

Preventive and Pro-active Ergonomics Influence on Maintenance Excellence Level

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Abstract. The equipment maintenance is an indispensable function in a manufacturing enterprise [1]. The role of maintenance is to reduce business risks in a cost effective manner. Thus achieving excellence in maintenance issues has to be treated as a strategic issue for manufacturing organizations to create world-class-manufacturers (WCM) [2]. In the following papers, the examples of activities realized to achieve excellence in maintenance area in two large companies working in food industry, especially in terms of their ergonomics, safety and employees' health.

Keywords: maintenance excellence, ergonomics, safety, health of employees.

1 Introduction

Maintenance, similarly to other areas of a company, is under continuous pressure of decreasing costs, proving achievements and supporting organization's mission. From a company's points of view, these expectations are logical, as a supportive process, maintenance plays an important role in its functioning and in the same time supports implementation of such concepts like lean manufacturing, just-in-time, total quality control and six-sigma program. That is why, from several years companies take more and more interest in implementation of the Japanese improvement approach called Total Productive Maintenance and defined by Seiichi Nakajima in the seventies of the twentieth century. TPM is an approach to management which involves all the employees in providing continuous production by team work in eliminating losses by focusing on customers' requirements and making profits. In TPM, operators perform basic equipment repairs and team of maintenance staff re-design and reconfigure equipment to make it more reliable and easier to maintain. Ensuring equipment reliability, preventing human error, and eliminating accidents are the basic tenets of TPM [6]. TPM is not a universal tool, suitable for each company. A company has to develop its own plan, which includes requirements and problems characteristics for

their processes, branch, production methods and type and condition of resources [5]. This is why in business practices both, classic approach to TPM, promoted by Japanese Institute of Plant Maintenance, and models realized according to World Class Manufacturing strategy are used. Disregarding the model organization has decided to choose, the common feature of initiatives taken by a company to achieve maintenance excellence is managers involvement, team work, hazards prevention, work methods improvement, work environment improvement and trainings and workshops for technical staff, to increase their competences (knowledge and skills) in techniques, safety, health and ergonomics.

2 Examples of Activities Taken by the Companies Analyzed

2.1 A Case Study – Poznan Brewery

Poznan Brewery with Tychy Brewery and Bialystok Brewery together create Kompania Piwowarska S.A. (Brewery Campaign) – a company which is the leader in polish brewery market and a part of the SABMiller group, the second beer producer in the world. The brands produced by the Kampania Piwowarska include: TYSKIE (Polish most favourite beer), ŻUBR (the second best sold brand in Poland), LECH, Dębowe Mocne, Pilsner Urquell, Redd's, Grolsch, Miller Genuine Draft and Peroni Nastro Azzurro. It is the largest producer of beer in Poland and its modern technology and strict principles of performing manufacturing processes (World Class Manufacturing) guarantee the highest quality of its products. World Class Manufacturing idea was launched in 2000 after decision concerning TPM implementation was made. Continuation and consequence of these decisions is an innovative WCM program started in 2007 and called in SABMiller “Manufacturing Way” (fig.1).

All the elements of the model are connected and related creating a system guaranteeing continuous and repeatable realization of the best practices and continuous improvement. General characteristics of the “5S & ergonomics” pillars are presented in the table 1.

Table 1. Characteristics of the “5S & ergonomics” pillar

Pillar	Description
5S & ergonomics	<p>General: the pillar is to change the way of thinking about the work performance. It encourages people to feel personally responsible for safety and provides them with tools enabling realization of such approach. To make their actions fully efficient, employees should be encouraged to use the methods and techniques, they have to believe they can use them and prove the tools are efficient.</p> <p>Relation with maintenance processes: integration of technical capabilities of the maintenance department and interpersonal capabilities and Basic knowledge on ergonomics resulting in improved efficiency of Communications and safety of service processes</p>

