Title of master thesis: Risk Assessment on Construction Site Accidents

Semester: RISK4-E20

Supervisor: Hanna Barbara Rasmussen

Co-supervisor: Anders S. Kristensen

Hand-in date: 8th of January 2021

Author

Dominik Kravec

Title: Risk Assessment on Construction Site Accidents

Subtitle: An inquiry on compliance with Occupational Health and Safety principles at the construction site and its influence on work accidents.

Theme: Master Thesis

Course: Risk and Safety Management

Semester: 4th Semester, Spring 2020

Institute: Aalborg University Esbjerg

Supervisor: Hanna Barbara Rasmussen

Co-supervisor: Anders S. Kristensen

Project period: 1st of September 2020 – 8th of January 2021

Hand-in date: 8th of January 2021

Pages with / without appendices: 59 / 57

Characters with / without spaces: 88,500 / 75,000

Author

Dominik Kravec

ABSTRACT

This master thesis addresses the issue of construction site accidents from the health and safety perspective. It defines the basics concerning the lack of safety procedures during work, which may lead to work-related accidents at a construction site.

To set the basis, statistical data from the construction site accidents, as well as work accidents in general, are presented. Additionally, types of the most common accidents, their occurrence, and preventive measures are presented. These accidents are further discussed and analyzed to provide a comprehensive comparison of the risks concerning these accidents. By doing so, its avoidance or the reduction in occurrence is further presented. Furthermore, reasons behind the accidents are presented, including the technical preparedness of the construction site to reach the highest security as well as site management team, which might influence the accident occurrence.

Current health and safety legislation is presented along with the actual requirements which are established to be kept during the construction work, in order to distinguish whether these are adhered by the site staff, or further improvement might take place to decrease the existing accidents rates and employees' awareness.

Lastly, the thesis aims to assess the process of the return of the workers back to the construction site, who presently experienced an accident with the actual sick leave. It focuses on the perspective of the accident by the injured, co-workers, and management, whether additional preventive measures are taken, if yes, in what sense and, whether overall site employees accidents perception and seriousness have transformed in any way.

The investigation has discovered that principles of Occupational Health and Safety at the construction site adhere to some extent. At the same time, there is a noticeable area for an improvement as mostly communication issues were discovered, where site management did not update their employees properly regarding details of operating when in an emergency. At the same time, alignment with the OHS rules and wearing of PPE that is able to avoid accidents was satisfactory. The outcome of the study also indicated that the consequences for the workers

that were involved in an accident at the construction site might often be very serious. Fortunately, the awareness of the employees at the site about this matter is rather distinctive.

PREFACE

This thesis was prepared as the final paper required by the university syllabus of the specific semester, included in the study program of the Master of Science in Technology in Risk and Safety Management, at Aalborg University in Esbjerg, as an individual work of the student.

The topic of the site accidents has been chosen because of the student's experience from the construction site during bachelors' practical placement internship, but at the same time due to the main supervisor's knowledge and experience from this field. Both student and supervisor agreed upon a fact that this topic is frequently present in theses, however, the lack of the post-accident scenario was detected, thus it was the overall goal whether it would be able to obtain necessary information in order to determine this specific matter. Therefore, this thesis might be aimed towards the professionals working in the management team of the construction site, but on the other side also towards those preparing the improvement of the legislation. At the same time, construction site workers who find themselves in a similar position might get an awareness of the risk and safety at sites.

This thesis presents the overview of the accident happening within the construction industry from the European as well as worldwide market perspective, as well as the importance of their limitation by application of the available safety measures. By presenting these, the thesis further looks at the risk factors of the accidents that are happening, whether there is any additional preventive measure – both physical and legislative, that could lower the risk of occurrence. Lastly, post-accident placement of the workers back to the site after sick leave is discussed, considering aspects that it includes.

Lastly, the proposal for further improvement in the health and safety measures which could lower the accidents rate as well as their risk of happening is prepared. Further possibilities of the topic development are presented.

ACKNOWLEDGEMENT

Acknowledgments for the formulation, structuration, and overall inputs for this thesis go to the main supervisor Hanna Barbara Rasmussen, as well as to the co-supervisor Anders S. Kristensen for the comprehensive formation throughout the Master program in Risk and Safety Management.

ACRONYMS AND KEYWORDS

ISO	International Organization for Standardization
PPE	Personal Protective Equipment
HSE	Health, Safety, and Environment
OSH / OHS	Occupational Safety and Health / Occupational Health and Safety
EU	European Union
EU-OSHA	European Agency for Safety and Health at Work
OHSAS	Occupational Health and Safety Assessment Series
ESAW	European Statistics on Accidents at Work

KEYWORDS

The construction industry, Construction site, Health and Safety, Risk prevention, Work accident, Post-accident

LIST OF CONTENTS

1. INTRODUCTION

European Statistics on Accidents at Work (ESAW) conducted a survey among fifteen of the European Union members states in 2000, where the outcome showed more than seven and a half million work accidents in general (European Commission, 2004). Even though this includes all sectors, the construction sphere itself covered almost 20% of the stated number (European Commission, 2004), which makes it the second most affected sector among all seventeen researched.

Another data gathered by the Eurostat in 2007 show that apart from the injured, another twenty-three million persons experience work-related health problems (European Commission, 2011). At the same time, the research showed that the socio-economic costs caused by work-related accidents are estimated to fifty-five billion (European Commission, 2011). When taking into consideration the earlier mentioned percentage which the construction sector covers, this cost might stand as high as eleven billion euros for the European construction industry itself (European Commission, 2011).

Therefore, the importance of safety at construction sites is relevant more than ever not only from the perspective of the general health of the people working on sites but also due to the associated causes such as economical influences. However, even in 2020, construction site employers are often not concerned about the safety at the site more than necessary or given by the law, as they are unaware of the true consequences these bring towards them, in the form of the benefits of Health and Safety (European Commission, 2004). European Institute for occupational safety and health conducted a case study where the prevention principles related to work accidents are presented, promoting the benefits of the investment in the preventive measures in comparison with dealing with an accident at the construction site (European Commission, 2004). According to the American National Safety Council:

> *"Companies can save three to five euros for every euro invested in a safety and health program."* (BIGRENTZ, 2020)

To be able to support the idea of keeping the health and safety principles by the companies and its employees, apart from the physical harm to those present in an accident, there are several

direct consequences after such an event occurs at the site. Some of them include (Work Inspections of the Slovak republic - Inšpekcia práce, 2019).

1. Employees:
   - Decreased quality of life or even death
   - Difficulty to get back in society/work environment
   - Financial losses
   - Decrease of life quality of the affected employee and relatives
2. Employers:
   - social consequences (employee frustration, often recruiting new employees, damaged reputation)
   - legal consequences (prosecution of those responsible)
   - economic consequences (delays in production, compensation of victims, government fines)
3. Government:
   - the cost of medical care
   - welfare costs
   - non-compliance with international obligations with labor protection

There are several ways to avoid earlier mentioned consequences and costs associated with them by minimizing the occurrence of work accidents, by the complete mitigative measures system implementation into all spheres of the construction site. These aim to eliminate or reduce the risk factors that determine the occurrence of work accidents and other types of harm to the health of the people.

Based on these findings, the thesis aims to present the seriousness of the situation of those affected by an accident, and available sources for the mitigation of accidents occurrence. At the same time, consider the post-accident stage of the affected employees' return back to work and its social and work acclimatization.

1.1 THE ORIGINATING IDEAS

Within the Risk and Safety Management, which is the overall topic of the master program, the course of Health and Safety management took place at a later stage. After the discussion with

the supervisor, construction site accidents were selected due to the internship at the site experience of the student, as well as the supervisor's previous experiences within the construction industry, specifically from the Health and Safety perspective.

As it was discussed during the start-up meeting, construction site accidents are rather a common topic within the construction industry researches, however, a lack of information on the specific post-accident prevention, recovery as well as the return of the injured one back on the site, was noticed. Therefore, this choice was made to examine whether it will be possible to touch upon this specific subject and withdraw some more information, as well as analyze the possibilities of the gathered information into practice.

Once this was settled, information research as well as on a specific matter was ready to start.

1.2 SCOPE

The scope of this thesis is the evaluation of the actual use of OHS principles at the construction site by addressing certain issues towards site workers. Based on the data from the available resources regarding accidents in the construction industry, an assessment is made whether the importance of more strict application and promotion of safety at the site is required. This project is scoped to an assessment of a selected construction site in one of the countries of EU - Slovakia. Based on the outcomes from this construction site, an assessment is made. The target group of this thesis is the general public, but mainly professionals and individuals working within the construction industry. Especially concerning Occupational Health and Safety.

1.3 THE NEED FOR THIS PROJECT

As mentioned earlier, accidents at construction sites are a well-known issue for decades. Nowadays, the view on an accident and its prevention has shifted slightly in a positive way, however, room for improvement is still significant, being a huge sector. Companies are looking at the effectiveness in all aspects, mainly the financial matter. Therefore, this thesis intends to provide an understanding of the problem and, the importance of the promotion of health and safety at sites, as well as performing of accidents and post-accident analysis by the presentation of the visible outcomes and result in indicators.

