

LEAN PHILOSOPHY IN THE DIGITALIZATION PROCESS

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Abstract: Lean manufacturing philosophy is known since the 1970-ies. It has been developed through the years and slowly accepted by the companies all over the world. It can be said that most of the companies in the world are using or at least are aware of the existence of lean philosophy. Therefore it is accepted as usual everyday activity and tool, present focus of the companies. The new trend is up and coming and that is the digitalization. Popularly known as Industry 4.0 in Europe, Internet of Services in USA. This paper deals with use and position of lean philosophy with its tools in the transitional process of a single company in order to implement the Industry 4.0 concept. The impacts of certain sectors, its advantages and disadvantages will be described.

Keywords: Industry 4.0, digitalization, lean manufacturing

1. INTRODUCTION

Industry 4.0 and lean management somehow have to be connected in order to use the advantages of both [1]. Digitalization, as crucial part of Industry 4.0, its transformational process, requires radical changes within the company floor [2]. Every change demands certain investment which isn't the favorite action for the management. Also, there is a fear of a change that disables the human workers to accept the new concept and its benefits [3]. Transitional period is very important, as well in the financial but also in the human resources field. The creation of autonomous system (cyber physical system), where the standard channels of communication aren't the only one needed and the human role within that system changes, must be done smoothly with as less loss as possible [4]. Lean philosophy with its tools has been known on the market for several decades already, yet there are companies that haven't accepted this way of thinking and working [5]. Still more popular and relatively widely used, it can be defined as a present event, while the digitalization is presented as the trend and the future event. With its advantages and useful tools, it can make digitalization period to have less negative impact on the physical part and human part of the company. Therefore, its role must be defined clearly with the slight changes that will enable it to function once the Industry 4.0 concept is being accepted.

2. TRANSITION TO INDUSTRY 4.0

The general idea of the lean philosophy is reduced of waste [6]. Waste is always somehow present and cannot be eliminated completely, but with help of certain tools it can be minimized. Since the Industry 4.0, the new working environment concept because of the digitalization within the company floor, demands continuous improvements by using data in the real time, lean management is very useful and can be crucial part of it. The transitional process of the company to Industry 4.0 requires complete system scanning [7]. This enables to see all the flows of it and the waste that is generated. To recognize the waste and its impact to minimize or eliminate it the lean philosophy can be very useful. Its definition of seven (eight) types of waste (Figure 1) can help to identify and to reorganize certain departments and processes within the company floor. Each type of the eight categories of waste can be also useful not only in the transitional process, but in the future life of the new company's concept. Reduction of waste will become extremely important since Industry 4.0 demands enormous flexibility, short time-to-market and low expenses in order to produce quality product by relatively cheap price, that would be satisfying for the customer.



Figure 1 – 8 waste of lean [8]

— Defects

Transitional process must be done with as less of a defects as possible. If the project is done with many flows, with investment already very high and risky for the company, the final result might not function the way it was intended to or the project might be cancelled even during the transitional period. Information gathered from the company floor have to be correct, in satisfying amount and well-structured so they can be used for the further actions. Actions of the company redesign and organizational re-arrangement also have to be without defects or the future consequences might be enormously big and destructive for the company.

— Overproduction

Overproduction in transitional process can be linked to unimportant changes due lack of complete picture of the system and its parts. Scanning procedure and readiness factor calculation are very important to get the detailed overview of the changes that have to happen. There are certain parts of the company that are more developed than other and that is why investments in those parts are not as big as in parts where the development stage is smaller. Changes shouldn't be standardized but rather optimized for each department within the company. Standard version might cause extra cost, loss, waste that must be monitored and eliminated at the very beginning.

