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LEAN CONCEPT IN A SUPPLY CHAIN

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ABSTRACT
Lean concept, as an approach for the establishment of the effective and efficient work processes, has not been perfected yet. Lean concept is a set of activities which includes principles, methods and tools for an efficient reduction of losses and errors in the process of company management. These activities are constantly being improved thanks to new accomplishments and software tools and techniques.
Lean concept is based on a harmonic coordination of human resources and techniques, focusing on work processes (from a supplier to production and a consumer that form a so-called supply chain). Supply chain efficiency will be higher if a higher level of integration between a buyer and a supplier is established. In this sense, lean concept in its principles, methods and tools can improve supply chain efficiency taking the environmental aspects into consideration. This work points out the possibility of presenting the effective ecological supply chain using a graphic method. A software tool eVSM (electronic Value Stream Mapping) will be used in presenting this graph.
Key words: lean concept, a supply chain, a graphic method, principles, methods, tools

1. INTRODUCTION

Lean concept's goal is to eliminate all appearing forms of losses in working processes whose main bearers are: (1) people, (2) quality of products and working processes, (3) quantity of working processes or production and (4) the information used in realizing working processes. Appearing forms of losses can be expressesed in time, material, energy and other units. These units are the basis for financial report of losses by structure in the frame of every bearer of losses. Losses represent useless activities, activities harmful in working processes because they decrease productive ability of each company [2]. They are 'free spaces' which are to be transformed in useful spaces or useful activities. In many cases those free spaces engage material and financial means which unnecessary increase production and storage space as well as production cycles, working cycles (lead time), internal and external transports, work in process WIP and use all kinds of energy used in working precesses. So, by-products of creating or making products are losses. They disturb projected balance of running a business and additionally pollute the environment. Eliminating losses requests synchronisation of very close processes, those which connect different functions inside the industrial system and stock holder community. That is why the main goal of lean concept is the 'minimization' of all appearing forms of losses.
This concept includes constant organisational and management modernization. Those are activities for managemet upgrading: supply chain management, factory flow of material, information and energy; inventory management, management design and development and manager customer relationship. The attention directed to quality and flows decreases losses by **lean supply chain**: from supplier to buyer.

2. LEAN CONCEPT IMPLEMENTATION

2.1. Lean concept elements

In companies, the lean concept is mostly based on projecting working processes which are applicable, flexible, consistent and persistent in time and space [3]. Labour is predictable and enterpreneurial. This concept creates the industrial system based on the real needs of buyers and continued improving of all working processes. In this way the labour is developed and qualified to use lean principle, methods and tools necessary for realizing company's goal functions and placing it on the high level among the market rivals. People 'who are able to change their behaviour', who posses ability, skill, knowledge and will, are needed for this.

So, to implement lean concept in a supply chain it is needed to have capability and will of employees and to lead in (1) the way of behaviour and (2) the way of thinking. The main conditions for creating a lean supply chain are: (a) lean behaviour of management structure; (b) lean thinking of management structure. They are basic elements of creating the vision, policy and goals in the industrial systems.

While decreasing losses in a supply chain it is necessary to have an universal analisis in many working steps. One of the most succesfull methods is a graphic representation of working processes. Its general advantages are: (1) graphs are easy-to-survey and improve communication, (2) graphs can replace a lot of text and reduce the documentation, (3) graphs represent mutual language inside the company and stockholder community.

In graphic representation the big number of diagrams and symbols are used. Here are seven most useful graphic tools which give insight into losses: (1) process flow chart, (2) time supply chart, (3) production funnel or production variety profile, (4) total product quality chart, (5) material and information flow chart, (6) chart of demand, sales plan, production plan, production and sale realisation, (7) used time profile[1].

2.3. Methods and tools in procedures of forming lean concept

Tools and methods used in procedures of forming lean concept are: (1) value stream mapping, (2) total productive maintenance (TPM), (3) single minute exchange of Dies (SMED), (4) pne piece flow, (5) 7 waste according to Ohno, (6) operating and virtual teams, (7) combination of pull/push systems, (8) standardized work, (9) '5S' – workplace organisation, (10) visual factory, (11) point-of-use-storage (POUS), (12) Kanban, (13) Kaizen, (14) pull/push planning principle, (15) quality at the source and others[4].