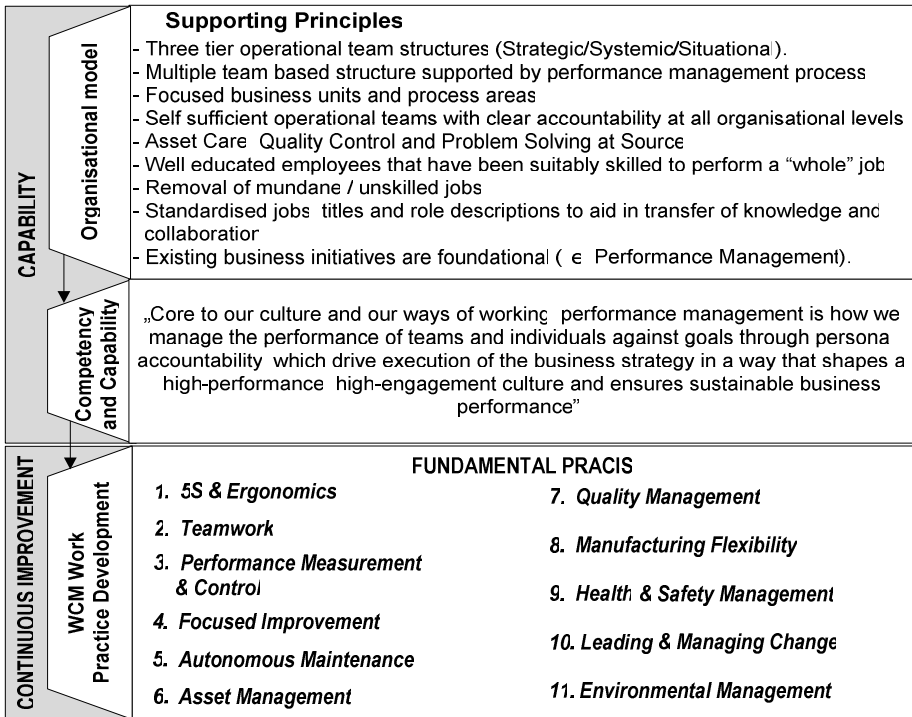
VISION: TO BE THE MOSTADMIRE COMPANY IN THE GLOBAL BEER INDUSTRY

Fig. 1. “Manufacturing Way” – Model WCM SUBMiller

The tool enabling assessment of advance and improvement is „Self-Assessment Checklist”, in which for every pillar (from the 1st to the 11th) the themes of assessment have been defined. Each of the themes is analyzed with respect to the level of fulfilling the predefined criteria and the level of excellence of practices realized is assessed. In the organization five levels of excellence have been defined with the lowest: basic – 1 to the highest: innovation – 5. Requirements are assessed in a very simple way: Yes / No (as presented in the table 2).

The final assessment of each mode is a sum of results obtained in each of the eleven pillars. “Manufacturing Way” project is supported with numerous trainings, and their efficiency is assessed with, among others, number of improvements suggested by employees and implemented. The examples of initiatives developed by operators and employees of maintenance department and realized in the company are presented in the figure below. “Ideas Campaign” on the other is a project developed in Poznan Brewery and striving for higher motivation of employees by promoting operational excellence, exceptional involvement and achievements. The program is organized by the Production Development Department. Each employee can present an idea individually or with a team. Criteria taken into consideration when giving rewards are the following: costs decreasing, efficiency improvement (of processes, time or work organization), ability to use and implement solutions suggested in other locations of Brewery, products and services

Table 2. Example of assessment schemes: Theme „Strategy”

5S & Ergonomics	Theme	Stage	Example of characteristics to be assessed
Strategy		2 Awareness	All team members have undergone practical 5S training, emphasizing 'making work easier' through basic ergonomics such as MODAPTS (Modular Arrangement of Predetermined Time Standards). Relevant links, interfaces and <i>for</i> integration with other work practices are clearly articulated & understood (e.g. Autonomous Maintenance, Safety-Health-Environment (SHE))
		3 Foundation	The 5S master plan has been reviewed and refined to focus more extensively on equipment cleaning and equipment condition. e. g. integration with Autonomous Maintenance. There is evidence that basic ergonomic concepts (e. g. MODAPTS) have been applied to 5S improvement projects.
		4 Development	The 5S master plan has been reviewed and refined to focus on causes of dirt; causes of wasteful motion or ergonomics; causes of difficult cleaning conditions; causes of cleaning requirements Defined methods and procedures exist to identify ways to ensure equipment. files and supplies are up to date and ready for use .
		5 Innovation	The 5S master plan has been reviewed and refined to eliminate causes of dirt; causes of wasteful motion or ergonomics; causes of difficult cleaning conditions; causes of cleaning requirements There is evidence of an ongoing review of safety, health and environmental date for identification of potential ergonomic projects

quality improvement, safety and hygiene of work level improvement, environmental issues improvement, operational excellence and/or exceptional involvement and/or extraordinary achievements and other, bringing benefits to the company.