1.4 BASIS

Construction site from the risk and safety perspective is not a new topic, therefore quite few could be found focusing on a similar subject as this thesis. Already available reports and research on construction safety can help lawmakers as well as site management teams, with mitigative measures. However, the lack of reports investigating the post-accident placement of the construction site workers affected by the accident encouraged originated this thesis' topic. This is where the report delivers beneficial information regarding the matter of the injured employees' integration after an accident. This may serve to the officials responsible for the overall functioning of the construction industry, as well as of each construction site to examine and re-evaluate the actual post-accident set-ups.

1.5 LEARNING OBJECTIVES

The learning objective of the last semester as well as the thesis of MSc in Risk and Safety Management is set to be able to apply gathered knowledge from the subjects included in the education and dispose of them in a real-life topic, which has been selected. The knowledge, skills, and competencies from the subjects such as Operational Risk Management, Health and Safety Management, and Emergency Management, are applied.

Specifically speaking, these include the use of methods by which the risk is identified, understanding these risks and risk factors that influences them. At the same time, there is a necessity to understand the methods that can mitigate these risks. To be able to do so, there is a need for a plan preparation as well as its possible modification whenever necessary, along with the capability of finding alternatives to some most critical processes. Lastly, the presentation of the findings and results understandably and efficiently is important.

2. PROBLEM DESCRIPTION

As presented in the introduction, there is no doubt work accidents require special attention, especially within the construction industry, which lies within the TOP 5 in most affected industries (Eurostat, 2020).

At the same time, most employers representing construction companies are well aware of the consequences that bring in the financial aspects, when an accident occurs. Several duties need to be fulfilled by employers when an accident already occurred. These include sick leave, time offs, replacement of the lost employee, additional training, etc (NiDirect Government Services, N/A).

As statistical data collected by the EU indicate, the number of accidents within the construction sector is still high, even though a slow decrease has been noticed in the period from 2010 to 2018 (Eurostat, 2020). Therefore, one of the essentials is to analyze different aspects of these accidents. Investigation of what has an impact on their occurrence, but at the same time, their reduction, is necessary. With ongoing worldwide development, a rising number of people and their needs, there is an expectation that construction jobs will be occupied by more people than ever before.

Based on previously mentioned, an inquiry on compliance with Occupational Health and Safety (OHS) principles at the construction site should certainly be the main point of research. At the same time, should any correlation with the occurred accidents be detected, an amendment is to be prepared.

3. PROBLEM FORMULATION

Following earlier presented, two research statements are going to be assessed and scrutinized as a part of an analysis provided further in the thesis. These are as follows:

1. **Assessment of the condition of OHS at the construction site, along with detection of the weaknesses, which might serve as a guide for the OHS improvement plan.**

To be able to resolve this, these sub-objectives are prepared to support it:

a) Investigate which PPE is in use at the construction site, whether it is provided by the employer and in case yes, if it is actually being used
b) Inspect the level of training, its content, and its practical placement
c) Examine whether there are fees or benefits for not holding to / keeping the safety guidelines
d) Examine whether employees can participate in a modification or creation of the safety plan

At the same time, to be able to fulfil one of the aims of this thesis, the second statement is placed. The purpose is to find out whether these workers experienced any accident at the site and if they know someone who experienced it. The focus is put on the integration of the person after an injury back to work, but at the same time, at the management of the site, whether they introduced any additional measures (such as training, new guidelines, additional PPE) after an incident happened. The second objective of this analysis is as follows:

2. **Assessment of the procedures taken by the management after an accident occurs at site.**

Sub-objective that are going to be the point of the examination are prepared for answering the second objective of the construction site analysis.

a) Examination of the existing procedures and practices performed by the management.
b) Assess whether workers are aware of the necessity for coping with OHS and possible post-accident consequences on daily life.

4. THEORIES AND TERMS

Explanation of the use of the theories and terms in this thesis is described below. To meet the criteria and the aims earlier mentioned in the learning objectives, several risk management tools discussed throughout the education are used. These theories and terms are used widely through the report by application of the proposed recourses, in combination with the gathered knowledge.

4.1 THEORIES

The description of the theories used in this thesis is explained in the upcoming paragraphs.

ISO 31000:2018

The overall content of this thesis was modeled based on the commonly used standard within the risk management sphere - ISO31000:2018. Specifically speaking, this model has been used to set the following:

- Establishment of content
- Risk identification
- Risk analysis
- Risk evaluation
- Risk treatment

Each of the mentioned is going to be separately introduced below.

Establishment of Content

In order to accomplish the desired goal, the content of the paper is proposed and discussed with the supervisor. This mainly includes the preparation of the correct form of the thesis, by using the framework presented within the ISO 31000:2018.

Risk Identification

This thesis uses the risk identification method to establish which risks are present in the specific case of the construction site and, at the same time, which of these risks are causing potential

harm to the personnel present at the site. By doing so, it is easier to differentiate between all present risks, which of them might cause an accident. The risk identification of this extent is essential for the preparedness of the upcoming risk analysis.

Risk Analysis

As mentioned above, risk analysis is the continuation once the risk has been identified. The meaning of this analysis is to develop present risks, perceive the cause of these risks as well as predict the possible consequences. Once the analysis is done, some of the causes and outcomes should stay uncovered and be ready for their evaluation.

Risk Evaluation

Once risk analysis is made, its evaluation takes place in order to assess present risks. Apart from the evaluation of the risks, it looks for an after-effect of the event in which these risks occur.

Risk Treatment

The last step is to apply the treatment of the risk, meaning, present the options for their mitigation. This is done to find preferably more than just one solution to mitigate the risk, present various alternatives and compare which of them might be the most efficient in several aspects, to be used for the analyzed risk. Treatment is done by a repeated look at previous stages of risk identification, analysis, and evaluation. At the same time, the gathered information is compared to other available information, such as health and safety regulation, building authorities, and other official authorities, to find the best available solutions for mitigating these discovered risks.

4.2 TERMS

There is some key terminology listed below, which is used throughout the report. To provide an in-depth understanding of the meaning it represents in this thesis, their description is clarified below.

Accident

Dictionary description of an accident is explained as:

"something bad that happens that is not expected or intended and that often damages something or injures someone". (Cambridge Dictionary, N/A)

Therefore, in this thesis context, it is understood as harm to a construction site employee (or any person present at the site) which may result in any type of injury on a physical level. These include all types of injuries – from those of the negligible consequences, through those that require certain medical help and probably also sick leave, ending with the most severe once, that may end up as a fatality. These different types of accidents are not categorized within the same importance level; however, this thesis places the matter of mitigation of the risk factors before the details of the injuries and their treatment, which is to be further specified in the delimitation chapter. The term accident is often used within the thesis as a "work accident", which stands for an event that caused harm at a construction site, which is the point the attention is given in this study.

Post-accident

This term is used in the report in a sense of something that happens to an injured person after the accident occurs. According to the dictionary description, post-accident stands for something:

"occurring after an accident". (Collins Dictionary, N/A)

In this means, it is not discussed what specific actions are taken after an accident, in sense of medical treatment of particular physical or psychological injuries. It is considered more of a post-accident placement of the person that undergoes the accident, and the return back to the work-life, as this is one of the key objectives of this thesis.

Prevention

Based on the dictionary description, the term prevention is:

"the act of stopping something from happening or of stopping someone from doing something". (Cambrdrige Dictionary, N/A)

In this master thesis as well as within the Risk and Safety Management, the term prevention might be equivalent to mitigation – therefore finding certain alternatives, that might be able to either reduce the risk of the accident occurrence or even, at the best scenario, even stop it completely.

Occupational Health and Safety (OHS)

OHS is a set of regulations that serve as a guide to avoid or significantly decrease harm created towards the health of the employees during the work performance. It includes specific methods, ways, and means intended for reaching the base function – protection of health and exclusions of possible damages (getsmarter®, 2016).

Personal Protective Equipment (PPE)

PPE is equipment designated for the protection of the persons against risks they can be exposed to during the performance of their work. These may include components such as safety helmets, high-visibility vests, safety footwear, etc (Health and Safety Executive, N/A).

Hazard

Anything that brings along a concern that might cause harm, is considered a hazard. For instance, these may include working in height, electricity explosion, noisy environment, and more (WorkSmart.org.uk, N/A).

Risk

Risk is an actual chance that that earlier mentioned hazard may cause a person harm of any type (WorkSmart.org.uk, N/A).

5. METHODOLOGY

This chapter is dedicated to the methodology used in this thesis. The purpose is to further clarify the procedures used for problem research from identification to evaluation.

Collection of data

Analysis of the situation within the construction industry is based on the available literature and the latest development of the accident in construction. These data were collected from the official EU organization named Eurostat, which gathered data on accidents for the recent 8-year period for all 27 EU member states. These recent data served as a prerequisite for additional research in the matter of health and safety procedures at construction.
At the same time, data on the actual condition of the OHS within construction sites were obtained from a survey that was handed out to fifteen construction site employees.

