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IMPROVEMENT OF MANAGEMENT PROCESS BY USING LEAN SIX SIGMA TOOLS IN SOME BIG ORGANISATION OF FOOD INDUSTRY

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A b s t r a c t

The research had been conducted in some polish production companies that are using Lean Six Sigma tools on daily basis. The aim was to evaluate the impact of Lean Six Sigma tools on the certain management process to eliminate or reduce wastage. According to the results it can be stated that Lean Six Sigma tools have positive impact on the management process by controlling internal costs. Cost reduction influences the increase in profit margin what can result in achieving the competitive edge.

DOSKONALENIE ZARZĄDZANIA W BRANŻY SPOŻYWCZEJ Z WYKORZYSTANIEM NARZĘDZI LEAN SIX SIGMA

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S ł o w a k l u c z o w e: Lean Management, zarządzanie wyszczuplające, Lean Six Sigma, ciągłe doskonalenie, przemysł spożywczy.

A b s t r a k t

Badanie zostało przeprowadzone w przedsiębiorstwach produkcyjnych usytuowanych na terenie Polski, które w codziennej praktyce stosują narzędzia Lean Six Sigma. Celem była ocena wpływu narzędzi na doskonalenie procesu zarządzania. Wyniki badań potwierdzają, że narzędzia Lean Six Sigma pomagają świadomie kontrolować koszty wewnętrzne w firmie, co pozwala na ciągłe ulepszanie procesu zarządzania. Ponadto, zmniejszenie kosztów własnych jest jednym z czynników wpływających na zwiększenie marży, która może zapewnić przewagę konkurencyjną przedsiębiorstwu na dzisiejszym, bardzo turbulentnym rynku.

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Introduction

A constant price increase of raw materials and decrease of profit margin led production companies in food industry into crisis (FORKUN and KINAST and ORZEŁ 2011). Profit margin is directly influenced by price as well as direct and indirect costs of a company. A company has no influence on the price of raw materials needed for production which form an indirect cost. Therefore, if a company wants to stay on the market it needs to control its own costs, which were defined by Ohno as „7 Muda" (LISIŃSKI and OSTROWSKI 2006). Wastage is defined as all activities which generate costs and do not add value: overproduction, inventory, waiting, motion, transportation, defects and over processing. The antidote for muda is to implement Lean Six Sigma tools, which aim to identify, reduce and eliminate all wastage.

Aim of the study was to verify and evaluate Lean Six Sigma tools and their influence on improvement of management in chosen production companies in food industry. Leading and operating an organization successfully requires managing it in systematic and visible manner using „a tool to allow an institution, regardless if it is a company, church, university or hospital, achieve their goals in an outside area in which it operates" (DRUCKER 2000)

The essence of Lean Six Sigma

Japanese Lean Management philosophy and American Six Sigma concept were evolving separately until it has been decided that Lean Management on its own is not able to provide stable processes and sole Six Sigma will not eliminate all waste. Only then was a new integrated approach developed called Lean Six Sigma (GEORGE 2002). The Lean Management tools focus on speed and efficiency of a process, while those of Six Sigma on its precision and accuracy (LAUREANI and ANTONY 2009). It can be stated, therefore, that Lean Six Sigma is focused to increase quality, reduce variability and eliminate any wastage from company (FURTERER and ELSHENNAWY 2005).

The main aim of the philosophy is to please a customer, i.e. to provide reasonably priced, high quality product/service at short notice (GOERGE 2004). To do that, process needs to be enhanced. All defects i.e. everything which does not satisfy a customer must be removed from the process.

Moreover, material and information flow must also be leaned which will eliminate buffers/lines. Employees who cooperate on every stage of the process are an important aspect of Lean Six Sigma. Group work is about mutual assistance, sharing ideas, collective problem solving and making thoughtful decisions. According to Lean Six Sigma every decision is made on the basis of

real data and facts. Data is being gathered, measured and analyzed. In agreement with Lean Six Sigma companies should gather and analyze data on customer's satisfaction, company's financial status, speed of the process and defects.