Employees of Techniques Department and Maintenance Department actively take part in the program presenting their own ideas and realizing ideas of employees of other departments (fig. 2).

a)



Fig. 2. Improvements in bottling line: a), washing and disinfection liquids preparation (before and after changes implementation), b) set-up, c) tools availability (a key regulating height)



Fig. 2. (Continued)

2.2 A Case Study – Unilever Polska S.A

Unilever products are chosen every day by 2 billion consumer. Unilever Polska Sp.z.o.o. is a leader of the Polish market of cooking products, including soups, fixes, instant dishes etc, as well as margarinnes, teas, ice-creams, cleaning products and hair-care products. To meet requirements of Polish consumers, four facilities strive for reaching planned capacity and production level (Banino – producing ice-cream, Bydgoszcz – chemical products, Poznan and Katowice – foods and teas) with over 3000 people employed. .

Improvement strategy TPM, which has been realized in the company (the organization was awarded with the Award of Excellence by JIPM), is based team work and 5S practices. They are the base for nine pillars including: Autonomous maintenance (AM); Focused Improvement (FI); Planned Maintenance (PM); Quality Maintenance (QM); Safety, health and environmental (SHE); Training & education (T&E); TPM in support departments (TPM in SD); Early equipment management (EEM); Customers service (CS).

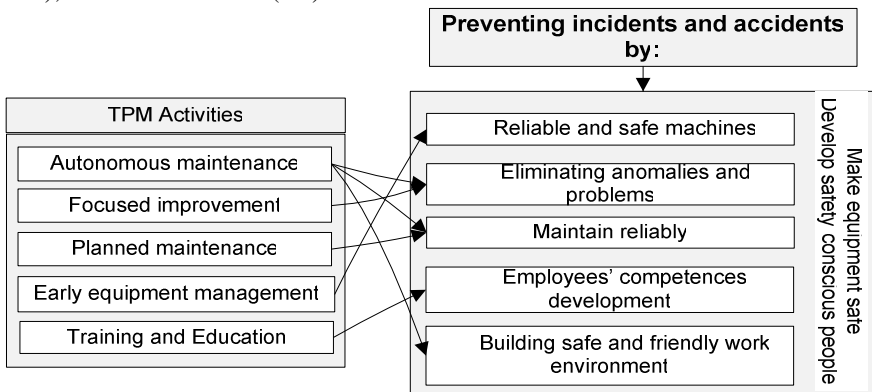
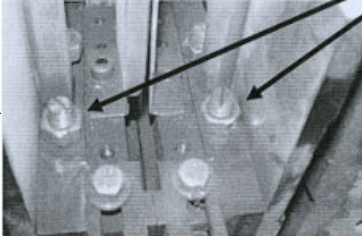


Fig. 3. TPM Activities and safety. Adapted from [6].

The main goal is achieving “zero” culture, which is in this case “zero failures”, “zero complaints”, “zero accidents”, “zero losses” and “zero problems with quality”. Each of the pillars listed above contribute to achieving the „zero” goal, f.ex. through application of 5S principles eliminates leaks and spills and makes workplaces clean, tidy, and well-organized, autonomous maintenance and focused improvements eliminate unsafe areas (fig. 3).

“Autonomous maintenance” pillar includes the following issues: team work (operator, mechanic and electrician together take care for machines and other devices to produce high quality products at reasonable costs), bringing optimal work conditions back (installations without defects, easily conservable, clean, operating according to technological and quality specifications), maintain optimal work conditions (systematic inspections, cleaning, planned lubrications). As a result of involving employees in improvement action, a system of initiatives development “Kaizen” has been developed. Participation of employees in work environment

a)

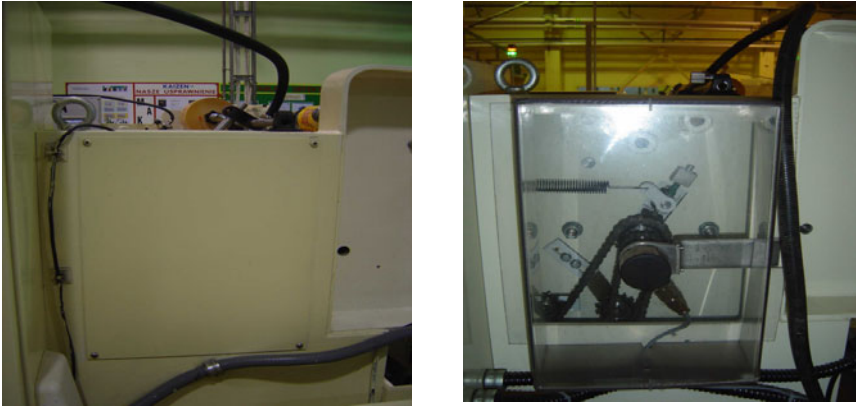
SPEEDY KAIZEN		Regulation of the device “X”	
Problem and measurable losses:		Causes for the problem	
No opportunity of checking the screw fitting the device in the front no opportunity to regulate it Operation is time-consuming and dangerous			1 Construction of the device makes regulation of the screw practically impossible 2 Location of the screw is difficult to reach and dangerous because of the heat
It is necessary to make the pins longer so that they reached the fitting area Before the change regulator took 2C after 8minutes only			Verification positive
Suggested solutions, measurable benefits		Verification of the causes	

b)