Data validity

The collection of data was followed by its validity. That was done mainly in selecting only renowned sources such as national or international organizations covering the sphere of OHS at construction sites. These data were used in connection with the thesis aim and re-evaluated whether they correspond to prepared content and may cooperate in the formation of this research's outcome.

Survey methods

Information regarding the survey used in chapter 7.1 is presented. Survey participants are construction site workers at Mochovce Nuclear Power Plant in Slovakia, and this is where the survey was conducted. They participated in constructing an administrative dwelling at the time. The selection of the workers and construction site is purely random, but dependant on a fact, there was a connection to workers due to the previous employment of a student at this specific construction site and therefore, it was possible to ask them to participate in a survey. Otherwise, it might be challenging to get any access to any construction at all. The actual situation of Covid-19 has participated in this matter of forbidden construction site visits. There was one representative selected from the management, which was able to hand out the papers to workers

and return them after fill in. This request with undergoing a survey and sharing a personal experience on OHS at the site addressed to fifteen site workers as this was the available number that was personally known and could be contacted. All these persons received a paper with survey questions they needed to fill in. Nine of them actually participated and returned these papers– 60% feedback rate. The age, gender, education, or working experience of the participants was not specifically set due to the shortage of construction workers being able to take the survey. As there are several subcontractors at this large site, these workers were reviewed on the OHS provided by the construction company they were employed in or hired by. The survey consisted of 11 questions. Their role was to analyze used OHS within their company, its downsides, and its benefits. The survey was anonymous and options were about to be circled. Received answers were analyzed further in chapter 7.1 based on the method of descriptive statistics. The intention was to summarize common signs of the collected data set, from the selected sample. As a part of the descriptive statistics, along with the presentation of the collected results, the characteristics of the answers were examined. This was done to make a judgment based on received replies and relate them to questions, that were prepared in the first place.

6. PROBLEM ANALYSIS

To provide a better understanding of the topic, this problem analysis is prepared. Within this chapter, construction at sites is going to be analyzed in order to refer to the issue of the accident in general. Therefore, the below-listed sub-topics are discussed:

- Introduction to the construction industry
- Occupational Health and Safety principles
- Overview of the types of accidents
- Explanation of the risk factors
- Preventive measures available to avoid accidents

6.1 CONSTRUCTION INDUSTRY

With more than twelve million people employed within the construction sector in Europe in 2012, this number makes it one of the largest industries. Despite the last crisis in 2009, in most of the European countries, the new job openings increased over the past years. In some European countries such as Germany and the United Kingdom, 8% of all new jobs provided were coming from the construction sector which at the same time covers up to 6.5% of total employment in Europe (Building Radar, 2020). As of 2012, more than 3 million construction companies were employing these people, making a turnover of 1.64 trillion euros (Statista, 2020). Forecasts for the construction industry assume an increase in the total revenue, therefore also in the total number of employees by about 3 to 4% in general in the upcoming decade, which will mean the construction sector will contribute to around 10% of total Europe's GDP (Building Radar, 2020).

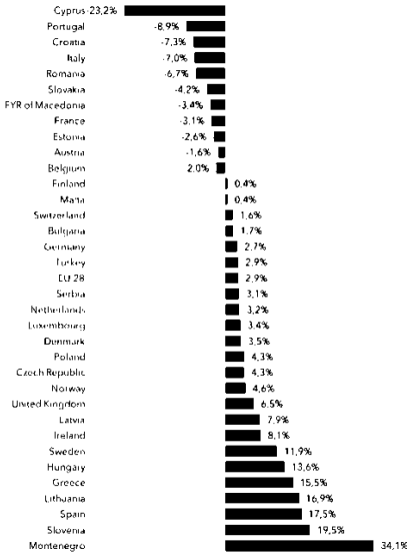

Figure 1 Construction industry growth in Europe in 2014 visible for about 70% of countries (Building Radar, 2020)

6.2 OCCUPATIONAL HEALTH AND SAFETY

Occupational Health and Safety (OHS) principle is rather a complex mechanism, consisting of several legislative norms from various scientific fields. OHS does not stand only for the prevention of injuries and accidents. It contains all the actions that are necessary for the overall safety of employees and all present at the construction site. It includes physical and psychological comfort, working and hygienic conditions, social equipment of work area, social security, and more. Adherence to OHS norms is the key tasks that are supposed to be covered by the employer and the management team.

The main role of OHS is the activities of the employees and employers which are meant to coordinate prevention in sense of work accidents and the health of the employees in general. The success of this prevention plan lays behind these two essential conditions (Ondavsky, 2013).

1. The preventive measure must be a part of the entire work process – starting with the planning, preparation, execution, technological handling until the hand-over of the final structure.
2. All employees must participate in the activities that are being prepared for the specific cases of the construction site in regard to OHS, for the entire period of preparedness and implementation, based on the specific role of the person within the team.

OHS is the main contributor to improved safety at the site, by specifying certain barriers for lowering the risk of work accidents, any type of harm to health caused by participation in specific work activities. As the effectiveness of the OHS cannot be denied, there is also support provided by the state with promoting the OHS principals. Each European country has a governmental organization responsible for the overall health and safety kept during performing work (Work Inspections of the Slovak republic - Inšpekcia práce, 2019).

Apart from the earlier mentioned, OHS contributes to the overall improvement of the quality of life and at the same time, supplies the development of business culture, improvement of the employee-employer relationship, which are the essential factors for healthy economic growth of the employer and the nation (Miklos, 2011).

6.2.1 OHS Legislation

Life protection is one of the basic human rights which is guaranteed by the democratic and economically developed society to their citizens. OHS and HSE are of high importance nowadays, mainly because of the previous finding on the influence of company productivity, effectiveness, and quality of performed work along with the competitiveness of the company. Most likely because of the earlier mentioned, a healthy working environment in it all means is in the last years of high interest by the European Union. As they introduced a new approach towards the OHS, the philosophy of the prevention, promotion of OHS, and employee protection has changed. Based on the mentioned approach, prevention consists of the following (Pacaiova, 2009):

- Performance of the measures in advance to avoid the creation of failure
- Application of the OHS tools, analysis of risks, communication, training, and repeated improvement when defects found
- Ability to identify and evaluate risks for persons, environment, and property and not rely on the regulations only
- Considering the human factor, not focusing on the technological equipment safety, but also on mistakes caused by the human factor
- Preparedness to avoid the creation of unwanted risks, but at the same time, once risks are present, be able to decrease them.

Apart from the earlier mentioned, there are also general prevention guidelines for employers, which are binding to be applied in an organization, for securing operational health and safety at the site. General prevention guidelines include (Law for people.sk / Zákony pre ľudí, 2006):

- Exclude danger and associated risks
- Detect risk which cannot be excluded, mainly regarding the selection and use of personal protective equipment (PPE), work materials, work techniques, and more
- Arrange preventive measures which may avoid the creation of danger
- Replace works where the risk is highly associated with those with lower risk
- Adjust works based on the employees' and machinery capabilities
- Take human capabilities while designing the construction site to decrease harmful factors affecting work

- Address instructions for preparing the OHS application at all times during work performance

Earlier mentioned OHS rules are given standards regulated by the European Union and its inside departments. The main agency responsible for the OHS application all over EU member state countries is the European Agency for Safety and Health at Work. This agency is responsible for setting the minimum standards for safety and health in the workplace, however, each European country may adjust their national legislation and make them more stick as they wish, therefore this legislation varies in the EU region (European Agency for Safety and Health at Work, N/A).

6.2.2 OHSAS 18001:2009

This standard is the latest update of the norm OHSAS 18001 whose role is to specify requirements for managing health safety during work. Based on this norm, an organization can manage risks associated with OHS, but at the same time, improve its own performance. Investments that are necessary for application and certification of the management system for safety at work are returned to each organization in the form of lower occurrence of accidents at work, lower costs related to those accidents and, at the same time, minimize the costs of fines applied due to breach of law regarding OHS. Managing system of OHSAS 18001:2009 is usable for any organization and does not limit based on the focus of it. Once the company uses the mentioned norm, they can get certified for their production, service, or educational courses related to the industry (Certificaton of managing systems / Certifikácia manažérskych systémov, 2019).