— Waiting

Change can't happen overnight but there is a high risk of waste in the terms of a waiting time. The most dangerous time is the waiting for the personnel to change. Resistance and fear of changes within the human is the biggest obstacle while accepting the Industry 4.0 concept. The educational time needed should not exceed certain limits because it can turn out to be contra productive. On the business level, readiness factor calculation should be done in the shorter time as possible, automatically but also personalized with help of special software and decision support systems. The transformation on the hardware level should be done in deal with vendors who are obligated to respect the deals. Any flaws within the transitional period can cause huge loss in the future.

— Non-utilized talent

Human resources are the most valuable resource in the company. Also, they are the key factor to make the change happen but also to make sure that the new concept with function well. With demands of continuous optimization and innovative approach, Industry 4.0 requires higher level of human knowledge, linked to specific skills. In the transitional period some might seem threatened for the loss of their current work position. Human are usually afraid that the robot will take their workplace and they won't be useful anymore. The reality is completely opposite – the manual work can and will be replaced by robot, but the same worker now has to gain new skills to control this robot and to adjust to new role within the company. If the workers won't be motivated, waste is increasing within the transitional process, the concept won't be implemented appropriately and the further development of the system and the general functioning won't be possible.

— Transportation

Logistics 4.0 is most present even in the today's companies. On the physical, hardware level, automatic material flow might cause waste if not optimized. The energy and machine resources can be easily wasted that is why special caution has to be made. Transportation of information and data has to be optimized during the transitional period and everybody have to inform about current state within the company. The change must be transparent and clear to every worker of the management member. Otherwise the problem might cause waste on many financial and time level.

— Inventory

Industry 4.0 concept requires minimum of the inventory. Just-in-time production can be more possible than ever because of the new way of the data and material flow. Real time availability of the data combined with advanced prediction methods can make sure that the excess of the inventory won't be part of the everyday work and therefore it won't generate waste anymore. In the transitional period it is very important to acknowledge the excess inventory and dismiss it.

— Motion

Unnecessary movements generate waste in terms of extension of the time needed for the certain task. With use of robot human motion can be completely eliminated from the manufacturing hall. Also, robot moves must be continuously optimized with the use of data collected in the real time. The machine-machine communication is another novelty that can create motion waste. The human controller with its knowledge of the optimization algorithms and predictive methods is there to eliminate extra motion that extends time needed for tasks and actions given to the machines.

— Extra processing

Big data collected in the real time from the manufacturing hall or from the other parts of the company must be sorted and used well. During the transitional period the scanning of the current situation should be done briefly, scanning the important parts of the company only, to avoid the extra processing which might give an incorrect overview which leads to creation of the false investment project that can later be reason for unsatisfying results that create major loss.

3. BIG DATA AND LEAN PHILOSOPHY

The ability to collect and process large amount of data has been one of the triggers for development of Industry 4.0 [9]. Hardware prices have decreased, their physical size has also decreased rapidly over the last decade with increase of their power – higher speed and memory space. This allowed the companies, even the small ones to buy such product and use them to collect certain data. With help of sensors, data is being collected in the real time and stored in the special database [10]. Those databases have to be well structured and safe to enable the constructive use of the data (Figure 2). The big data cover every aspect of company's business. From the customer relationship service to fraud detection, it is being collected and used to continuously optimize the process in order to create value. The value is being created in every single database, but every part of company from which the data is being collected, but the biggest value is being created with interaction between all to optimize and improve the system as a whole.

The advanced predictive methods can help to recognize usual patterns within the manufacturing process, but also improve the communication with both vendors and customers. Lean philosophy is an ideal for keeping the data in order and getting the most of it. Industry 4.0 demands constant improvement and remaining the leading position on the market. The continuous improvement and system check lean has to bring not only on the hardware and software level, but also as the mindset of the human who are most important part of the system. Data should be collected in the real time, but the optimization not only of the processes but also the amount of data collected has to be monitored.

Linkage to other databases from the system has to be constantly put in question with self-check algorithms to eliminate waste and the possibility of the mistake in the data collecting and processing.