Chosen Lean Six Sigma tools

Lean Six Sigma uses a set of tools of Lean Management philosophy and Six Sigma concept. In every stage of a process based on DMAIC model (Define, Measure, Analyze, Improve, Control) companies use various tools. The choice of tools is not forced by the concept, therefore, companies depending on their character (structure, size, branch) choose their own set. Because of the fact that Lean Six Sigma tools are numerous, the article will describe only the most popular ones in the authors' opinion. Methodical approach to Lean Six Sigma implementation, however, allows the use of an ordered chart from ISO

Table 1

Typical Six Sigma tools according to ISO 13053-1: 2012 Quantitative methods in process improvement – Six Sigma – Part 1: DMAIC methodology

Tool	Define	Measure	Analyse	Improve	Control
CTQ (Critical to Quality)	O	O		O	O
Financial justafication	O				
Project review	O	O	O	O	O
Chat review	O				
Six Sigma indicators	O			O	
Data colection plan		O			
MSA (Measurement System Analysis)		O	O		O
Probability distribution		O	O		
Defining sample size		O	O	O	
FMEA (Failure Mode and Effects Analysis)				O	
Control plan					O
5S				S	S
Poka-Yoke				R	R
SIPOC (Supplier, Input, Process, Output, Control)	R			S	
Pareto chart	S	S	S	S	
Value stream mapping	R				
Regression and correlation			R	R	
Hypothesis test			R	R	
TPM (Total Productive Maintenance)				S	S

O – Obligatory, R – Recommended, S – Suggested

Source: ISO 13053-1: 2012 Quantitative methods in process improvement – Six Sigma – Part 1: DMAIC methodology

standard document 13053-1: 2012 *Quantitative methods in process improvement – Six Sigma – Part 1: DMAIC methodology,* where a set of tools have been aligned with 5 stages of DMAIC concept (Table 1). The table contains only those tools from the Standard, which should obligatorily be used in DMAIC implementation and tools which according to the authors are most commonly used in enterprises, and are recommended or suggested to use by the Standard.

DMAIC model (Define, Measure, Analyze, Improve, Control)

DMAIC concept is a methodical approach to Six Sigma implementation, yet in a survey poll made in enterprises it has been treated by the questioned personnel as one of the tools. The aim was to determine if the concept is used in practice in connection with the set of 31 recommended tools regarded as indispensable, recommended or suggested in the ISO Standard 13053-1: 2012.

DMAIC model is used to improve organizational processes and remove problems. DMAIC model helps to identify a problem, determine key measurements, implement solutions, set procedures and finally control implementation process and allow continuous improvement. DMAIC cycle is focused on continuous improvement of the process to meet the needs of a customer. The model consists of 5 stages: Define, Measure, Analyze, Improve, Control. Define stage determines key characteristics of a product from a customer's point of view by the use of e.g.: „voice of the customer". On the basis of results project team decides which process shall be improved, what the problem and the target are. A visual effect of the define stage is a map of temporary process which can be created with the use of e.g. SIPOC tool (Supplier, Input, Process, Output, Customer). The second stage – measure – aims to determine key measures of the process and gather necessary data. Next stage – analyze – aims to determine a source of variability basing on data gathered in the previous stage. All the bottlenecks and limitations in the process are identified. During the fourth stage – improve – all possible solutions are determined and the best option is chosen. The solution is being implemented as a pilot project. Moreover, a map of a future, improved process is prepared. The last fifth stage – control – aims to determine if the assumed target has been achieved. If the implemented changes are efficient, standards and procedures must be determined. During control stage control charts are often used.

Value Stream Mapping

Value stream mapping is a method of presentation material and information flow. It allows identification of all activities from the moment an order had

been made by a customer until it is delivered. It also presents both activities which add value and those which don't. Activities which do not add any value and are not indispensable for company to operate on the market must be eliminated.

Value stream mapping can be divided into two key stages (SOBCZYK and OLEKSY 2011):

– creation of a map of current processes for a chosen group of products, which will be amended to include all necessary information on the current condition,

– creation of a map of a future condition, which is a vision of desirable condition.

Visualizations

Application of visual control allows employees to act immediately to any problems, distractions, production delays and any deficiencies that occur. The condition of a production system must be clear and simple and understandable for every employee, therefore, all necessary tools and parts should be stored in a visible place. Visual control requires also a simple work manual to be present at every work station. 5S is the most important method of visual control. 5S is a tool used to build and maintain a well-organized, clean, efficient and high quality work station. The use of 5S is not limited to production, but works just as well in other departments e.g. administration. 5S method is often accompanied with other Lean Management tools such as: TPM, SMED, Heijunka, Kanban, standard working conditions or Jidoka.

The name 5S comes from five Japanese words:

1S Seiri – Sort i.e. sorting out the required or not required items, removal of non required items.

2S Seiton – Storage i.e. work station arrangement, assignment a proper place and logical organization to every object in order to make their use easier.

