

PONENCIA 114

THE WORD CLASS MANUFACTURING AS A PRODUCTION MANAGING SYSTEM IN CERAMIC INDUSTRY

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Abstract

World Class Manufacturing (WCM) is the generalization of commonly known managing system “Toyota Production System”. WCM is the kind of philosophy which organizes manufacturing and logistics, including the interaction with suppliers and customers. This system is known under different names: as Lean Manufacturing and Kaizen as well. It was largely created by the founder of Toyota, Sakichi Toyoda, Kiichiro Toyoda and Taiichi Ohno. System takes some advantage elements from work of Edwards Deming and Henry Ford also. The main goals of WCM are to design out overburden, smooth production and eliminate 7 basic waste (overproduction, transportation, inventory processing, waiting, defects, motion). The main benefits which can be obtain, are: strong reduction of lead time, increasing of productivity (decreasing of cost production), reduction of work-in-progress inventory, improving of quality, reducing of space utilization and all employees commitment. In this paper author want to transfer his own experience and knowledge result form 3 years managing of implementation of this system in ceramic factory.

1. Introduction

WCM program (*World Class Manufacturing*) is well-known but certainly in engineering industry, especially in motor industry, aerospace and machinery industry. Regarding to author's own experience the program can be successfully implement in many different branches (metallurgical : Aichi Steel, ARCELOR, toys: LEGO, electrottools: Bosch, Vulcano Housekeeping: Electrolux, tires: Pirelli, MATADOR) as well as in ceramic industry (TOTO Company, Glassworks Gostynin, SANITEC, EPCOS Piezo Technology, BPB Gypsum).

Let's try to enquire about essence of this program. Its basics is a mix of American and European managing rules with Japanese ones; including in addition of some Japanese national features as national pride, patience, devotion, diligence, care of details, obedience.

In Japan already before the 2nd World War, Sakishi Toyoda (in future founder of Toyota Company), small-scale industrialist and inventor possessed small weave workshop. By observing the looms' work he formulated first rules of this what became a basis of Toyota Production System (WCM, KAIZEN also) namely MUDA and Jidoka and JiT.

In Japanese MUDA means, **waste** but S. Toyoda defined seven types of WASTES (overproduction, inventories, defects, waiting, transportation, motion, overprocessing). The first rule of this new production management system was an elimination of all possible wastes.

Jidoka, has the same meaning as “autonomation” and in term used in WCM mean “automation with human touch” or “intelligent automation”. In this sense, autonomation implement some supervisory functions rather than production functions. In the case of any abnormal situation arises the device stops and the operators can stop the production line. This system prevent the production defective products, eliminate overproduction and focuses attention on understanding the problem and ensuring that it never recurs.

First example of application the idea of “autonomation” and eliminating defects, was invented and patented as a system “semi-activist” of the loom by S. Toyoda (Fig. 1. – from Toyota Museum), which was stopping immediately and automatic after detecting any irregularity in device.

Fig. 1. S. Toyoda's loom first device that owned the

element of WCM (Toyota's museum).



The third idea JiT, has been taken form Ford Factory and developed firstly by S. Toyada and later by Koichiro Toyoda (*son of S.Toyoda*) and Taichi Ohno. JiT (just in time) means “right material in the right place, in the right time and right quantity”. The extension of JiT system are Supermarket and Kanban systems which are common in car or maschinery industry.

After the 2nd World War modern economy did not exist in Japan, it was a strong emperorial system with a feudalistic trends and country was occupied by American forces. When a “Cold War” happened USA needed a strong ally rather than a devastated and hostile

country. It was a beginning of a big reconstruction schedule of a Japan. The industry was rebuilt and new technologies ware transfer. Many managing specialists were sent there (a.q. E. Deming or W. Shewhard), who many times visited Japan in order to teach local industrialists quality management through a standardization and statistic control of a production process. Representatives of a Japan industry studied in USA, they were served a factory apprenticeship. They were acquainted with rules of the mass-production using assembly line and standardization of the production process.

This process lasted a dozen or so years. First symptoms (Table 1) of a quick implementation of foreign inventions and its far going improvements in USA and Europe were ignored, but they showed yet a quick changes in Japan industry. We have to remember that a invention is an idea, sometimes with a operative prototype or a single batch of products and an innovation is a invention implemented into normal production and had a market (outlet).

