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Work safety in production processes located in Poland

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Abstract
This article presents selected aspects connected to work safety, related to production facilities in Poland, where production lines are installed as new, or transferred from other locations. The author focuses on ensuring work safety from the moment the decision of is made by company authorities, through the transfer of all production means and their commissioning to a regular production stage. The article contains the review of legislation, literature on technology transfer as well as researches and experiences of the author gained during his cooperation with international companies from the industries like food, energy, automotive and others.

1. Introduction

Nowadays, workers' safety in industrial production is, to put it mildly, on a subpar level. One of the reasons is that there are problems connected with efficiency of machines, devices and installations in technologies that are used in production processes, mentioned by Rut and Wolczanski (2016) in their study. New factories, that are constructed in Poland as a part of Foreign Direct Investment (FDI), presented by Bayraktar (2013), and also Kowalewski and Radło (2014), are often equipped with an industrial park. It usually means potentially high standard of work safety as a result of new safety technologies that are connected with it. Unfortunately, there are industrial plants that due to their relocation (OJHA ET AL., 2016, CONROY ET AL. 2016) are often equipped with machines that were already intensively used.

The aim of this article is to describe problems of work safety that occur due to the need

of adjusting machines and devices as well as production processes to the conditions after relocating them to Poland, correlation between regulations being in force in Poland and EU and practical challenges during planning, relocation, implementation and execution

of production processes will be presented.

Number of accidents in Europe in production and transport, and construction branch, is one of the highest. As it is shown in Figure 1, according to Eurostat's data (ESAW, 2013), these areas require special care if it comes to work safety. The aim of this article is to present this issue thoroughly.

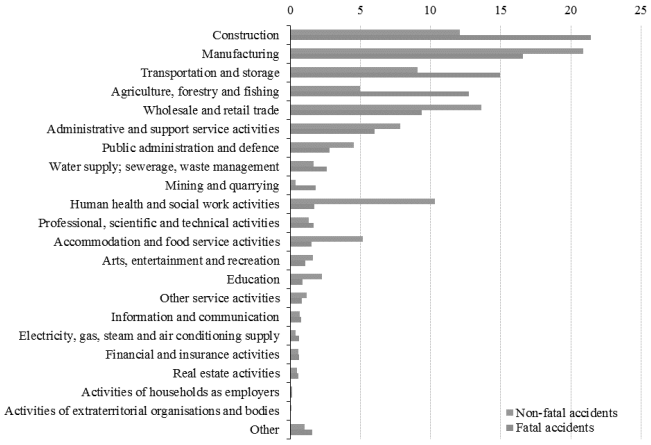

Fig. 1. Fatal and non-fatal accidents at work by economic activity, EU-28, 2013 (% of fatal and non-fatal accidents), source: Eurostat, doi: 10.2785/40882

2. European concept for machine safety and Polish regulations in this area

According to EU machine safety concept, machines are divided into two categories: new that are introduced to EU market for the first time, and old which have been used previously. Article 114 of Treaty of Lisbon (2007) presented a new approach unifying technical regulations in Europe. A new directive concerning machines, called 'machinery directive' (2006), was included in New Legislation Packet. Machines used previously were included in 'tool directive'

(2009), which is a part of so called Social Directives based on Article 153 previously mentioned Treaty of Lisbon 2007. Conception of machine's safety in EU considering responsibility for its realisation was presented in figure 2. What is more, in Poland, requirements concerning machines regardless of the date of their introduction on the market are included in the Decree of the Minister of Labour and Social Policy from 26th September 1997 regarding environment, health and safety regulations (2003).

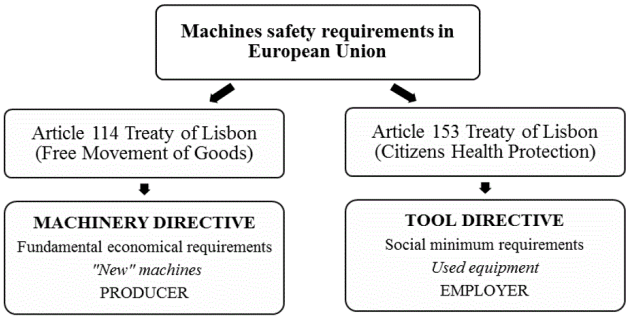

Fig. 2. Machine safety concept in the European Union

According to their complexity production processes must be introduced with a proper care and must be improved constantly. It is mainly the management's responsibility to popularize and obey safety work regulations, as noted Leitao and Greiner (2017). According to article 215 and 216 of The Labour Code (2016), most of the regulations regarding safety at work concern employers who are obliged to provide safe and hygienic working conditions including ergonomics (ROTHMORE ET AL. 2017). Nevertheless, the employee that controls the process directly and is equipped with collective protective measures, personal protective equipment, working clothing and working shoes as it is stated in Article 211 of Labour Code, must do his job with precautions and following the regulations and environment, health and safety rules.