Besides these, other tools which give better results for specified conditions can be made.

Lean concept points out the importance of graphic representation of working process. Graphic representation of current and future state encourage managers to make decisions to reduce losses in complete supply chain. Software tools like eVSM (electronic Value Stream Mapping) and Minitab have been used in this analisis.

3. LEAN CONCEPT IN A SUPPLY CHAIN

Lean supply chain is a group of procedures and actions happening in a stockholder community during production goals realization in companies. It is an orientated network in the process of material supplying, production, product delivery and customer service accompanied by planned removal of losses (time, material, energy, etc.) in the purpose of perserving the environment. Managing supply chain should provide the efficient integration of suplliers, producers, wholesale, warehouses so that the goods are produced and distributed on time, in the precise quantity and to the right place. The ultimate goal of supply chain management is minimizing all apparent losses and system costs.

So, the lean concept is emphasised by the integration of raw material suppliers, producers and buyers. The term integration here means coordination, synchronisation and cooperation of all parts of supply chain on every level in order to have the integrity in a stockholder community. Losses appear in every function of the company but are the most evident in a production one.

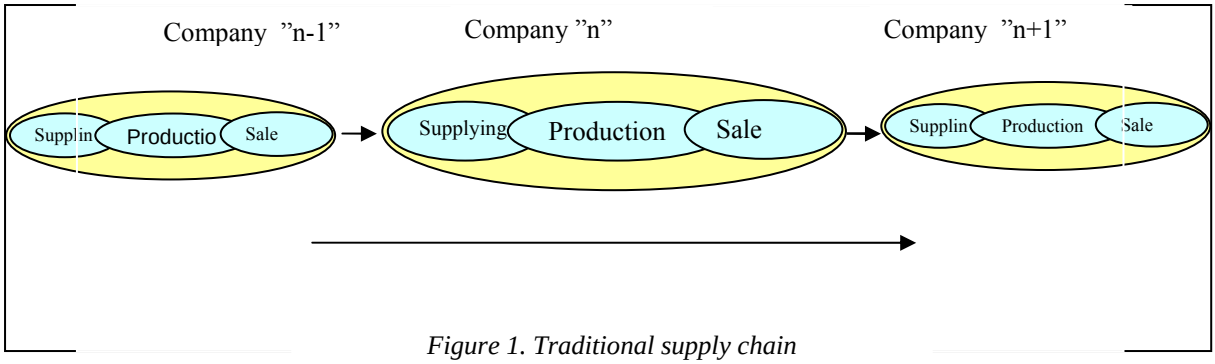

Figure 1. Traditional supply chain

4. LEAN CONCEPT EFFECT ON INCREASING THE LEVEL OF FUNCTIONING THE SUPPLY CHAIN

4.1. Graphic representation of the supply chain

Graphic representation of material and information flow presents the dimensions of loading of certain sections (Value Stream Mapping). Those are collections of all actions inside and outside the industrial system. They represent gradual refining of values of raw material on its way to the final product and its buyer. These actions are the core of succsessful business in the whole supply chain. Flow graphs represent the visual mean of observing all flows of the production system. They help managers to detect the advantages and disadvantages of the projected processes before the final decision is made.

One of the software tools for graphic representation suitable for PCs is eVSM (electronic Value Stream Mapping). This applicative software connected two softwares, Visio and Excel, in a way that is very fast to reach the observed dimensions like: production cycle, lead time, inventory loading volume, polluting and other parameters interesting for projected processes observing.

Flow graphs can be useful as good stert position for companiec which want to introduce lean concept. Graphs' advantages are: (a) can visually show processes in all functions of company and stockholder community, (b) can help to recognize losses, their causes and bearers, (c) they are synonym of mutual language about working processes, (d) provide basis for lean concept implementation.