Table.. 1. Inventions vs. innovations.

Invention	Creator	Innovator
Transistor radio	Regency (USA)	Sony
Video	Amper (USA)	Sony, Matsushita
Rotary engine	Felix Wankel	Mazda
CD player	Philips (Holandia)	Sony

World was freaked out during the first energy crisis in seventies of XX century. Exactly then Japan showed small, economical and first of all foolproof cars to the world. It was a real beginning of the expansion of the Japanese goods to the whole world. How was it possible that non-effective economy can produce so good goods? What was their way to achieve such a high efficiency and low production costs?

During the same time in Europe dominated (and they are still dominating in many places) two several managing elements such as keeping “status quo” and “innovations”. They have particular importance in production companies. First element links to the all activities guided to keep the standards (managing system, technological and production parameters and procedures). It is linked with our mentality and activities which results from overriding managing systems, like ISO. In mane companies, there are Standard Operations Procedures, board makes the policy of the company, mission, and vision, there are made purchase, production, sale and complaint procedures. Later all take care, in order to obey of these procedures. There is a lot trainings, and the managing is based on oriented system: “top to bottom” and worker discipline. The cases of procedures change take a stand seldom and accidentally. Most of time and energy is devoted for maintance of “status quo”.

Second element, innovation is a method of implementation of the changes, but in principle just a big ones. In this way, we are implementing new trends in managing or we make some breakthrough or major change in production. We include, change of the technology (new technology or some new aspects of technology), implementation of new, modern devices on the productionl lines, implementation of new product. In other departments, it would be implementations of new computer system, new methods of cost accounting, financial control etc. Changes like those are usually one big event, which the whole crew is focused on, spending a lot of time. This event is being accompanied by making new standards, linked trainings and finally we come back to

keeping a “status quo”. The truth is, that Japanese have taken all advantages from our system and adding, besides some certain national features, one “small” element: “continous improvement”.

Transfer WCM know-how from Japan to some european and north american countries started in 80-ties of the XXth century, as a result of Japanese investment to a new factories. In Japan, mather-companies already used this modern production managing system and corporaive implemented it in their new plants. Additionally they required similar actions from their cooperates and suppliers. WCM program known under many different names was becoming more popular. In 1982 in Japan there was established a KAIZEN Institute, and in 1996 in WSA Lean Enterprise Institute, both this organizations goals to popular and spread the WCM philosophy.

In Poland WCM history beginning particularly in the middle of 90-ties, and it is linked like in other countries with the entry of the Japanese and western companies and construction of new. There were established Polish branches of KAIZEN Institute and Lean Enterprise Institute. There were arisen many consulting and training companies focused on introduction of the WCM rules, and on the technical universities there are made courses programs in this scope. The WCM Program is becoming more popular, not only in auto and machine companies but also in food industry, chemical, pharmaceutical and ceramic industry also.

2. The tale of WCM in Polish Ceramics Industry

Let us start with one but very important statement. WCM Program is not a kind of panacea against problems in companies, it is not a system ready to immediate implementation. WCM is a some kind of philosophy, long-lasting process, a basic knowledge what to do in order to achieve changes and success. Major advantage is all-purpose, the system can be introduced in every industries, in little and big factory, can be implement to logistic systems, to the offices - practically everywhere. After a period of time, a program spontaneously fits to the requirements and needs of the branch, a specification of the company and people competences. Second advantage is a easy way to achieve an effect of self-speeding up the program, first visible changes activate a growth of involvement and a avalanche of initiatives from shoop-floor employees. Certainly, everythinks under certain conditions.

The biggest weakness and danger of the WCM program is a necessity of engage whole organization (from top management to operators) to its implementation and a hard work to change of the mentality of the workers, and specially change of their attitude towards their work. Until now, workers made what they were told to made, according to the procedures. In new system they are required to take all responsibility for their job, according to the rule: “Make the same thing, but start thinking, what is possible to be made in order to make your job easier, lighter, more effective and better quality. In other words try to show people possible effects, give them tools, teach how to use them and encourage to use them. In authors opinion it is the most important and also the most difficult element of the implementation of WCM Program. The whole idea of this program is based on the people, their cooperation, passing to the line workers all the responsibility and making decisions. We know that only 5 to 10% people accepts changes in their environment quickly, about 15 to 20% are sympathise of the changes, but they waits for the visible results, rest of the crew are sceptical or hostile (this last are about 5 to 10% also). Additionally if we think about vertical managing structures in factories that are used now, the most difficult thing is to convince middle level managers.