During the transitional process the places from which data will be collected must be detected and the most useful methods of the data analysing. The system has to remain flexible with easy possibility of the change, having the lean philosophy of continuous improvement on mind. This helps not only to create system with minimum waste, but it also enables its sustainability.

The importance of waste elimination in the terms of big data collecting and processing is very important also for the security reasons.

4. 5S – STEP TO INDUSTRY 4.0

During the digitalization period, 5S tool is one of the possibilities that can lead to best results (Figure 3) [12] This tool can be used before or after readiness factor calculation. Probably the better solution would be the use before readiness factor calculation because this is a cheap procedure that could improve the current situation that might result in the higher readiness factor result, but the transitional process/investment project afterwards will be less demanding and easily to be made.

— Sort

The first step is the scanning of the current situation. The sorting of the physical inventory enables the overview in the possessions from which some might be lost during the time or not even evidenced in the archives. Also, with sorting the waste is being eliminated and things that are needed and aren't needed for the work are being defined. This is the first step to digitalization. The sorting might not only be done on the physical level, but also on the both organizational and software level. The inappropriate procedures that create waste can be recognized and the flaws of the current software which disables the normal and optimum workflow can also be recognized.

— Set In Order

After the sorting, the workplace should be set in order. The workplace on the physical level is to be organized to eliminate waste in the very beginning state of the digitalization. With organized workplace its digitalization can be done easily – the organization on the hardware level enables the easier definition of the future software level that will collect data and its processing.

— Shine/Sweeping

Clean workspace is one step towards successful implementation of Industry 4.0 concept. After first two phases, the cleaning enables the new working environment functions properly and is ready for the future changes.

— Standardize

Some manage the readiness level by the standardization level within the company. That is why this step is very important for the future changes and improvements of the system. Standardization of the procedures and environment organization given in the last three steps can lead to better preparation for the new concept. Digitalization is basically the set of the standardized procedures that are flexible, autonomous and adaptive to change. With standardization the readiness factor automatically increases and the investments into this field is lower with less loss than it would be if the digitalization/readiness factor calculation would start before the 5S. Standardization on the software and organizational level enables the recognition of the weak parts, waste producers and places from which to collect the data and how to use it with predictive analytics.

— Sustain

Sustainability of the concept during the transitional period is an important learning tool for the future activities and mindset of the human that have to accept the concept of Industry 4.0. The resistance for the change may be the greatest



Figure 2 – Big data influences [11]



Figure 3 – 5S cycle [13]

obstacle in the final step before completely achieving the new concept, which is why the sustainability is the most important part. The future flexibility and adaptiveness to new working environment at the very beginning is key to the success.

5. CONCLUSION

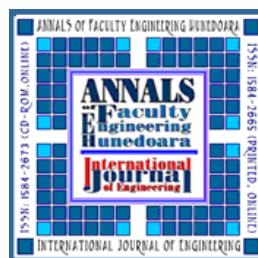
Lean philosophy is the current way of proper functioning of the companies. The new trend is the Industry 4.0, aka 4th industrial (r)evolution. Digitalization has become a future goal for many companies, while the great world leaders have already accepted it and started to change the current working environment. The advantages of using lean philosophy during the digitalization process are better waste recognition and elimination, worker's mindset definition in terms of continuous improvement, demand to workers to generate new ideas and innovational methods which could make the transitional period as less hurtful for the company as possible. The biggest disadvantage is the omnipresent resistance to change coming from the workers. Lean has shown as one of the key factors in the companies of the future, the continuous improvement must remain as the everyday philosophy. Autonomy and flexibility of the new Industry 4.0 concept demands the innovative approach in order to make it sustainable and to retain the leading position on the market. Lean is not only useful in the future state, but also during the transitional period it enables the lower the investment. The elimination of the waste has to be recognized during that period and 5S as a useful tool has to be used even before the readiness factor calculation. Future research is to calculate the possibilities of measuring the productivity increases by using lean philosophy within the Industry 4.0 environment, but also its impact on the human resources, as the most important part of every company.

Note

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