Organizations that will implement standard OHSAS 18001 can expect benefits in this form (Certificaton of managing systems / Certifikácia manažérskych systémov, 2019):

- Full alignment with the legislation
- Decrease of the potential risk related to the creation of danger, financial and time expenses
- Better control of possible dangers and minimalization of risks based on emergency planning and organization development plan
- Improved investment plan and business plan while considering OHS guidelines

- Enhanced condition for cooperation with investors, banks, and insurance companies in the form of lower interest rates, better conditions for instance
- Improved relationship with employees, governmental institutions and public
- Decrease or complete exclusion of expenses that are caused by the improper organizational structure in the OHS system
- The stable reputation of an organization
- Wider options for export, participation in governmental tenders, business aids
-

6.2.3 Personal Protective Equipment

Personal Protective Equipment (PPE) creates a barrier between threatening factors and the human body or human body parts. Their role is to avoid any damage to the health of the worker. PPE serves to eliminate dangerous and harmful factors related to work, possibly reduce its effect to less significant damage to the health and safety of the worker. PPE is designated for individual users which means that at a specific time, just one worker can use it. Based on OHS is the employer required to (Law for people.sk / Zákony pre ľudí, 2006):

- Analyze possible dangers at the site and create a list of available PPE based on them
- Provide employees free of charge PPE based on the needs of their work activity
- Take care of PPE so they are fully functioning and ready to be used

Each employer is required to provide PPE, so the health and safety of the employees are sufficiently protected. In case the equipment does not provide sufficient security, it is the obligation of the employers to replace them with new ones that fulfil the demanded quality. The most common situations that require the use of PPE are as follows:

- Exceeded permitted values of harmful factors
- Present harmful factors that do not exceed allowed values, but their effect might damage the health and safety of workers in the long run
- In contact with substances that might damage the skin or mucous membranes
- During possible transmitting of infection
- In danger of falling objects, persons or material, mechanical factors, unusual weather conditions, cold, heat, noise, and other factors
- In case special regulations require their use

- In case their use is demanded by the governmental inspection of work, state health supervision, etc.

6.3 ACCIDENTS AT WORK

Despite available physical (PPE) and theoretical (legislation) factors that are intended to protect people at work, all types of accidents, those more or less severe, are still present in the construction sector nowadays. Along with the earlier mentioned overall growth of the building sector, to obtain a decrease in the number of accidents is a difficult task. Within the 28 European member countries, there were over 3.3 million accidents during work in general (Eurostat, 2020). According to European statistics, the construction and manufacturing sectors are the ones most affected by these accidents. At the same time, about 2/3 of all accidents at work involved males. As of 2017, a ratio of fatal versus non-fatal accidents corresponded to approximately 1 death to 1000 injured (Eurostat, 2020). Statistical data also show that:

> *"the highest incidence of non-fatal accidents at work in the EU countries was observed in construction, with 2,876 accidents per 100,000 persons employed".* (Eurostat, 2020)

At the same time, the EU conducted a data collection for the last decade, where the decreasing trend is visible for the construction industry. As it can be seen in the graph underneath, while in 2010 the number of non-fatal accidents within the 27 EU member countries was reaching towards 500,000, in 2018 was this number just about 350,000 for the construction industry. It can be considered that with more sticker politics regarding OHS promoted by the EU at the beginning of the decade, the decreased number of accidents might have benefited directly from the promotions.

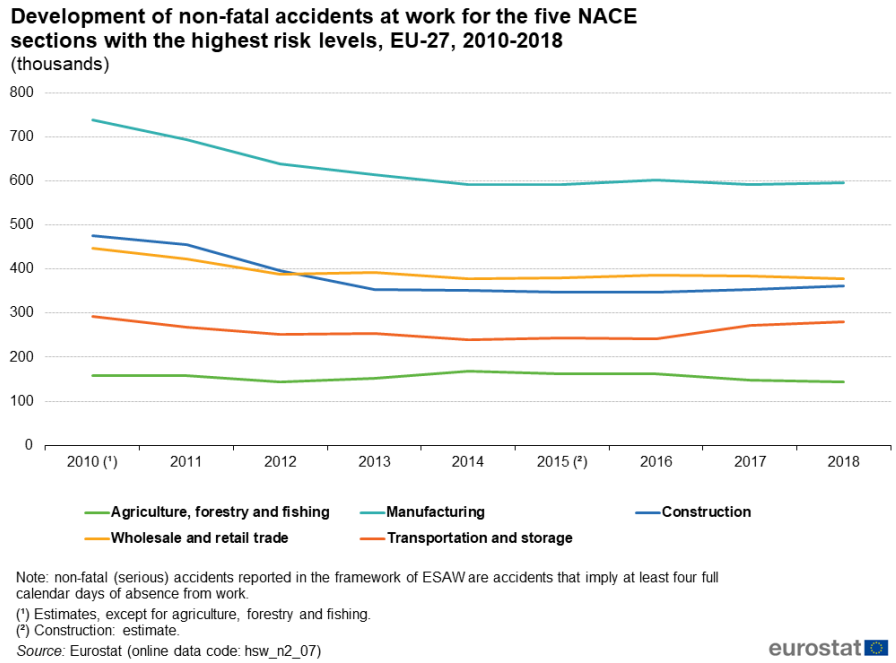

Figure 2 Non-fatal accidents in EU construction in 2010-2018 (Eurostat, 2020)

A similar trend is present for the same period of the gathered data from 2010 until 2018 for fatal accidents in EU countries. Data show that 1,000 construction workers have died at work in 2018 which decreased by 300 persons to 700 fatalities from 2016 to 2018. Unfortunately, the construction sector is the leader among the top five sectors with the highest risk levels, showing the highest number of fatalities in all 8 years researched (Eurostat, 2020).

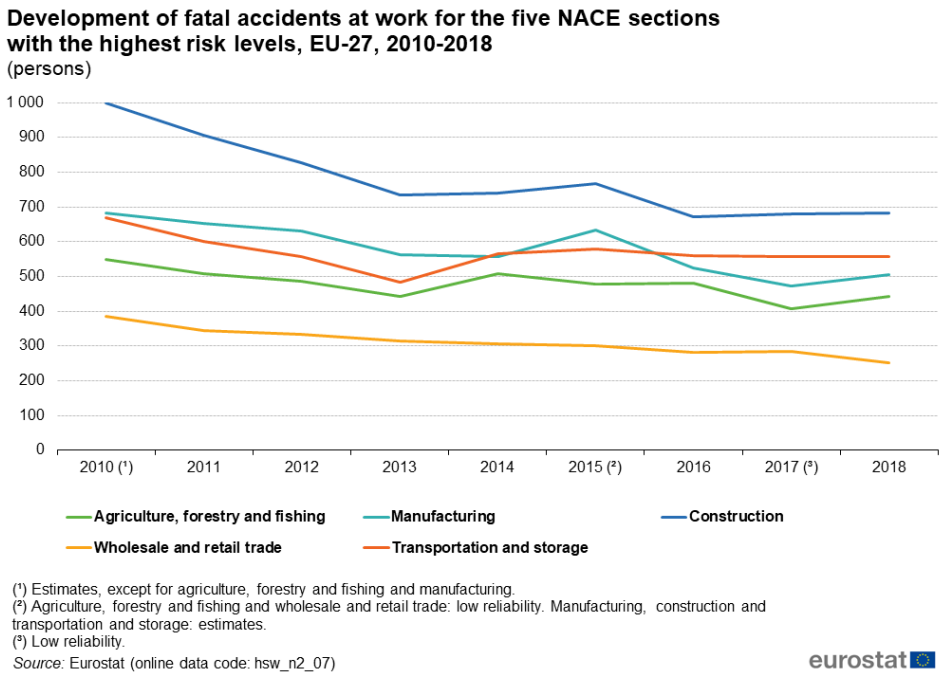

Figure 3 Fatal accidents at work in EU construction in 2010-2018 (Eurostat, 2020).

Some of the official sources place the manufacturing and construction sectors within one category. As it can be seen in the attached figure below, another source differentiates between manufacturing and construction, therefore, the construction sector is no longer leading in the non-fatal accidents at work. However, statistical data gathered by the European union show significant evidence for the fatal accidents within the construction, where it represents the highest number among all, as an average of all researched European countries.

NACE (Section)	Non-fatal accidents at work									Fatal accidents at work								
	Total	Industrial site	Tertiary (office, amusement area, miscellaneous)	Public area	Construction site, opencast quarry or mine	Health establishment	Farming, fish farming, forest zone	In the home	Other or no information	Total	Industrial site	Tertiary (office, amusement area, miscellaneous)	Public area	Construction site, opencast quarry or mine	Health establishment	Farming, fish farming, forest zone	In the home	Other or no information
NUMBER	(thousands)									(number)								
Total (all activities)	3 344.5	995.5	615.1	333.0	307.5	227.3	106.5	80.6	678.9	3 552	637	174	1 017	518	29	287	58	832
Agriculture, forestry and fishing (A)	155.5	8.5	1.0	2.1	0.5	0.4	55.1	0.4	87.6	453	23	2	27	3	0	209	3	186
Manufacturing (C)	624.7	468.6	24.1	22.2	25.8	5.1	6.1	6.8	66.1	496	237	13	85	40	2	11	7	101
Construction (F)	376.4	51.4	6.9	22.9	232.4	0.9	1.7	8.3	51.9	733	61	8	135	388	2	10	10	119
Wholesale and retail trade (G)	412.5	153.8	166.0	27.9	4.5	1.1	2.0	4.3	52.7	297	83	32	113	9	1	9	7	43
Transportation and storage (H)	300.7	111.8	10.6	109.1	3.9	0.6	1.2	5.8	57.7	633	113	15	391	9	0	7	6	92
SHARE	(%)									(%)								
Total (all activities)	100.0	29.8	18.4	10.0	9.2	6.8	3.2	2.4	20.3	100.0	17.9	4.9	28.6	14.6	0.8	8.1	1.6	23.4
Agriculture, forestry and fishing (A)	100.0	5.5	0.6	1.4	0.3	0.3	35.4	0.2	56.3	100.0	5.1	0.4	6.0	0.7	0.0	46.1	0.7	41.1
Manufacturing (C)	100.0	75.0	3.9	3.5	4.1	0.8	1.0	1.1	10.6	100.0	47.8	2.6	17.1	8.1	0.4	2.2	1.4	20.4
Construction (F)	100.0	13.7	1.8	6.1	61.7	0.2	0.5	2.2	13.8	100.0	8.3	1.1	18.4	52.9	0.3	1.4	1.4	16.2
Wholesale and retail trade (G)	100.0	37.3	40.2	6.8	1.1	0.3	0.5	1.1	12.8	100.0	27.9	10.8	38.0	3.0	0.3	3.0	2.4	14.5
Transportation and storage (H)	100.0	37.2	3.5	36.3	1.3	0.2	0.4	1.9	19.2	100.0	17.9	2.4	61.8	1.4	0.0	1.1	0.9	14.5