Second weakness of the initial period of the implementation, is a long lasting awaiting for the first effects so very important is a visible and active involvement of the top management and careful chose of the initiative implementation area.

In a company, where I work from 2003 to the and of year 2006 as a Production Director, a work using the WCM program began in year 2004 from a meeting with people in charge of realization such program in other companies. A result of this was a possibility to visit glassworks company (also ceramics), in which the program was strongly involved (implementation of SixSigma metrology), although the success was achieved after a second introduction. It was a very interesting experience, initial defeat and later success. Next step, was a tentative presentation for the Board Management about possibilities of the WCM program, and a proposal of a preparation of the implementation of the WCM program, what was approved. Second stage was getting a wider knowledge about WCM, taking part in International Congresses dedicated to these issues. These meetings, especially getting to know and a discussion with many people from many branches of the industry bring some changes in our attitude towards WCM implementation program. New contacts let us to visit some factories which are in order the WCM program implementation such as Toyota in Wałbrzych, Pratt&Whitney in Kalisz, plasterboards producer RIGIPS, CanPack cans producer .

Next stage were meetings with four chosen WCM consulting companies. Those companies made inside WCM audits and Value Stream Mapping in our company. The results of the audits, meeting and visits, which lasted two weeks let us to prepare a schedule and cost estimate of our plans, we also chose a company that should supported a implementation of the program. Additionally we built a small two-person WCM Team - inside Changes Agents and Trainings Coaches. Certainly, Steering Committee was formed with members from Board representatives (CEO and CFO), Production and Logistic Manager, Chief of WCM Team and Factory Manager. The committee during every two weeks meeting, discussed about progress in implementation schedule and made key decisions about the whole program. Indeed, one of steering committee representative always took part in meetings of the production lines team, group leaders, crew trainings and they encouraged rest workers to get to now with WCM program. The full responsibility for implementation was took by the author. The whole schedule of the WCM program implementation is showed in Fig. 2..

Main objectives of the program were:

- elimination of wastes
- production only in accordance with orders
- no device breakdowns
- no production stops
- 100% quality

Some of mentioned above goals may seem abstractive, but "zero" or 100% cannot be a goals ? In Japan during a visit of continuity steel cast lines in Aichi Steel Company, it say us, that 15 years ago there were registered line stops above 2 hours, 5 years ago above 5 minutes, and nowadays to the stops are rated stops of the assembly line above 15 seconds !!!! A opinion if it is a zero of near to the zero a leave to the readers.

3. WCM Programm - KPI's (key performance indicators)

The company I talk about in the lecture is made up of three independent industrial plants built in different times. First one is above 50 years old, second one is almost 30 years old and the most modern one is 8 years old. Older plants were of course modernized, the technology, devices and equipment were changed there, but if we look to the production forces, buildings constructions and internal transport systems they are not comparable. As a pilot area the middle aged one was chosen. It is a plant, which is so technically exploited that he needs a care from Professional Maintenance, and it is so technologically advanced that could be easy to pass any result and experience gained during a implementation of program to both other plants. There were assigned the pilot area, where elements of the WCM program had to be implemented gradually. On this area, there were 10 production lines and it works about 100 workers, who have created separate teams on each line. It was decided to start from following elements: 5S, SMED and TPM. For each element, there were determined convinient KPI one for each elements and one overriding - OEE. This stage was preceded by a series of trainings on the rules of WCM, 5S, SMED and TPM for all the workers of this department, and lately for spontaneous emerged team leaders, ("Soft Skill's" training as a team build, teamwork, a role of the leader in changes etc.). After achievement successes, we went to start implementation gradually: workers ideas system with elements of the continous improvement rules, and finally autonomous maintenance system and TQM.