The implementation of production processes takes place immediately after making the decision about location and initial planning of these processes, deployment and equipping used or new machines. The stage of regular production, which is constantly improved, occurs after implementation. Figure 3 shows the scheme of life cycle of typical relocation of production. During each of the presented stages of the project operations of environment, health and safety service need to be accomplished as their role is to advise and control the employer.

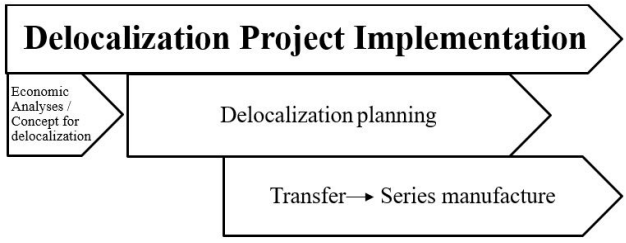

Fig. 3. A diagram of a life cycle for the production relocation

3. Relocation of production resources

The basic issue is the identification of safety hazards in advance in the context of all work procedures (MACEK W. 2010). The project's plan of moving machines and devices from one company's location to another should consider all identified activities/procedures and the approach of their execution (PISZ I., ŁAPUŃKA I. 2015, RUT J. ET AL. 2013). Location, infrastructure arrangement, approach of machines and devices delivery, workflow of resources, human resources are among the key elements taken into consideration while planning. Execution of all project's activities should be controlled based on proper management tools such as control lists, due to the level of their complexity.

Relocation of machines and other equipment is a challenging task, demanding the highest level of caution and accomplishment of safety requirements, such as Road Transport Act (2001), regulates conditions of admission to employment for drivers. Figure 4 shows installation of large production machines. Transportation, building and installation of the machines and devices is only a part of tasks connected with implementation of production processes.

Fig. 4. A photo of assembly works of the large production machinery

The consequences for the health of the employee need to be anticipated with the knowledge of ergonomics ta the stage of designing and organizing work processes. When planning the deployment of the company's equipment, as well as in relation to the individual positions, graphic schemes (layout) are often used. It is important to foresee all the object's infrastructure, such as road transport, places of storage of goods, sanitary facilities for the employees as soon as possible.

In the case of new machines, operation and maintenance manual (OMM) should be drawn up in at least one official language of the European Union. If the instructions are not written in Polish, the equipment manufacturer should provide an authorized translation. A good practice is an adaptation and translation into Polish other important elements of the technical documentation, all operating machines, which also significantly facilitates the work, in particular maintenance services. The colours and safety signs are set in the European

Standards ISO 7010:2011 (2011), adopted to Polish standard PN-EN ISO 7010/2012.

4. Implementation of production processes

Training is an essential element of the implementation of each of the production process and should be carried out for workers performing their tasks at all stages of the project. Staff training is equally important for new and transferred jobs. Therefore, the scope of training should be significantly expanded, for example, the acquisition of knowledge at the headquarters of the prior user or the manufacturer of machinery and equipment. The employer is obliged to provide machine operators instant access to the current user's manual of health and safety on the use of these machines and other additional equipment. Limitation of preparing employees to only initial-overall and position trainings , provided for by law, may not be sufficient. For deployments of technology from another company, one can benefit from the experience of employees gained in the original location, for example, information on the risks. The machine park based on the machines transferred from the previous company headquarters is sometimes a challenge for the maintenance services, as well as health and safety services. Figure 5 shows the age of the machines transferred to one of the example plants of machining company. The arithmetic mean of the equipment was 12.6 years.

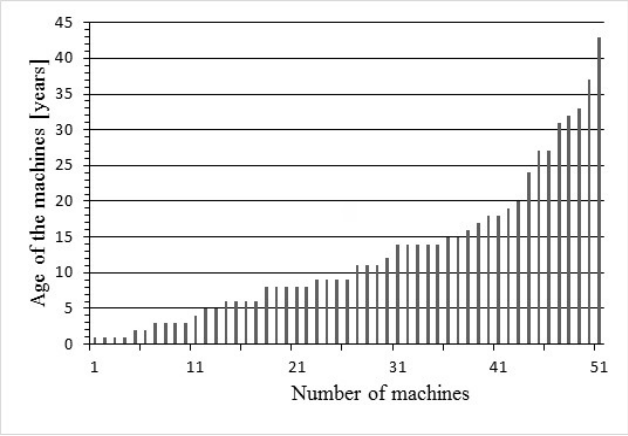

Fig. 5. Age of the machines transferred to one of the plants

All assembling and modification of work equipment to be installed as a new or transferred from the old to the new headquarters of the company, should be documented in the project plan of transfer and the technical documentation.