Note: all accidents for Belgium, Greece, Finland and Sweden are included in the heading for no information (as well as in the total).
Source: Eurostat (online data code: hsw_ph3_02)

eurostat

Figure 4 Non-fatal and fatal accidents at work in European Union in 2017 (Eurostat, 2020)

According to Eurostat, 52,9% of all fatalities that occurred during work within the construction industry, happened on a construction site (Eurostat, 2018). Therefore, it is necessary to further investigate the reasons behind these accidents. As a part of this analysis, the most common accidents types and their contributing factor is going to be presented further.

Situations associated with hazards at the construction site occur in almost every kind of this industry. General hazardous factors can be divided into three categories (Lorko, 2009):

- Psychosocial
    - Workplace relations among colleagues
- Physical
    - Climate (pressure, humidity, temperature)
    - Dustiness
    - Radiation (electromagnetic) and optical (lighting)
    - Vibration-acoustic (chemical preparations)
- Biological factors

- Harmful fauna and flora

These are hazards present at the construction site; however, it is possible to identify various risk factors that interfere with the construction process and whose direct effect comes from the earlier presented hazards. Yet, it is necessary to take these risks into account so that such risks can be eliminated in the future. For several years a great effort has been devoted to the study of risk as such, due to the new developing situations which occur, and that the entire industry can learn something from.

Several publications have appeared in recent years documenting include risk factors such as:

- Vibration
    - causes the movement of the body in space due to internal and external forces. This effect might create damage to the nervous system, locomotor system, and the multiple numbers of other orangs of the human body (EUR-Lex, European Union law, 2008).
- Noise
    - might affect the performance of the workers and their hearing. Excessive noise generated by work, ambient noise, or background noise from other work performed in the workplace can cause several undesirable pitfalls, such as deafness. Excessive noise can increase the risk of accidents, especially due to inefficient communication between workers, thus increasing the likelihood of accidents. Also, several studies define that noise also causes an increase in blood pressure. Long-term exposure to such a factor in the workplace can have long-term consequences for the body (Lorko, 2009).
- Work at heights
    - requires compliance with coordination on the construction site combined with special attention paid to the presence of industrial activity, electrical risk, busy places in confined spaces, and spaces located one above the other. It is therefore particularly important that construction workers are medically fit and have physical and mental abilities to perform work at heights (European Commission, 2008). PPE is one of the most sufficient ways to prevent the risk of falls.
- Climate
    - affect construction workers as pressure, humidity, heat as well as cold, and airflow. In the context of health and safety at work in preventing risks on the

construction site is coping with climate change. It is necessary to accept these conditions as a fact, but also eliminate them if they can be eliminated (Lorko, 2009).

All the above-mentioned risks might significantly contribute to the increased accident rate. As construction is one of the riskiest areas and is also the area with the highest accident rate, it is important to constantly name and define the risks associated with this work activity and thus avoid possible risk situations that could lead to accidents. Several factors might support the reduction of these risks, which include:

- classification (how and why they contribute to the risk)
- determining the probability of implementing solutions
- setting goals and priorities that are realistically achievable
- specification of management responsibilities
- monitoring of work procedures and evaluation of the program

Due to occupational and other risks, we define the most common occupational accidents, which are analyzed in the upcoming subchapter.

6.3.1 Most common accidents

American Occupational Safety and Health Administration performed data collection and statistics, which might be used as evidence, having in mind that the overall accidents rate number in the US and EU are fairly similar mainly due to the fact, that the number of inhabitants is similar. The stated source presents the so-called “the fatal four”, which is the four most common reasons behind the accidents at construction sites (Block O'Toole & Murphy, N/A). These include:

Falls

These are responsible for about 34 to 40% of all construction deaths, depending on the specific year we look at (United States Department of Labor, 2020). The reasons behind these accidents might be multiple, however, their avoidance is possible when following the health and safety guidelines. Risks that should be avoided to prevent falls include proper scaffolding installation, proper marking of the excavation zones, coverage of the slippery surfaces where possible to

slip or trip, etc., as these include the most common reasons behind the fall accidents (Block O'Toole & Murphy, N/A).

Struck by object

Accidents are responsible for about 8% of all fatal accidents. These are caused either by improperly secured construction material or equipment. Again, several techniques help to prevent these accidents, such as keeping materials and equipment away from the opening where they could fall from or safer handling of materials when there are other workers nearby that might be hit. There are also mechanical protective systems available, which might catch the falling objects (Block O'Toole & Murphy, N/A).

Electrocutions

The third most common reason for a fatality on site is electrocutions. As there are several open wires during ongoing construction, workers that are non-electricians might have contact when there is the improper marking of the power lines and touched accidentally. Another reason mentioned by the Health and Safety Administration is that some of the workers from abroad might not speak the language of the country where they work, therefore they do not understand the warning tables, therefore they should be warned every time there is an electrical source change made at the site, in the language they speak (Block O'Toole & Murphy, N/A).

Caught-in/between

The fourth of "the fatal four" most common accidents. These include construction worked being pulled into machines or being compressed by the moving machinery. The reason behind the accident might be improper manipulation with the machinery or usage of machines when there is no guarding person involved, which could warn other workers passing by or working within the same zone focused on another matter. These types of accidents can be reduced by proper information of the construction works, by training and informatization of the persons present at the construction site (Block O'Toole & Murphy, N/A).

Apart from the training and keeping the guidelines by the workers to keep the accident rates low at the construction sites, there are several other methods available nowadays, which can

avoid or at least reduce these accidents. Basically, for each of “the fatal four”, there are systems developed which might help with the lower occurrence of the accidents, such as drying systems for reducing the slips and falls on wet surfaces. Furthermore, there are safety systems that can catch the falling object and therefore replates the head coverage equipment, which might be in certain situations ineffective (HoldRite, N/A).

7. OHS CONSTRUCTION SITE ANALYSIS

Meaning and application of the OHS system for management is the ongoing development of the OHS level at the specific construction site. The role of the authorities responsible for OHS is the creation of preventive and mitigating barriers. Management present at the construction site should analyze the effectiveness of OHS in an organization, whether they are meeting set goals in this area. The organization may use for their analysis of OHS functionality several tools such as their performance outcomes or feedbacks.

Based on the findings from the problem analysis chapter of this thesis, along with the data presented in the part dedicated to operational health and safety at work, this chapter intends to analyze the effectiveness and real-life application of OHS. To be able to provide an analysis and attempt to find the area where an improvement is necessary for reducing the accident rate at the site, this study part is provided.

As it was possible to gather some data from the construction site workers at the Nuclear Power Plant in Slovakia, it was decided to use their opinions within an analysis. The replies from this survey are going to be further used to determine whether OHS guidelines are kept in real-life, especially at the construction site of such dimension. The outcome is used further whether there is an area for improvement to decrease the number of non-fatal and fatal accidents at the construction site. The selection of this construction site happened purely because of the available relationship connections towards workers at this site, due to the personal previous work experience of a student at this particular construction. The survey itself is attached in chapter number 13 – Appendix.

7.1 Survey results

Results shared in this chapter are based on the replies collected from the survey that was filled by the construction site employees. As 9 out of 15 surveys returned, it might be considered that the overall interest in OHS might not be that high from the perspective of the employees. However, it must be considered that there might be several other aspects that stopped papers from returning, such as loss, damage, being not present at work when the collection took place, and so on.

Further, the question from the survey is going to be analyzed below by showing the actual question and number of replies by the employees. Each question is graphically presented to reinforce visually the successfulness of occupational health and safety procedures in real-life examples.

Question no. 1: Have you participated in an OHS training at the time of your admission to this job?