❖ 5S

The idea of 5S comes from five Japanese words (five tasks), describing the essence of the program:

- SERI – Sort
- SEITON – Set in order
- SEISO – Shine
- SEIKETSU – Standarize
- SHITSUKE – Sustain

In practice it is a separation of the things useful from useless (useless are marked with the red cards and accumulated in the red cards center for 30 days till the moment of their identification and potential application - otherwise they are eliminated). Next, introduction of frequent self-controls of work-place, systematical cleaning up, standardization of the all actions, visualization of all the elements and periodic auditing of the 5S area. In the last stage, monthly for all defined category there is a check of the number of criterions, giving for each points from zero to tree. Average number of points in each category of 5S shows the improvement or lack of work in program. Presentation of the audits results are shown on Fig. 3 (shows a mark of the results on two chosen production lines on the 1st department in July 2005) and Fig. 4 (shows changes of average mark for all pilot area in July 2005 vs. July 2006)

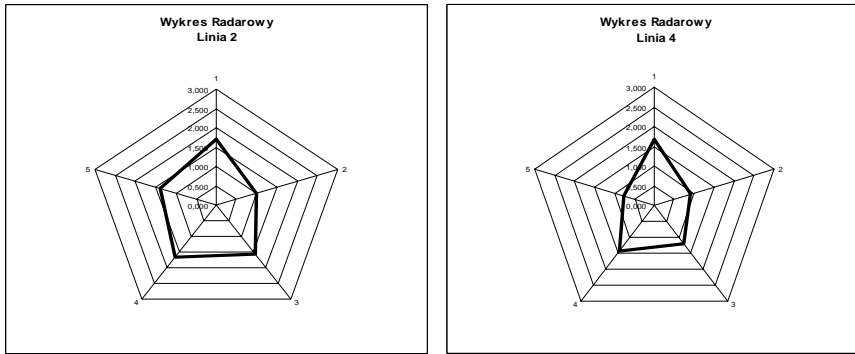


Fig. 3. Results of 5S audits for both production lines in July 2005 after 5 months of program's implementation.

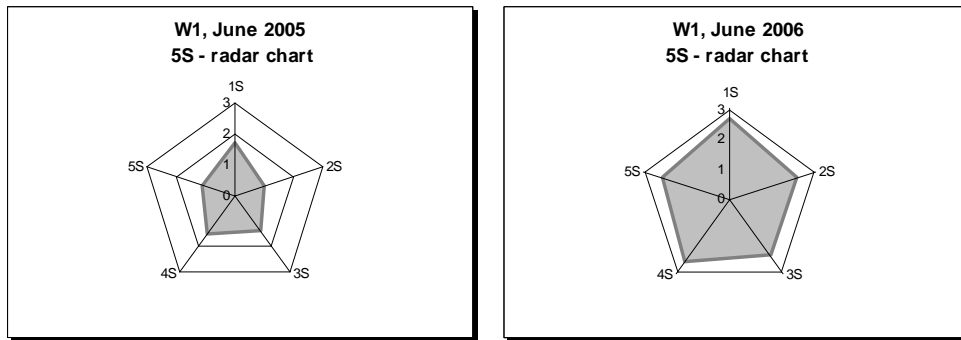


Fig. 4. Results of 5S audits for all 1st department interval 12 months of program's implementation.

Every axis of the graph shows a mark in several categories of 5S program. A short summary, valuation is a measure of the competences and involvement of the departments' workers, who see a chance of their own development as well as plant and business' development. Every month, the best team awards a title of best in 5S and they have a law to display a 5S flag over their area with the inscription: "WE ARE THE BEST IN 5S".

Very important element of the program WCM and every elements is a visualization of the work of each team (progress or reverse), achieved improvement of planned tasks, relations from the meetings, trainings, schedule of meetings. On Fig. 5 are shown samples of visualization - tables of two teams in pilot area.

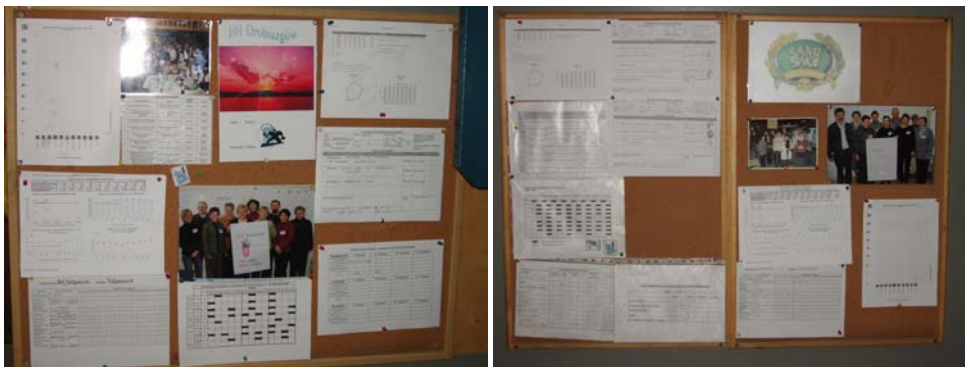


Fig. 5. Information tables of two teams in pilot area during the WCM program.