3S Seiso – Shine i.e. maintaining a clean work station on daily basis to improve work safety and detect process distractions.

4S Seketsu – Standardize i.e. creation of work station standards to maintain the conditions created by the first three rules.

5S Shitsuke – Sustain i.e. to adhere to 5S principles by means of audits, work inspections or visualizations of the results of 5S teams.

Poka-yoke (Mistake Proofing)

Poka-yoke technique is used to avoid mistakes. It works in all processes where human error may occur. It is assumed that every person makes errors, therefore, attention must be drawn to minimize and eliminate them. An efficient Poka-yoke mechanism should be simple (simple control and measuring devices situated in the vicinity of an error) and cheap to install.

TPM (Total Productive Maintenance)

TPM is defined as „a method for improved machine maintenance performed throughout whole company by operators and employees responsible for traffic control" (CZERSKA 2006). The major target of the method is „zero breakdowns and zero defects" caused by machines. An efficient TPM will improve equipment efficiency, prolong machine life expectancy and increase employees' involvement.

TPM has nine stages of activity (CZERSKA 2006):

1. Evaluation of the current condition using OEE (Overall Equipment Effectiveness). Machine efficiency is measured basing on its performance in: availability (active work of a machine), use (planned percentage usage) and quality (of produced goods).
2. Determination of initial problems.
3. Analysis of physical conditions of actions, based on observation of work station in the aspect of identified problem.
4. Identify variable conditions which influence the work of a machine.
5. Possibility to regulate and deregulate machine basing on conclusions gathered through earlier stages.
6. To determine vital elements in a machine, their control and means of repair.
7. Results control.
8. To determine rules of control and machine repair, as well as the range of machine operator responsibilities.
9. Improvement.

SMED (Single Minute Exchange of Dies)

SMED is a method for reducing tool changeover time to a single-digit minute. A key factor in this method is to separate operations into (CZERSKA 2006);

internal – not possible to perform when a machine is running
external – possible to perform when a machine is running.

SMED main stages (MARTYNIAK 1996):

1. Preliminary stadium, a very detailed analysis of changeover process and developing ideas how to improve them.
2. Separate external from internal changeover is made in order to reduce time of internal changeover.
3. Convert internal changeover into external one by additional analysis of activities and their belonging to a particular type, and also search for new means of conversion internal changeover into external one.
4. Streamline all aspects of changeover operations. Another attempt to find additional ways to reduce changeover time after analysis of implemented changes, separation and conversion internal changeover into external one.

Methods

Research has been conducted with use of a poll questionnaire sent by electronic mail to Lean Six Sigma specialists. Specialists are representatives of food industry production companies, who were found on Goldenline portal. The respondents had been grouped as follows: Lean Management, Six Sigma, Lean Six Sigma. 30 questionnaires were sent to 30 representatives of different food industry production companies.18 out of 30 were replied. 100% replies came from large food industry production companies (over 250 employees). Additionally, individual face to face interviews were run with 4 Lean Six Sigma specialists and trainers who deal with implementation, maintenance and improvement of the philosophy in 4 different production companies on daily basis.

Results

The research indicates that the tools most often used by companies are: 5S, Kaizen, Pareto Diagram and Ishikawa Diagram (Figure 1, 2). 5S and Kaizen are the tools which companies use to start to implement the philosophy, because they give visible results fast at relatively low implementation costs. Moreover, they do not require specialist knowledge to implement, as oppose to e.g. implementation tools for statistical adjustment of data, such as: hypothesis test ANOVA analysis or DOE (design of experiments). Three quarters of the respondents uses TPM, SMED, VSM and DMAIC, more than half uses standardized work, voice of customer and process mapping. Half of the

questioned companies uses control charts, FMEA, histogram and control charts on daily basis. A surprising fact is that few companies use JIT and Jidoka), which are a basis of Toyota production system. JIT aims to eliminate stock, while Jidoka aims to eliminate production flaws. Experts say JIT and Kanban should be supported by Heijunke, and Kaizen shall go together with standards. Typical Six Sigma tools (SIPOC analysis, FMEA, DMAIC, VOC) are less popular in companies, therefore, it may be concluded that companies' first priority is to increase speed and efficiency of a process, while elimination of process variability is of secondary importance. This may be a result of the specific character of production processes in food industry, where products' best before date is very short, therefore speed and throughput are vital and both are guaranteed by Lean Management tools.

