and notifies the department responsible for quality assurance, thus, preventing waste in the form of defects or damage to mechanisms (Vochozka, 2012).

Upon the game's (training's) conclusion, it's possible to mention other Lean method tools during evaluation, e.g., types of wasting in production and administrative processes, the added-to-unadded value ratio or general information about the company's costs whose existence or significance may usually go unnoticed by the employees.

Other existing games: There are a great number of games teaching the LEAN methods. Focusing only on the above-mentioned areas, the following can be listed.

The 5S number game a game that is both easy to understand and play. Still, it has disadvantages such as an insufficient connection with production processes and the fact that it's suitable mainly for employees with technical-economic jobs. The game's goal is to gradually arrange numbers, so that, they are in sequence and don't need to be looked up (Bicheno, 2009).

The 5S letter/shape game a variation on the previous game where numbers are replaced by letters or shapes. Lego standard research a game for practicing 5S methods and the standardization of research. There are two players: the first one has a detailed research manual and organized sequential material while the second one has only a photo or a description of the final product, along with jumbled up materials. The game's main benefit is a simple comparison between a standardized workplace and chaos.

Standard pig this is a typical game for practicing the standardization of research. Firstly, the players are asked to draw a pig. Then they draw another pig by following text instructions. The main purpose is to compare the pictures drawn during both rounds with the desired outcome. The game's benefit lies in its simple execution

Table 1: Differences between levels

Round	1st	2nd	3rd	4th	5nd
No. of wheels	3	5	5	5	8
Time limit (sec)	60	60	60	60	60
No. of types (wheels)	2	1	1	2	6
No. of types (shafts)	2	1	1	2	3

and entertainment value to the group (Kiehl, 2005). Other games are mainly variations of those listed here or focus on different areas (e.g., Kanban, the push-pull rule, the PDCA cycle, etc.).

Game's description: The game's original purpose was only to practically teach the 5S methods which are a basic Lean method and include other elements of Lean management, e.g., visual management, standardization of research, jidoka or production wasting.

The players are to arrange cogwheels, so that, they fit together with no clearance and yet are all turning. There are altogether five rounds, each distinguished by used materials and the number of cogwheels requiring a correct placement (Table 1).

Initially, any manipulation of materials without a trainer's instructions is forbidden. Everybody is presented with the basic organization information regarding the number of repetitions, time limits and the need to check provided materials. The players are informed that there's no clearance allowed between the wheels and only one solution exists.

They are introduced to the worktop and starting holes for individual rounds are shown to them including a clear animated illustration explaining how to insert the shaft into the worktop and how to attach the cogwheel (Fig. 1). The worktop contains 50 holes, however, only half of them will be utilized. The rest function as dead ends.

It's also important to identify a single line, so that, the cogwheels can be arranged behind one another. The resulting assembly mustn't begin in a starting hole and end with two wheels turning despite not being connected to each other.

Before starting the game, players are presented with an illustrative top with a system of cogwheels already installed, so that, everybody can see the desired outcome of his or her upcoming efforts.

Before each round, all players are informed about the time limit for completing the assignment, about the utilized materials and the task's difficulty. The material is presented via. pictures and visually. The players are warned that there might be dead ends. After the completion of each round, the players are asked: "How was the game this time?" and "What could be improved?"

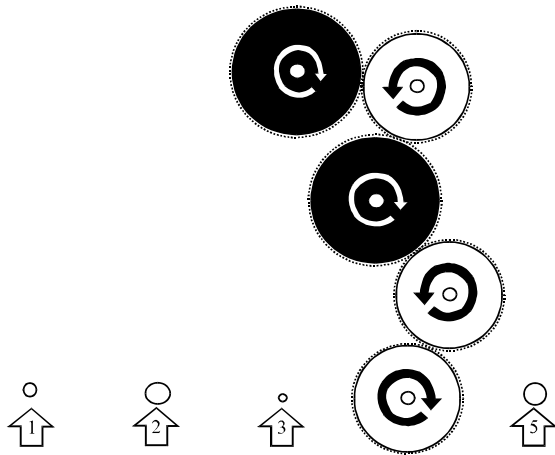


Fig. 1: A correctly assembled train of 5 wheels

First round: Before the first round starts, the material is prepared in a closed box. Apart from the needed cogwheels and shafts, the box contains materials of various sizes and types, along with entirely different materials which will never be used.

The players don't know what's being asked from them. That's why the task was made easier by lowering the number of cogwheels requiring a placement. The goal of this round is to remove unnecessary materials which hinder the task from being completed and result in excessive searching or the necessity to look for the right type of material.

Second round: Before the second round starts, the players are asked to remove all unnecessary materials. They're also closely introduced to the type of cogwheel used in this round and informed that they must use only identical materials (see the demonstration).

The players are now fully concentrated on placing the wheels without realizing that they have two types of cogwheels of the same size which differ only in height and an easy-to-miss marking. The purpose of this round is to point out how easy it is to mistake visually similar materials an error which could result in an extensive claim for replacement on the part of the customer and increased quality control costs.