It is necessary to affirm, in comparison with a quantity of the visualization tables which authors saw during a training for European top management group in Japanese plants of sanitary ware it is just a beginning.



Fig. 6. Examples of the WCM information tables in Japanese sanitary wares plants.

Is necessary to emphasize, 5S program were initially not accepted by the operators or accepted with strong untrusting, after some time period, has big change in their approach to work and WCM Programm.

One more thinks, fully implemented, the 5S Programm, create positive impressions on customers, and increase efficiency and improve internal organization. Not only will employees feel better about where they work, the effect on continuous improvement can lead to less waste, better quality and faster lead times. Any of which will make your organization more profitable and competitive in the market place.

❖ SMED. Single Minute Exchange of Dies

A SMED description is defined in title of the subsection. Exchanges of Dies can mean a change layout of all the production line or its elements, a adjusting of the line's devices to product other assortment or just a change of line's parameters. Every kind of the exchange needs a partly or even complete stop of the production line for some time. Returned to MUDA's idea (waste) it is clear that every stop is a waste, which according to the WCM program principles should be eliminated. SMED program's goal is such reorganization of the exchange process to lead to simple one minute adaptation line to different production. There are many tools used which helps us to analyze of the exchange process, to draw conclusions from and implementation of the new exchange process to the normal practice in plant. Basic and the most frequent is mapping of the process. Commonly it is used a filming of all the exchange using one to tree cameras and than analyzing all the process with its executors. Using a analyze results it is created a new scheme for next process. After new exchanging; again: mapping, analysis, action plan, activity, mapping For every exchange process it is registered KPI defined in advance, in this

case a time of the exchange. After 3 to 5 months the teams are taking the initiative and full responsibility individually organizing a meetings before and after the exchanges, planning actions and discussing for the improvements. Every actions, conclusions, and their results are showed on the tables of several teams and on this stage they are created by the workers.

The results of SMED project on pilot area are shown on Fig. 7 (black column means a reference with average time of the exchanges from year 2004, next columns changes of average exchange times in next months).

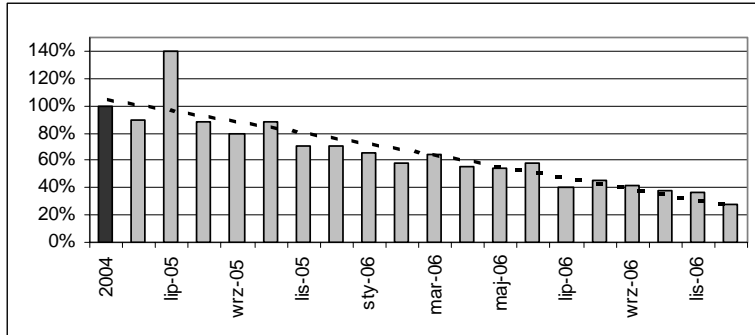


Fig. 7. Changes of average exchange times on the pilot area where the WCM program was implement.

❖ TPM (Total Productive Maintenance)

Total Productive Maintenance means a managing over all devices in company, involving all workers (not only a Professional Maintenance) to keep a continuity of the production through team wastes elimination connected with the any stops, machines and devices breakdowns. Main goals of TPM are: no machine faults, no production defects and no accidents during the work. TPM is a inseparable part of the WCM program, and I know few plants, which base their production managing system on TPM. In simplification we can say that TPM is:

- absolute priority under a maintenance and service of all the machines under a production plan
- teamwork to eliminate stops and faults and finding methods of preventive prevention

It is entirely different, in comparison to traditional, understanding a Maintenance in a factories. Let us remind that in traditional attitude, Maintenance Service in a plant, are to “put to extinguish a fire” if there were a fault, in this was trying to keep the machine part in good enough condition in order to keep a continuity of the production, and a production plans have a priority under a schedule of planned services and maintenance.