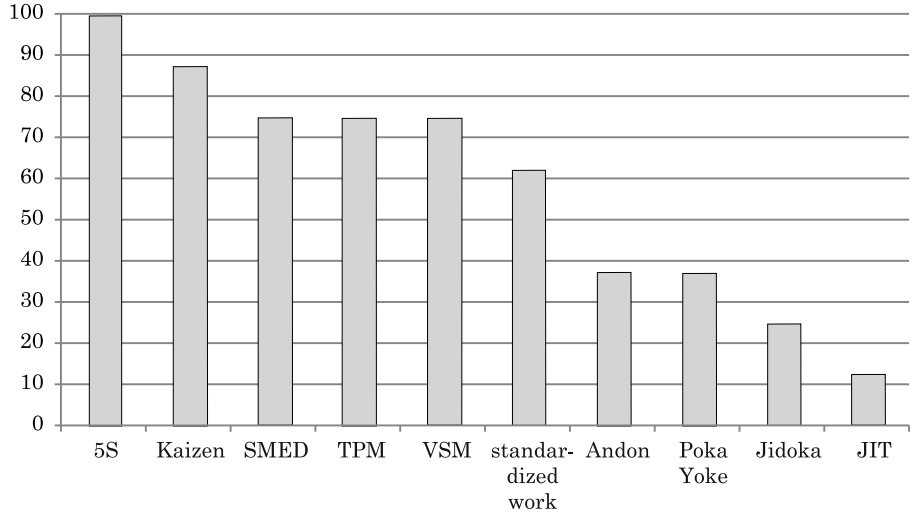

Fig. 1 The most commonly used Lean Management tools by production companies in food industry
Source: Own source

Most companies, (Figure 3) seem to follow the words of dr Mikel J. Harry: "If we do not measure, we do not know anything. If we don't know, we cannot act. If we do not act, we are prone to lose" and Lean Six Sigma methodology, and measure efficiency and productivity of their activities. Financial factor is the most frequently measured factor which seems to confirm that profit is what companies' owners care for the most. Less than half of the questioned companies do measure customer's satisfaction, which is not only a reason to worry but also against Lean Six Sigma assumption that a customer is most important. Only less than half focus their actions on customers' needs analysis

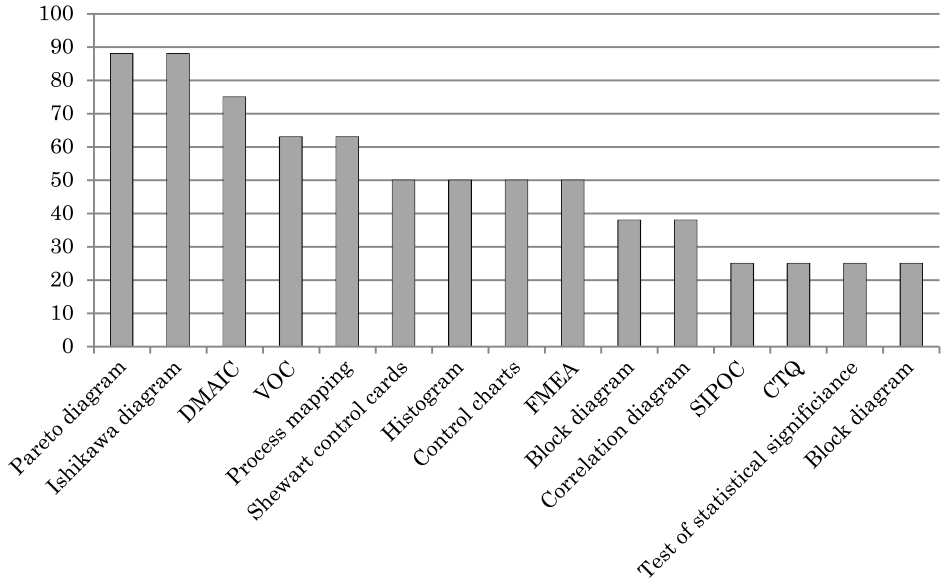

Fig. 2 The most commonly used Six Sigma tools by chosen production companies in food industry
Source: Own source