Available answers – received answers (in persons):

a) Yes - 7
b) No - 2

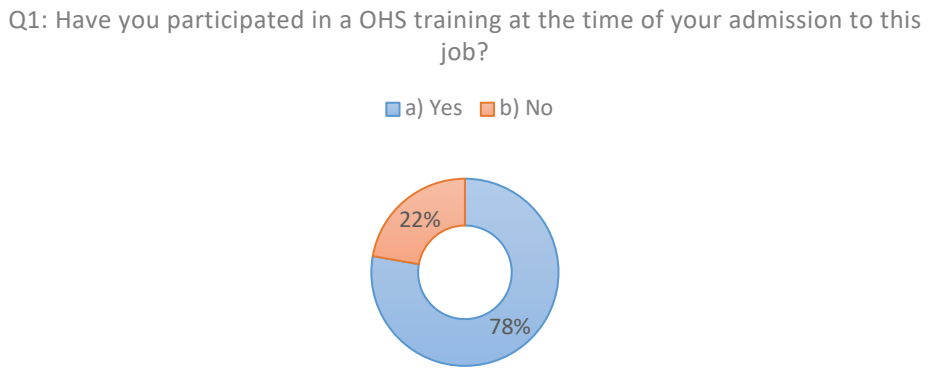

Figure 5 Graphical representation of question 1

Based on the received replies we can evaluate that company is aware of the need of providing this OHS training to their employees. At the same time, we can observe that it is still not considered as something binding, as about 20% replied that they did not undergo such training. However, it must be considered, that these employees are often transferred from one construction site to another and therefore might misunderstood the question and think that the question asks about this specific job at the mentioned construction site, not at the time of their start at their company in general.

Question no. 2: Do you think that your OHS training was sufficient?

Available answers – received answers (in persons):

a) sufficient - 2
b) quite sufficient - 6
c) insufficient - 1

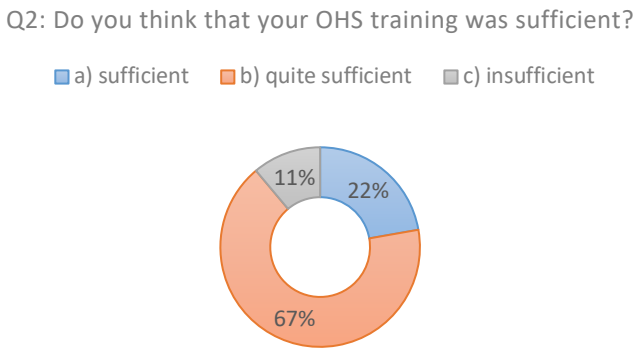

Figure 6 Graphical representation of question 2

From these replies, it may be considered that employees were mainly satisfied with the level of OHS training, as 8 out of 9 persons thought of it as sufficient or quite sufficient.

Question no. 3: Have you received information regarding OHS at this construction site?
Available answers – received answers (in persons):

a) Yes - 2
b) No - 7

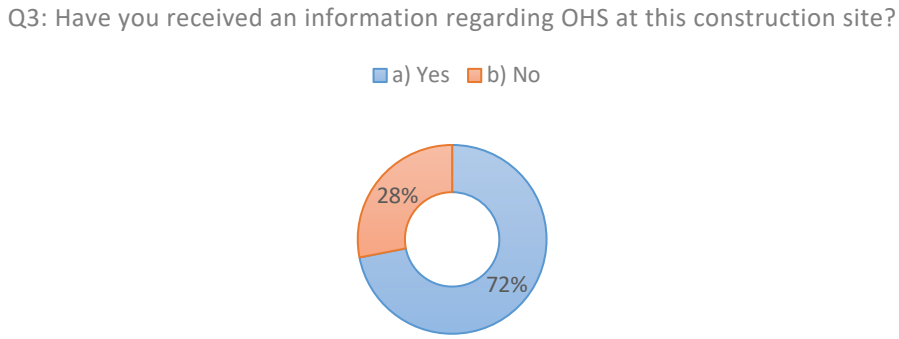

Figure 7 Graphical representation of question 3

Received answers to question 3 signify that a high percentage of employees (72%) were not informed about the actual occupational health and safety rules valid for this specific construction site, even though the construction of such a power plant requires some additional information. It can be assumed that the employer's management team considered general OHS guidelines that were workers informed about sufficient enough as no additional training was provided. At the same time, it must be mentioned, that within the larger sample size group, results may show a different result.

Question no. 4: Have you been information who is a construction site coordinator or whom to contact in case of a problem or an accident?

Available answers – received answers (in persons):

a) Yes - 7

b) No - 2

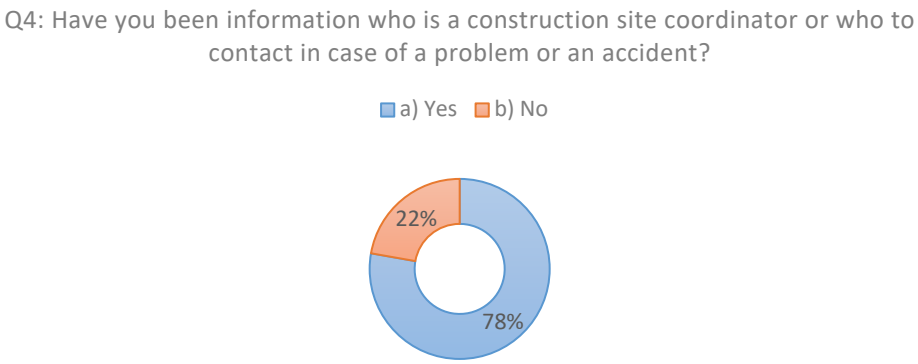

Figure 8 Graphical representation of question 4

Results show that informatization is at an acceptable level, at around 80% of knowing whom to contact in case of an emergency. However, it is not satisfactory, as all people present at the construction site should be able to react immediately when in need to report.

Question no. 5: Have you received PPE before entering to the construction site?

Available answers – received answers (in persons):

a) Yes - 9

b) No - 0

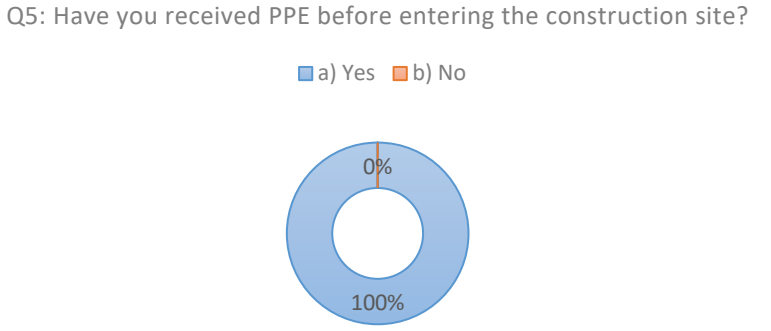

Figure 9 Graphical representation of question 5

Obtained results regarding the PPE of the employees has reached 100%, therefore none of the employees could have entered this site without PPE. This result is enforced by the fact that is

known from the personal sources that on all entries to this site is placed a security guy whose responsibility is to ensure whether required PPE is worn, and no person can enter if any of the PPE items is missing.

Question no. 6: Have you seen an accident at the construction site, or do you know anyone after a site accident? If yes, did it change your perception of PPE?

Available answers – received answers (in persons):

a) Yes, and I wear more PPE - 4
b) Yes, but I wear PPE at all times - 2
c) No, I have not seen an accident happen and do not know anyone like that - 3

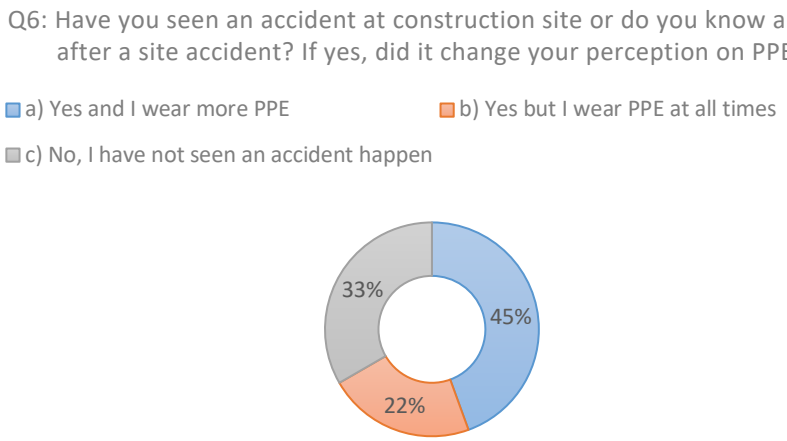

Figure 10 Graphical representation of question 6

Having experienced an accident at the site in the past has positively influenced workers. Therefore, almost half of all asked feels that wearing PPE is for their good and is a necessity to keep them safe. The last group, the third of the group has not seen any accident happen, but as at this specific site they have to wear all PPE and are checked whether they do, they do it anyway. Because of that another option d) could have been created to find out whether they wear PPE at another construction site as well regularly where they are not checked instantly.

Question no. 7: In case you answered yes for question 6, please answer, otherwise, skip. Was that person after an accident able to return to work and to the same position? In both cases, yes or no, please specify details.

Available answers – received answers (in persons):

a) Please specify – 3 (6 did not participate)

- My colleague fell from height during the apartment dwelling construction abroad, was in the hospital for several weeks and just survived. Then he was just getting well at home for some months and visiting doctors. He was not able to return to construction, so he started to work as a supplier in a restaurant near his house. It's been 3 or 4 years since.
- My friend's husband was working at the motorway construction company. During some road reconstruction where speed was decreased from 130 km/h to 60 km/h, one of the drivers did not switch lanes that were ending and hit him by car. He stayed paralyzed.
- I know a guy who cut off three of his fingers during cutting with machinery at a construction site probably because he did not wear protective arm equipment. He was fit and back to work after a few days.