Transfer to new role of Maintenance Service is a pass to machines operators more responsibility for the machine park and increasing the knowledge and competences in range of cleaning, service and remove the faults and breakdowns. Last stage of TPM implementation should be a Autonomous Maintenance when it comes to very big limitation of the people or elimination of the Professional Maintenance Service, and whole responsibility for the devices is taken by their operators. Even highly used up equipment, after such change of the attitude shows much better results and production effectiveness mainly through a decrease of quantity of faults and breakdowns what is shown on the Fig. 8.

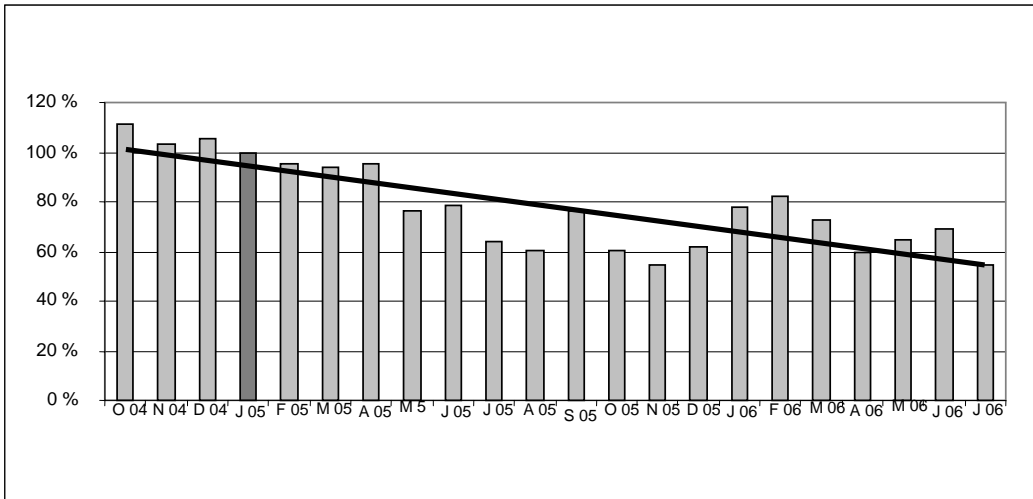


Fig. 8. Changes of the devices faults on the pilot area during an implementation of the WCM program.

❖ **OEE (Overall Equipment Efficiency)**

In every companies, many devices could work more efficient. According to the literature’s givens results that the majority of the devices produces only a half of what could they produce and their the whole use of their productiveness is on the 30 till 60% of ability.

There are many ways to measure how good or how bad several devices work. We often use the indicators as MTBF, MTTR or value of the production in the unit of time. They are good and checked methods but one of their weakness is lack of possibility to benchmark with other companies from the same branch and from the every other branch. The universal method that let us compare the devices, lines, production processes, plants and companies is making a coefficient OEE (Overall Equipment Efficiency).

OEE is a method of quantitative show of the wastes results connected with different kinds of the stops. micro stops, and decreases of the device work speed that affect with effectiveness and thereby a efficiency of the line, department or plant.

If we talk about the effectiveness of the device we think about equipment that is:

- available for the production for majority of time, and do not having different stops and faults
- effective – works all the time with nominal speed
- produce products with acceptable quality

To avoid optimization of the single indicators we measure “General Efficiency of the Equipment” which is a multiple of tree factors:

- availability (S)
- utilization (O)
- quality (J)

$$OEE = D \times O \times J$$

Changes of the key OEE indicator for the piloting area from January 2005 to November 2006 show Fig. 9.