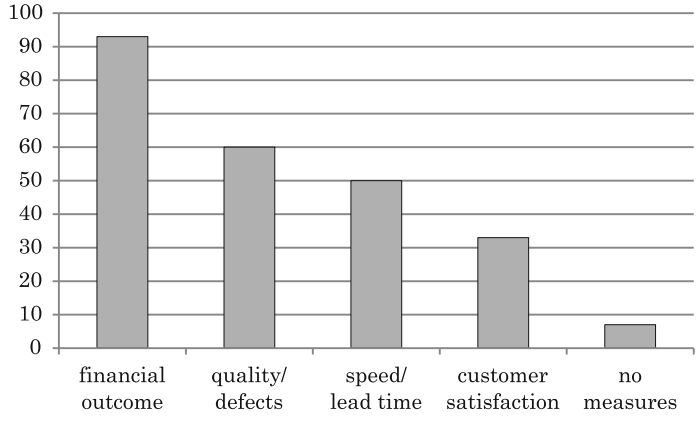

Fig. 3 Efficiency and effectiveness indicators of Lean Sic Sigma tools

Source: Own source

(Figure 3). More than half respondents do measure defects, 50% the speed of a process i.e. factors such as Lead Time or Takt Time. Only 7% of companies do not use any indicators).

The benefits from Lean Six Sigma implementation have also been analyzed. Every interviewed company has noticed positive effects of Lean Management and Six Sigma tools implementation. None of the companies denied positive effects, which confirms usefulness of Lean Six Sigma tools implemen-

tation, despite the fact that not every company fully adheres to Six Sigma rules – only three quarters respondents confirmed their actions are based on DMAIC. Companies which use chosen tools identify a great improvement in group work activities which is one of Lean Six Sigma philosophy pillars. Most of the companies claim their employees cooperate better in a team and see benefit as an improvement in problem solving process and decision making process. 5S has been implemented by all of the companies, as a result most of them noticed improvement in working conditions; increased efficiency and improved safety. Yet other benefits are strictly connected with control and reduction of personal costs. Three quarter respondents claim that their costs decreased, reduced process wastage and eliminated stock which generates additional costs. Half of the companies shortened process realization time, and only less than one quarter cut down time of delivery. For companies from food market, where speed is significant, shortening time of vital processes may result in achieving competitive edge. A surprising fact is that only 37% companies noticed an increase in customers' satisfaction as benefit, while it is a major purpose to implement Lean Six Sigma. It may be attributed to the fact that companies are more focused on processes than on customers directly. In their opinion customers will be satisfied with the quality and speed of delivery, therefore are unwilling to spend additional resource for expanded study on the increase of consumer's satisfaction.

Conclusions

The above mentioned analyses suggest that food producers search for solutions to achieve competitive edge. They take actions on various levels such as: to optimize chain of delivery, eliminate errors caused by processes and machines, eliminate any wastage and increase employees' involvement. For this purpose they most frequently use Lean Management tools: 5S, Kazein, SMED, VSM, standardized work, TPM and Six Sigma tools: process mapping, control charts, histogram, Ishikawa and Pareto diagrams. Lean Management tools are chosen more frequently which may be attributed to a specific character of the business where speed is vital. Companies declare that the use of tools brings positive results such as: cost reduction, stock reduction, wastage elimination, processes time reduction, team work improvement and improvement of problem solving and decision taking processes. The above mentioned benefits confirm usefulness of Lean Six Sigma tools implementation in food industry companies as a tool to improve management.

By the analysis of Lean Six Sigma tools implementation, maintenance and development it may be concluded that the biggest problem is to treat Lean Six

Sigma as a „toolbox" to reduce costs in a company. Companies implement tools without considering the most important factor – change the way of thinking. Companies still first look for the guilty party and only then will they think on how to solve the problem. According to Lean Six Sigma philosophy first priority is to visit the place where a problem occurred (Gemba), then gather employees and think together on a solution. 96% of problems lie inside a process and only 4% are caused by human error (Deming). Employees; fear of changes (POTWORA 2012), based on intellectual, socio-cultural and emotional backgrounds, is an enormous barrier. Employees, on one hand, fear to lose their job, on the other hand, fear additional responsibilities, schemes and structures. The reason why Lean Six Sigma tools are less efficient than they might have been may be caused by: leader's lack of leadership abilities and/or competence, lack of funds for necessary trainings for employees when it comes to competence and qualification increase, not outsourcing a Sensei.

Despite many barriers and difficulties hampering Lean Management and Six Sigma rules from full implementation, it may be stated that particular tools may indeed influence growth of competitive edge in food industry improving the management process. Growth is achieved by elimination of activities which add no value, 7 Muda reduction i.e. conscious cost management. The division of costs into indirect, the costs a company has no influence on, and direct, which are costs that company manages itself by using set of Lean Six Sigma tools, is an obvious sign that a company is improving their management. Moreover, a proper use of Lean Six Sigma tools may increase a profit margin (cost reduction) and improve products' quality which may help company stay on the market during crisis period.

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