Fig.4. Examples of improvements through “Autonomous maintenance”: a) “Speedy Kaizen”, b) Improvement of Hard-to-access areas. Packing machine – Horizontal deployment, c) Transparent covers

Fig.4. (Continued)



improvement is especially valuable as employees know the problems connected with their work best, and being well prepared (thanks to trainings realized as a part of the Training & Education pillar) they can, and want deal with them. The solutions and improvements suggested by employees are realized, depending on their range, realization time and investments required, with such tools as so called “Sheet success”, “Speedy kaizen” or “Big kaizen”. Examples of “Kaizen” activities are presented in the figure below (fig.4).

In TPM, **SHE pillar** is the most important one. In this area focus is on to create a safe workplace and a surrounding area that is not damaged by their process or procedures. This pillar will play an active role in each of the other pillars on a regular basis. The aim is to achieve zero accidents. Two factors help people acquire a zero accident – daily practice as part of workplace and strong, visible companywide support.

The idea of SHE pillar developed in the organization is based on the assumption of parallel improvement of two areas (as presented in the figure below): operators’ and technical staff’s technical culture (referred to as a safe work environment – “7 steps” program) and safety culture (referred to as shaping quality through trainings, observation and workstations monitoring – currently realized with “SHE Champions program”(fig. 5)

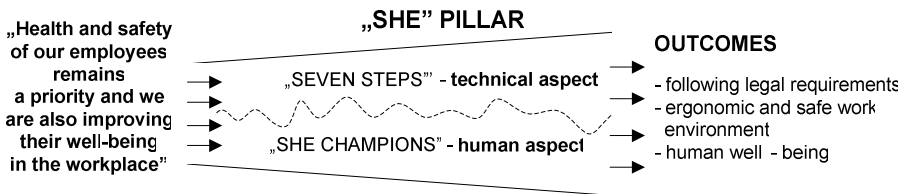


Fig.5. Model of the “SHE” pillar

The Champions program is a continuation of the two programs, realized from 2000 till 2009: “Safety month” and “I am your Archangel”, which were striving towards building knowledge and awareness among employees, shaping proper and correct behavior and elimination of dangerous activities by using so called “library model” (as presented in the fig. 6)

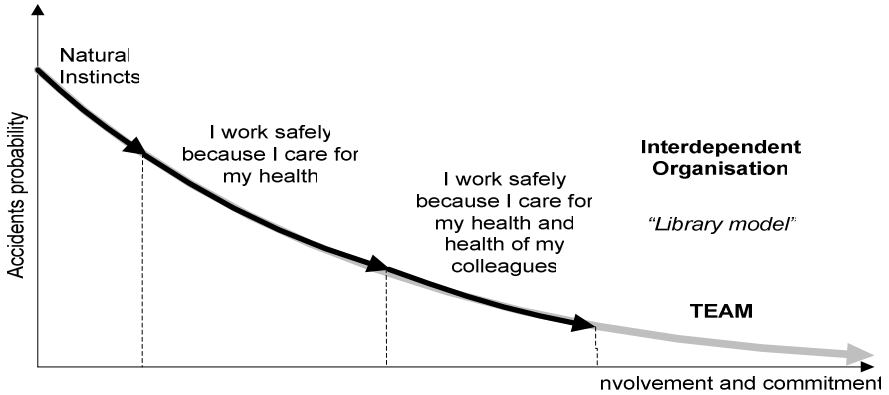


Fig. 6. Safety culture development model. Source: [4]

The goals of the launched in 2010 “SHE Champions” program are the following:

- Identification of safe and risky behavior at workplaces;
- Reaction to improper/ risky behavior (information concerning proper and improper behavior is each time given to the employee operating the workstation analyzed),
- Elimination of risky behavior.

Planning, realization and assessment of activities included in the „SHE Champions” program follows the scheme presented in the figure 7 below.