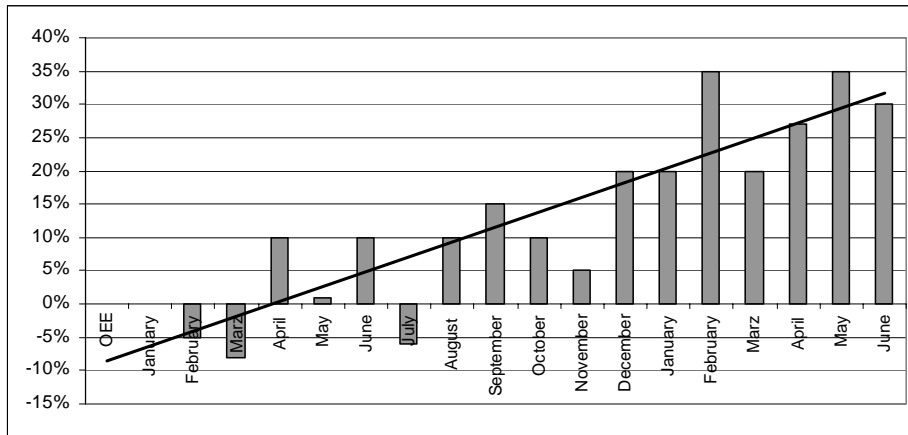


Fig. 9. Changes of the OEE indicator for 1st department coming from WCM program

❖ Workers Ideas Program

Program of the realization of the workers ideas was initiated in April 2006, also on the pilot area. The ideas submitted by the workers, were connected with improvements of the devices, better of the efficiency, easy access to all the device elements, making a work more safety, improvements with the exchanges etc. All the ideas brought many measure effects, let me show that every invested 1€ (if the money were necessary) paid back at least 2€ and maximal 10€ during next 1 to 4 months.

4. Wnioski.

Cocnclusions:

- World Class Manufacturing Program showed in this lecture is a perfect tool to improve efficiency in industry production plants
- Indicators that were presented in this lecture showing the progresses during the implementation of the WCM program in such elements: 5S, SMED, TPM shows profitable changes that occurred in a functions of chosen production department
- World Class Manufacturing Program is one of the most modern and the most efficient system is support of the production managing
- Finally yet importantly, I want to emphasize that WCM program is still changing with our knowledge about this subject, widening our knowledge and the competences of the lines operators. Changes are consisted in constant adapting of the program to needs, modifications of the schedule, but not a delay of the realization of the tasks, rather adding of the some new elements or their modifications. It does not go to show about a bad start, but conversely, it shows that the program is alive and spontaneously starts to go on coninous improvement of the implementation process. We have to remember to control the program not to surpass our abilities.

5. My advises to Road Map of WCM

If you think about start of the WCM program and you are a beginners of this method read the remarks below:

- Get the sufficient knowledge about WCM program by yourself
- If you know the company where the WCM program is on the high level try to see it, talk with the people who were in charge of implementation (*change agent*), talk with people from the board and with line operators
- Find in your company (or hire) “Change Agent” – with adequately knowledge and experience (*or maybe you are right person*)
- Give him an opportunity to explore more about WCM
- Start the implementation from defining the added value in your company and Value Stream Mapping

- Share with your own experiences with other people and use their pieces of advice – you can only find new helpful solutions
- In big company choose important but not too big pilot area, using it you would be able to show the rest of the crew the basics and rules of the program and you would achieve visible results faster
- Visualize every progress, every success, every problem and show to all the employees
- As fast as you are able try to widen the program to next departments in your company
- Implement the WCM program the fastest you can to all the offices unless it will split-up workers in your company
- Do not pay extras for progress in implementation of the program
- REMEMBER THAT IT IS NOT A TYPICAL PROJECT WITH ENDING DATE AND SUMMARY OF THE RESULTS, IT IS A CONSTANT WORK – CONTINUOUS IMPROVEMENT BECOMES A BIG ELEMENT OF THE LONG RUN EFFECT
- ONLY AUTHENTIC INVOLVEMENT OF THE CREW (FROM COO TO CLEANERS) WOULD BRING VISIBLE EFFECTS

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WCM Programm Objectives	2004												2005											
	V	VI	VII	VIII	IX	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII				
First contact with WCM Programm	■																							
First visit in WCM Factories	■	■																						
Reaching of WCM know-how			■																					
WCM Presentation to Board Management		■	■																					
WCM Assessment Audit, Calling for Steering Committee				■																				
WCM, 5S training for Management (<i>top and middle level</i>)					■																			
VSM - Pilot Area (PA)						■																		
WCM, 5S, TF, SMED, 5S training for floor shop workers - PA							■																	
Official Kick off of WCM Programm - PA								■																
5S Audit's - PA									■															
WCM, 5S, TF, SMED, 5S training for floor shop workers - SA										■														
TPM Presentation and training for floor shop workers - PA											■													
Summary One Year WCM Programm running																			■					
VSM - Second Area (SA)																				■				
Kick off of WCM Programm - SA																				■				
5S Audit's - SA																				■				

Fig. 2. Schedule of the implementation of the WCM program.