4.2. eVSM usage with the research results

EVSM usage has been done on a real industrial system[1]. Company condition parameters research has been carried out for lead time, work in process (WIP), energy consumption, waste recycling time, decreasing the degree of polluting caused by transport fuels and time losses. Figure 2. shows the final solution of process of the supply chain in the observed industrial system with stated parameters using the eVSM software [1]. Green colour represents the environmental parameters. Analytical data in the researchs are being found using the factor analisis 2^3 , applying MINITAB software. Directing has been done on three lean tools: (1) LAYOUT, (2) SMED method and (3) TPM method. Stated condition parameters have been observed on two levels. Analisis of their effect on the three mentioned lean tools and their corelation conection have been solved using MINITAB software. It is used to carry out the complete regressive and variant analisis. Regressive equation of the lead time cycle behaviour T_{cp} is [1]:

$$Tcp = 429 - 59.5\ LAYOUT - 6.38\ TPM - 8.75\ SMED \quad \text{..... (1)}$$

Table 4.1. shows the effects after the lean concept introducing in a supply chain of the observed company [1].

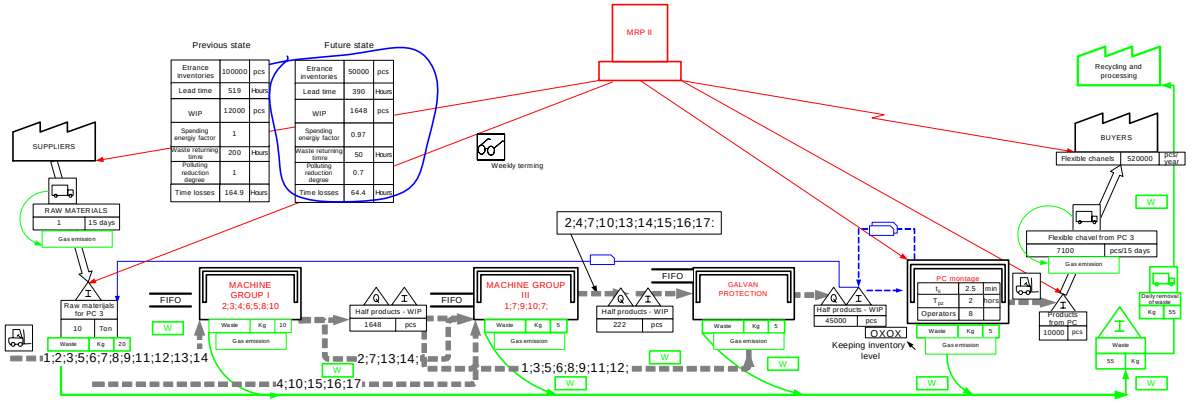

Figure 2. Ekologikal and eVSM graphic of the future state

Table 4.1. Research results of lean concept application in a supply chain

Ordinal number	Process measuring characteristic	Before lean concept establishment (level "-1")	After lean concept establishment (level "+1")	Commentary
1	2	3	4	5
1	Raw material inventory /pcs/	100.000	50.000	Decrased for 2
2	Production cycle time duration Tcp /hours/	519	390	Decrased for 1,3
3	WIP /pcs/	12000	1648	Decrased for 7,2
4	Energy consumption factor	1	0.97	Decrased for 3%
5	Waste recycling time /hours/	200	50	Decrased for 4
6	Decreasing pollution degree	1	0,7	Decrased for 1,4
7	Passive time /hours/	164,9	64,4	Decrased for 2,6

5. CONCLUSION

Lean concept represents group of efficient and rational procedures in a system usage of principles, methods and tools used for detecting and eliminating useless activities (losses and mistakes) in working processes, thus creating conditions neccessary for harmonious company functioning in certain time and existing conditions. Its implementation provides efficient procedures in working processes which have to be constantly advanced and internally for each company standardized and accepted as models in performing working processes in order to acomplish their business excellence. In that way it contributes the the more efficient system of supply chain management and increases the general efficiency of the company's work.

6. REFERENCES

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