Combined machinery, as defined in the Machinery Directive 2006/42 / EC (Regulation of the Minister of Economy of 21 October 2008. On essential requirements for machines), are the units of machinery, including the partly completed machinery which, in order to achieve the same end, have been summarized and they are controlled so that they function as an integrated whole. In the case of complex machinery, it is necessary to conduct a risk assessment for the whole team. If the individual machines are marketed as machines ready for use, that could also operate independently of each other, they must bear the CE marking (HILL D. ET AL. 2015) and the accompanying declaration of conformity WE. If they are introduced into the market as partly completed machinery, there is no need to put the CE marking on them, but a declaration of incorporation and assembly instructions must be attached. If replacing or adding machine unit in an existing assembly of machinery does not significantly affect the operation or safety of the rest of the team, it is not required to take any action with reference to the team, but the new unit the machine should meet the requirements resulting from the Machinery Directive. If the replacement or addition of new machinery unit in an existing assembly of machinery has a significant impact on the operation and safety of the team as a whole or is associated with significant changes in the team, a change can be considered equivalent to building a new assembly of machines, according to Machinery Directive.

Modified machinery should be treated as new if their parameters, use or type change significantly after putting into service, and the level of risk is higher. The increase in the risk assessment is the reason that the used modernized machines become modified machines are subject to the Machinery Directive.

Ratings of modernized equipment in safety, can be made, for example, according to the algorithm shown in figure 6.

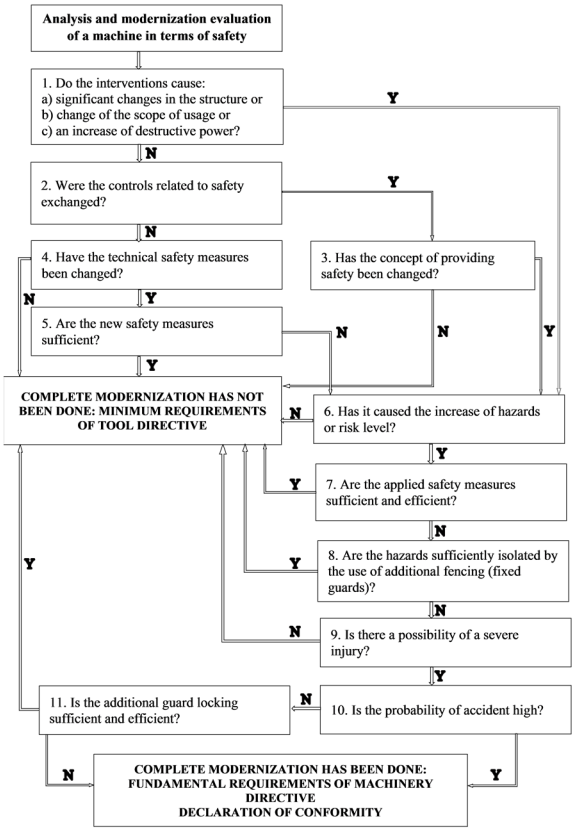

Fig. 6. The algorithm of machine modernization assessment in terms of safety

Place of work where the safety is in the first place is the place where the cleaning and maintenance on a regular basis is a habit. Regular internal audits, standardization procedures

and the implementation of the principles of the so-called 5S (HAERI A. 2016) are invaluable assistance in this aspect.

Mature companies (showing a high level of safety culture) implement policies on health and safety, for example, according to OHSAS 18001, presented by Abad et al. (2013), or polish standard adoption - PN-N 18001. It is reflected in declaration on intentions and rules applicable to the general effects of activities in the field of environment, health and safety. Framework and objectives of the organization, regarding safety management within the company are specified in it.

5. Continous improvement

A good practice of manufacturing companies is to promote the awareness of employees (GRANERUD R.L., ROCHA R.S. 2011) about their impact on the environment and their own safety. State Labour Inspectorate in Poland promotes this approach, which is reflected in the information campaign „Safety depends on you", which was one of its tasks, for the year 2015. A good base to take measures within the production are the implementation and maintenance of formalized quality management systems ISO 9001, environmental management ISO 14001, the management of occupational health and safety OHSAS 18001 and information security management ISO 27001, presented by Liu et al. (2012).