After this round ends, the players are asked to arrange the materials and inquired about possible improvements that would make the job more pleasant for them. At this point, a request for a better arrangement of materials is usually voiced. If it isn't, the trainer will guide the player to this idea.

Each player then receives a holder for all types of cogwheels and shafts. The corresponding places in the material holders are marked in colour. The players are

informed that the material used in the following round will be specified by colour (colour-based visualisation of material types). If there are no questions, it's time for the third round to start.

Third round: The purpose of the third round is only to point out that since the colour-based placement for a particular type of cogwheels wasn't standardized, there's still a 50% chance that the material will be misplaced considering the fact that there are two empty places in the holder and the remaining cogwheels from the previous round.

It may happen during this assignment that somebody asks what the correct position is. If this occurs, the person is complimented and the round can be skipped. After the round ends or is skipped, altogether three possibilities for improvement are expected from the players. Workplace clean-up since the first round, the worktop has been covered with materials which won't be needed for the duration of the game. This represents wasting in the form of a supply of unutilized materials.

Working manual it's still necessary to look up the correct configuration of cogwheels. Standardization of workplace the purpose of this point is to organize the workplace according to a predetermined standard, i.e., the workplace will contain only the worktop, material holders and manual. If the players didn't require instructions for the third round, this standardization should help them reveal these imperfections. They will all receive a manual for the following round to follow.

Fourth round: The fourth round is only a control round. All operators should be able to fulfil their task. The only room for improvement is placing the research manual under a clear worktop. Usually, more than 60% of players don't place the manual under their worktop without being prompted to do so.

Fifth round: The last, fifth round is meant to assure players that applying the 5S methods brings results. In the last round, eight cogwheels of five types need to be placed. Although, the 75% increase in number of wheels and the diversity of wheel types make this task more difficult, the time needed to assemble the configuration is often comparable to the previous round.

RESULTS AND DISCUSSION

Evaluation of the game: The game's conclusion focuses on statistical information and the final evaluation. The players are shown a diagram representing the time needed to correctly place a single cogwheel.

Furthermore, a chart with the number of correctly placed wheels and the best times needed to complete a particular task (if there was a 1 min limit) was being filled in during the course of the game.

Upon the game's conclusion, the players are presented with the chart and a comparison is made between the game's financial indicators and a real production. The chart contains the following simplified division of expenses and incomes:

Costs for a late delivery: One financial unit representing the customer's fine for failing to deliver was put on all teams that weren't able to assemble the required configuration in the set interval of one minute. In a real operation such fine would be, for example, a penalization for stopping a car factory's production in the "Just-in-time" mode.

Costs of poor-quality parts: By "poor-quality" we mean mistaking visually similar parts which can cause the product to defect in the future and don't conform to the customer's specifications.

Costs of unutilized materials: Modern-day companies strive to eliminate the supply of materials present during the process by trying to have one piece flowing and most of the materials consigned, i.e., owned by the supplier. Therefore, until the unutilized materials aren't cleaned-up during the game, they represent the costs of unused capital that has no application. Such costs are usually termed WACC, meaning the average costs of capital or alternative capital costs invested by the company in order to be able to use the capital for its business activities (Shannon, 2010).

Fixed costs the costs of depreciations, building and machine administration, energies, technical-economic employees, etc. which emerge even if no product was assembled. Profits from timely delivery any single plus item represents the profits from a correct configuration delivered on time. What's worth pointing out is the trend of decreasing profits which is caused by the contracts with customers involving the manufacturer's obligation to lower prices each year.

The last paragraph is one of the reasons why there's an increasing pressure on making the processes more efficient and address the situation when the costs (wages, energies, etc.) are rising while customers put a long-term pressure on suppliers to lower the prices.

CONCLUSION

Overall, the game's implementation can be judged as trouble-free, even though the 5S method is viewed rather negatively as it's become a part of each employee's evaluation and the management oversees its observance.

During the entire course of the game, the researcher encountered only two negative reactions. The reason for them was the need to repeat the game with several employees which was caused by changes in shifts and transfers of employees while the game was still in progress. Maintenance workers, too had a negative reaction because they like the most of the other players during the second and third round swallowed the bait, not tolerating it well.

The researcher didn't observe any significant differences between the performances of men and women with working and purely technical jobs. Overall, the quickest player in the entire game was a middle-aged man, however, women performed better on average. Taking technical-economic positions into account, women performed visibly better than men.

The game had been modified several times during the course of its existence, so that, it would be as illustrative as possible and at the same time short enough to execute since trainings of workers translated into losses in production. Temporary shutdown periods were therefore, most often utilized as they offered the room for a thorough training. The entire game lasted for about 30-40 min. Most of the employees received it well and called it an interesting variation on their regular research shift.

Considering the fact that the game differs from those involving numbers or Legos, it's suitable mainly for workers. Still, possibilities for its application are wide and the game can be used to teach other Lean methods. Nonetheless, it's not recommended to repeat it with players who already completed it as they would be demotivated and might inform other players about its chief obstacles.

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