Question no. 8: Did you notice that the management made rules any stricter after an accident has happened? In case yes, please specify.

Available answers – received answers (in persons):

a) Yes (specify) – 4
b) 5 did not participate

- We got additional PPE
- We were called for a meeting regarding what happened and what was done wrong
- Yes
- We repeated OHS training

From the received replies it can be deduced that those construction site workers that were aware of a recent accident also noticed that their management made some effort to prevent an occurrence of such accident in the future either by providing an additional PPE or repeating the safety training. The rest of the group either did not have any experience with such thing or did not reply for other reasons.

Question no. 9: Have you been informed about the fines or penalties for not coping with OHS rules?

Available answers – received answers (in persons):

a) Yes - 6
b) No - 3

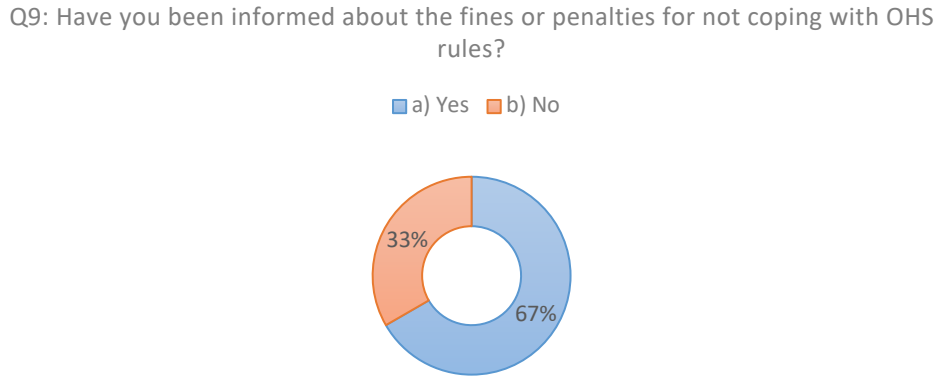

Figure 11 Graphical representation of question 9

Received answers show that almost one-third of all asked do not know there are penalties, or they are not aware of their height. On the other hand, the other two-thirds are aware of them and it can only be assumed whether the penalties do have any effect on wearing the PPE in the means of fear of getting fined. However, this might be the way in case it is discovered this does improve the overall safety and keeping the OHS principles.

Question no. 10: Have you ever been motivated to wear PPE and keeping OHS rules in any form of financial or benefit compensation?

Available answers – received answers (in persons):

a) Yes - 8
b) No - 1

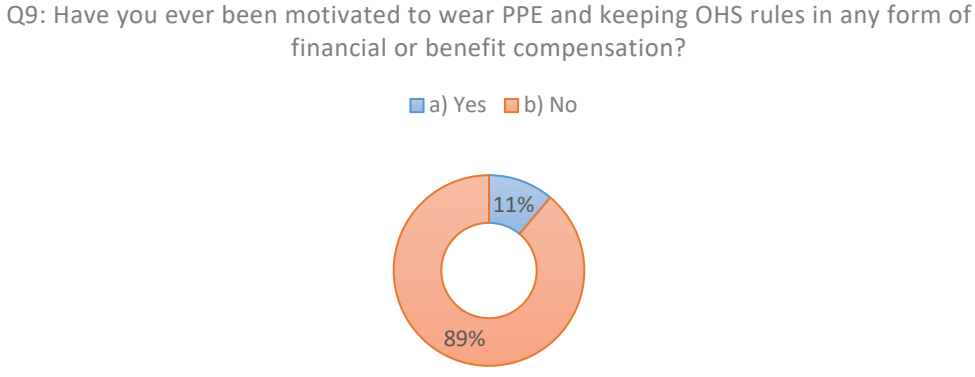

Figure 12 Graphical representation of question 10

It is interesting to observe that almost 70% of workers are aware of the penalties, but almost none are aware of the benefits they could be getting for keeping the safety guidelines.

Theoretically, benefits to the employees in any form might be considered to increase the overall safety awareness and possibly, at the same time, decrease the number of accidents.

Question no. 11: Are you included in the preparation of the OHS plan or do your bosses discuss possible improvements with you?

Available answers – received answers (in persons):

a) Yes - 0
b) Sometimes - 3
c) Never - 6

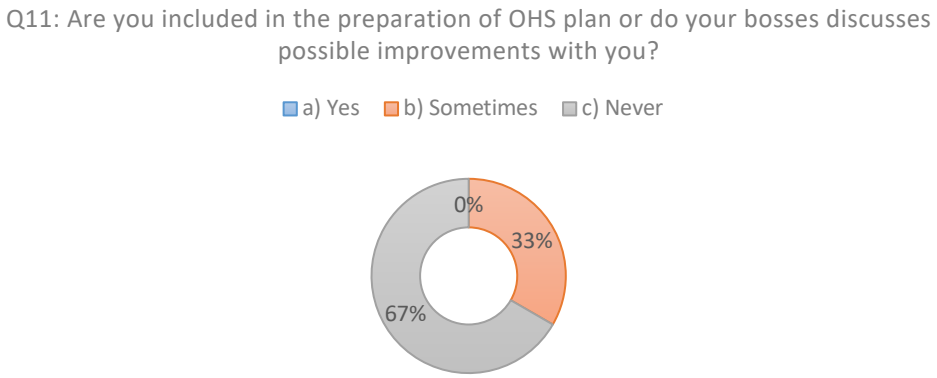

Figure 13 Graphical representation of question 11

Results show that these employees were included in the preparations of safety plans rarely, as none answered surely that they are included, only about third responded that they do, sometimes. Often, management that is not physically present in the specific jobs being done does not see the situation from the same perspectives as their employees, therefore their inclusion is necessary to express to them that the management is concerned about their safety and their opinion on safety procedures.

8. PREVENTION PLAN

Each management system that is implemented in an organization has some imperfections. Therefore, the importance of the previous chapter and the survey placed was necessary to detect these imperfections, where are the weak points of the OHS management within the organization these employees work. Based on the statements given after each question on the received replies, an improvement prevention plan is going to be proposed.

8.1 Improvements to the organizational structure

After scrutinizing of replies received in questions regarding the informatization of the employees regarding contact person in case of an accident, the inclusion of employees in the preparation of the guidelines it can be considered, that communication was one of the key aspects missing. As the OHS structure is formed by the site manager, OHS coordinator, and the workers, all are responsible for the overall safety at the site (Monash University, 2007). The OHS coordinator is the person responsible for most of the issues related to OHS. The overall objective is to keep the construction plan but at the same time OHS principles, to avoid accidents (PlanRadar, 2019). To assure the safety at the site, these obligations are advised to be kept by the OHS coordinator:

- Coordinate all present persons concerning OHS and make sure that general guidelines are kept to protect the health and safety of people and therefore avoid the creation of work accidents.
- In case any defects to OHS are detected during an ongoing construction process, the coordinator is responsible to list and communicate these issues with the site management or the entire management team to apply an amendment to the currently used rules.
- Communicate and discuss improvement possibilities all matters with the representatives of construction workers.

As last was mentioned cooperation of a coordinator and employees. Based on the outcome of the survey it is considered as the most common issue and it is believed that the importance of

communication between the management and employees is essential to avoid misunderstandings by the employees concerning occupational health and safety. It is assumed that by sufficient communication the workers will understand better what is required from them and therefore keep the OHS principles better. Based on this knowledge, organizational structure for the OHS at the site is provided to ensure quality communication which may lead to a safer construction site:

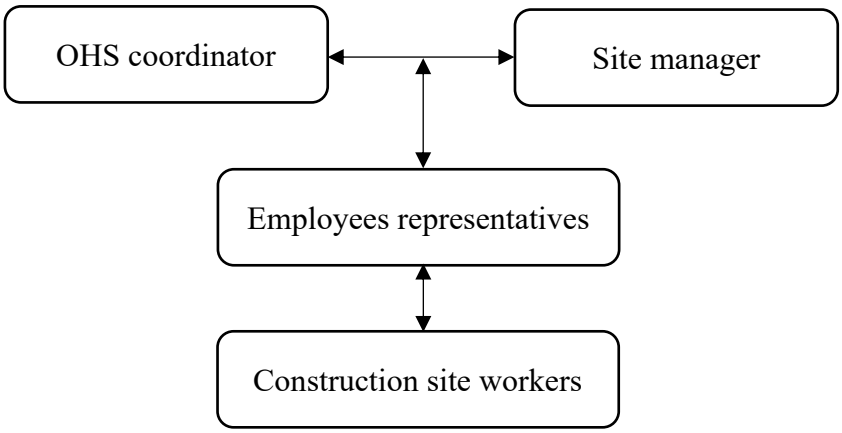

Figure 14 Proposal of organizational structure in regard to OHS at site

The figure above represents the proposed organizational structure at the construction site, which may lead to an improvement of communication and therefore, decreases the number of accidents. OHS coordinator and site managers are those important to promote the same approach to address specific issues correctly and without doubts about the employees' representatives. At the same time, the employees' representative is responsible for addressing the boss information and opinions to the management to make sure it is double-sided communication. The last cell is the site workers whose job is to adhere to OHS principles.