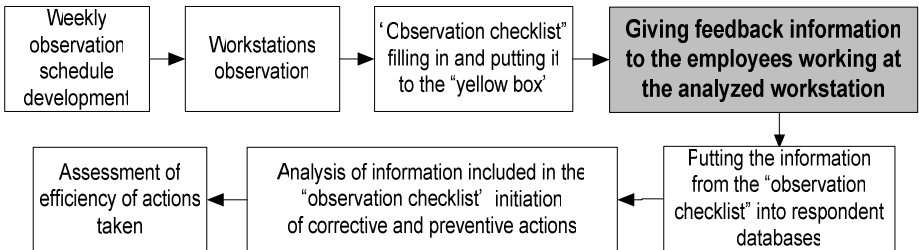


Fig. 7. Planning, realization and assessment of behavior at workplaces

The program is realized for All the Workstation of the organization and the assessment is performed by trained observers. Each of the observers has been trained behavioral observation by internal safety and hygiene of work staff supported by external experts,

based on Du Pont system. The training included theoretical issues and practical skills training performer at workstations. The observers are operators as well as top managers (f.ex. CEO is the observer and is obliged to make one observation a week). Top managers commitment, both in trainings and observations, proves their positive attitude and stresses the importance of project proving priority of safety issues in corporate strategy.

Workstations observations take generally 15 to 30 minutes, depending on SHE Champion's experience. Workstations observations take generally 15 to 30 minutes, depending on SHE Champion's experience. The tools used during observation include checklists developed by internal safety and hygiene of work staff. After observation is finished, there are meetings organized to analyze observation cards and opportunities of changes implementation. Many employees are interested in participation in the program and taking the role of the SHE Champion and increased number of Kaizen initiatives is observed and implemented.

Authors notes

“DuPont System” is a program of courses and interactive training Safety Training Observation Program (STOP™), which strive for “zero injuries” and „zero incidents”[6]. It is top-down and job-focused interactive approach that helps employees to think about safety, allowing it to become fully integrated into what they do every day. The goal is to develop a culture of anticipation by focusing on behavior.

The program of courses and training includes, among others, the following modes:

- STOP™ For Supervision focuses on: regular spontaneous safety observations and frequent scheduled safety observations; everyday safety as well as observing; Conditions as well as actions of people, safe and unsafe; communication about safety every day, not just while observing, an educational approach
- STOP™ For Each Other focuses on: everyday safety – not just auditing, safety of co-workers, conditions as well as actions, peer-to-peer communication, an educational approach,
- STOP™ For Ergonomics focuses on: hazard awareness; risk identification (observing for ergonomic risk factors: static posture, awkward posture; forceful exertions; repetitive motion; contact stress; and vibration; injury prevention (preventing injuries related to musculoskeletal disorders (MSDs) and the suffering they cause; an educational approach.

The tool suggested to be used when making observation is Safety Observation Card, on which observers put their remarks and conclusions referring, among others, to: reaction of people (adjusting personal protective equipment, changing position, rearranging job, stopping job, attaching grounds, performing lock), personal protective equipment (head, eyes and face, ears, arms and hands, legs and feet, trunk, respiratory system), positions of people, tools and equipment

3 Summary

Human mistakes emerging from lack of knowledge, improper work conditions and improper tools use, during service operations (set-ups, conservation, repairs etc) and during its work, can cause threats for both operators and other employees who stay in its neighborhood. Thus, it is necessary to build employees' awareness and promote

good practices in the area of safety culture. Implementation of safety procedures and safe work systems should be supported with activities striving towards safe behavior shaping, trainings and spreading useful information. System approach to safety issues with special reference to employees' and managers' participation is one of the well known ways for safety culture creating and including ergonomics in everyday activities. These elements are part of practices used in both facilities.

Acknowledgments. The authors wish to thank to Mr. Dariusz Luczak, Maintenance Manager, Mr. Tomasz Miazek, Manufacturing Development Manager in Poznan Brewery and Mrs. Monika Baranska Unilever Polska S.A .for help and cooperation.

References

1. Ahmed, S., Hassan, M.H., Taha, Z.: TPM can go beyond maintenance: excerpt from a case implementation. *J. of Quality in Maintenance Engineering* 11(1), 19–42 (2005)
2. Brah, S.A., Chong, W.K.: Relationship between total productive maintenance and performance. *International Journal of Production Research* 42(12), 2383–2401 (2004)
3. DuPont Sustainable Solution, <http://www.coastal.com/dupont-stop/dupont-stop>
4. Nakajima, S.: *Introduction to TPM*. Productivity Press, Portland (1984)
5. Poster "I am your Archangel". Unilever Polska S.A. Foods Division Factory in Poznan (2008)
6. Suzuki, T.: *TPM in Process Industries*. Productivity Press, Portland (1994)