Increasingly, enterprises take comprehensive measures supported by the involvement of employees, and aimed at achieving the goal of accident-free workplace. Figure 7 presents a strategic approach to safety management, using the tools of continuous improvement.

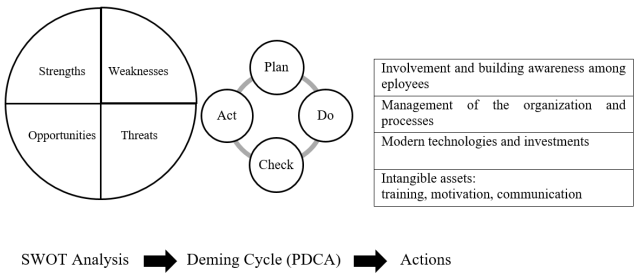

Fig. 7. Strategic approach to work safety management

The role of the trainings is extremely important and repeatedly emphasized in this article. The impact of feedback from machine operators to supervisors should be also appreciated (Nazir et al., 2015). A good approach is also conducting observation and analysis of the risks by third persons, from other departments or outside the company. Figure 8 shows a comparison of numbers of events relating to safety and hazards between 2015 and 2016, in respect of one of the production companies in Poland. The greater the number of threats detected, the lower the probability of accidents or potentially accidental events (Kumar et al., 2016). That is why it is important to engage employees to operations related to continuous improvement, such as hazards registers and ideas for improvements.

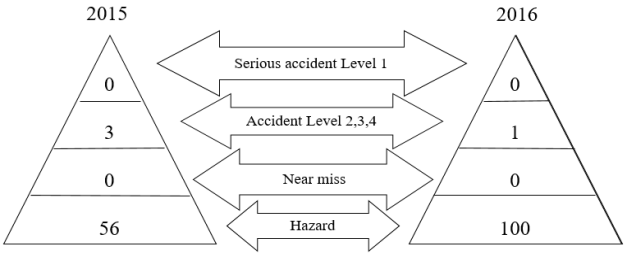

Fig. 8. Comparison of the number of incidents related to risks and safety for one of a production facility in the years 2015 and 2016

Figure 9 shows a Value Stream Map (VSM), which consists of 64 operations in the production process with 182 cards with the process observations made by the team. VSM (TOIVONEN T., SIITONEN J. 2016) is a tool for the Flow Analysis. This method allows to estimate potential areas of optimization, but also gives a thorough understanding of the flow of the manufacturing process. This is one of many methods that can be a good starting point for activities related to the implementation of Lean Management in the company.

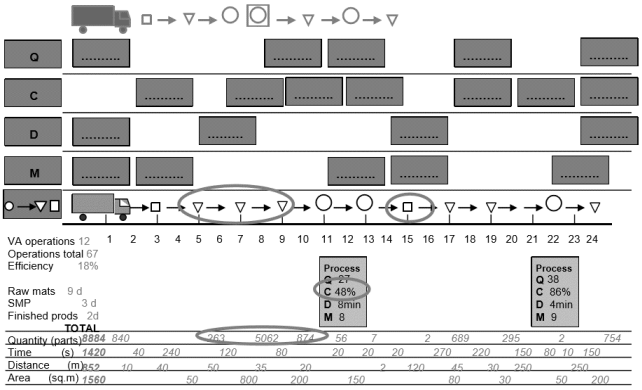

Fig. 9. A map of stream value in an exemplary production process

6. Summary

Occupational safety and health policy's assumptions as well as the presentation of the priority of safe working conditions in the context of company's strategy should be clearly defined and made available to the employees.

Training at every stage of the implementation process, especially the set of experiences of previous users of transferred equipment (lessons learned), are extremely important in the context of maintaining a high level of safety.

There is a growing interest in the idea of continuous improvement, both in theory and practice of management. Employee engagement is one of the key factors for the successful implementation of this idea.

However, even checking the compliance status of safety in the company with legal requirements, outlined briefly in the article does not give absolute certainty that there will be no situation in which even an external, specialized observer (such as labor inspector or auditor), will not be able to identify all sources of danger. Therefore, the legal requirements and „good practices" should be connected in order to continuously improve the processes of taking care of safety.

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位于波兰的生产流程工作安全

關鍵詞
生产转移
流程实现
机械安全
波兰OSH系统

摘要
本文介绍了与波兰生产设施相关的工作安全性的一些方面，生产线安装为新的或从其他地方转移。作者着重于从公司当局决定的时刻，通过将所有生产手段和调试转移到正常生产阶段确保工作安全。本文包括对与技术转让相关的立法，文献综述以及作者在与食品，能源，汽车等行业的国际企业合作中获得的研究和经验。