8.2 Introductory training

It is believed that first OHS training is one of the key aspects to start safely. As it was discussed earlier, there is a law within each EU country to performs such introductory training. After undergoing such training, employees should be instructed regarding Occupational Health and Safety at the construction site. It is believed that by performing this training for more employees at the same time, this may help them come sort of to the same adherence of principles within the group, compared to making it individually.

Such training should contain basic information regarding the safety plan at site, fees for breaking the principles of OHS, the organizational structure in case of an accident – whom to contact, etc. Exactly this was found by the survey to be missing relatively a lot. It is important that this training is performed in a certain quality, according to the pre-prepared scheme, to make sure that some points are not skipped and therefore, employees will miss necessary information. Ideally, by the end of the training, participating employees could fill in paper feedback where they would be required to answers questions that were discussed. That would be done to make sure they were informed properly and understood the entire guidance. Lastly, in the case received replies on the feedback would not be satisfactory, a proposal for its repentance should be addressed by the OHS coordinator.

To make sure that employees are aware of all regulations, such a list should be prepared for the introductory training:

- General guidance on keeping the safety standards which are employees committed to
- Introduce entire construction site in which are workers performing their jobs, introduce working machinery, equipment, etc
- Present the most predictable risks at work which may employees face
- Explain specific jobs that require wearing of PPE
- Inform that operation of machinery lies within the responsibility of the person that is instructed for its use and cannot be used randomly by others
- Instruct on keeping machinery in dedicated zones, keeping them in good condition so it could not expose the others
- Inform regarding required clothing
- Report each situation that may cause harm, such as broken machinery, dizziness, deterioration of health, to decrease the risk of accidents
- Inform whom to contact and how when an accident of any type and seriousness happens and instruct on how to behave when such a situation occurs
- Clarify where are electricity switches, gas, and water shutter, where is first aid placed, and where the emergency exits are
- Instruct on first aid and possibilities of ambulance call

As these are fulfilled, in order to show interest to employees, each of them should have space for questions, explaining their doubts and opinions. Based on the received replies and

researched literature, it is believed that this introductory training may prevent an occurrence of accidents at the site.

8.3 PPE

The survey displayed that PPE is for the workers' sort of everyday routine. However, there were situations discovered where an improvement could take place. As per law, the employer is responsible for providing PPE in zones where the hazard cannot be prevented by technical equipment or methods for work reorganization.

Therefore, the prevention plan should include a record of which employees were handed certain PPE, and a person that will be responsible for keeping this list should be assigned. As a construction site is a place where equipment gets damaged quite quickly due to the environment, these PPE as well as work clothing and boots should get replaced regularly to make sure this PPE serves the purpose they were firstly designed for. Thus, replacement of these could take place for instance every 6 months.

Employees could be encouraged in a sense that they know responsible OHS coordinator might check on them anytime during the day whether they stick to OHS principles and whether they wear PPE and in case yes, whether these are worn effectively to avoid any accidents. In case of any doubts, it should be the coordinator’s responsibility to immediately address these issues to the site manager.

8.4 Motivation towards compliance with OHS

According to personal opinion, each organization has available options by which they can promote compliance to OHS principles and therefore decrease their accident rates. As it was discovered earlier, companies often do not wish to invest in motivation but are not aware of the fact that motivational bonuses might cost them by the end less than cost related to an accident. These expenses may include insurance surcharges, compensation payment, lost working time at site, damaged machinery or products, delay in production time, repeating education, and more.

Based on that, an organization must be aware of the fact presented in the introduction of this thesis:

> *"Companies can save three to five euros for every euro invested in a safety and health program."* (BIGRENTZ, 2020)

We are convinced that by promoting safety in form of motivation, the effort of the employees to comply with the safety regulation is going to increase. The proposal is to prepare a noticeboard where main OHS principles are going to be promoted interestingly. This should be placed at the most frequent spot. At the same time, a board could include a paper for employees' suggestions that will be checked regularly by the OHS coordinator, and then it will be easier to address these issues to the management. By doing that, employees will be able to see that their opinions matter to their management.

Further motivation could be the valuation of the employees for the days when there no accident happened at the site. This motivation could, for instance, occur in a form of gifts. For example, for a certain number of days without an accident, a cup, or a t-shirt with the company logo could be handed out to employees. In case the number of days without an accident would exceed management's expectations based on their previous experience, employees could be motivated by a financial bonus added to their usual wage.

9. DELIMITATION

As this thesis was prepared in the limited time resources of one semester by one person, there surely are several delimitations to it. The first of them lies within the specification of the construction sector. Construction is a large area with many different areas, such as large-scale residential buildings, commercial buildings, small houses, bridges, tunnels, roads, offshore works, and more. We are aware that each of them requires a slightly different approach on the OHS principles. However, due to lack of time as well as available data, the construction site within is the thesis is considered as every location where is any type of ongoing construction.

Following, the report does not consider details of an injury or an accident in details. The focus is not put on the seriousness of an accident or its later consequences from the medical perspective. This analysis leads towards avoidance of these accidents by creating an awareness of their possible seriousness. Therefore, it is not differentiated whether an outcome of an accident was for instance a broken leg or paralyzation. The reason for looking at those incidents is to resolve why it happened and attempt to find possibilities to mitigate them. All earlier stated was a prerequisite for the preparation of the prevention plan presented within the thesis.

Moreover, it must be mentioned that all data were collected either from the statistical agencies of the EU and other countries or from the survey that was conducted. While data gathered from renowned EU sources may be considered highly relevant, the survey was conducted within a small group of 9 persons from one specific construction site. This was done due to the inability to collect more personal opinions from the site, neither from more construction sites. The low number of participants may influence the overall judgment and generalization of the presented results. Unlike with the larger sample group, selected construction workers were from one workgroup, therefore may also present similar opinions. At the same time, as they were filling these surveys at the site, they may be doing it together, hence, their opinions might be different otherwise. Therefore, in order to present opinions based on received replies more certainly, it would be essential to increase the number of participants significantly.

Regarding the survey, it must be considered that surveyed persons could not answer already legitimately. This might be due to incorrectly understood the question, not clearly formulated question. At the same time, some of the questions were about their past experiences regarding

OHS and how they were introduced to it. These workers also may not remember how this was happening some months ago, therefore they provided irrelevant replies.

Lastly, this survey did not consider different age groups, educational backgrounds, genders, etc. This was unable to obtain due to a lack of data. All these were put in one uniform group that was used as a research point.

10. DISCUSSION

Regarding workplace accidents, in the thesis' survey sample group it was discovered that employees who have experienced an accident at the construction site were more careful in the proper wearing of PPE. It means that their experience encouraged them to work on accident prevention. A similar approach was reached by the thesis which claims that:

"Learning from accidents is considered a fundamental step forward to guarantee more generic prevention of their repetition ". (Department of Chemical Engineering, University of Rome, 2019)

Similarly, as presented in this thesis, organizations investing in prevention and motivation can ease their financial situation, as post-accident stages require specific expenses that often outmatch expenses related to prevention. A similar outcome has been discovered in the research dedicated to the description of work accidents. They found out that apart from the serious social and economic consequences related to the employees and their families after an accident, company and governments needs to spend on assistance or rehabilitation (Victor Hrymak, 2007). At the same time, often workers of productive age are lost due to an accident (La S Aracema Scussiato, 2013). As was advised by this thesis, the employees and employers need to understand the consequences of the accident. One of the studies also present the need for publication of the accident impact on the employee and the employer is necessary (Victor Hrymak, 2007). The same source presents, that further research on proving the effectiveness of avoidance of workplace accidents is needed. This might motivate both, the employer and their employees to consider OHS principles more seriously (Victor Hrymak, 2007).

In means of proposed OHS preventive measures for decreasing accidents at the site, the intention was to set rules within the construction sector, which could be designated specifically for the actual situation that occurs at sites. There are general OHS guidelines published by governmental authorities and these serve as general guidance on OHS at the workplace. We intended to amend them for the specific site. A comparable result was discovered within research where it was found that:

"The results can be used to reduce the occurrence of similar accidents by means of specific OHS measures in this sector". (Department of Chemical Engineering, University of Rome, 2019)

Therefore, our presented intention of modification to OHS based on certain accidents occurring at the specific construction site is reasonable. This is confirmed by another research conducted,

which claims that safety barriers for different hazards vary and the management is required to implement these barriers and modify them accordingly (Jørgensen, 2016).

In the context of accident reduction, the thesis was not able to refute or confirm whether more training and additional preventive measures might have a direct impact on the accident rates. This was mainly because of the insufficient survey sample size. However, several types of research confirm fact that more prevention and more training is the way to go in ensuring safety at a workplace (Wahab, 2017). Their results are validated on a sample of a few thousand participants.

To sum up, the continuous need for improvement and prevention plans within the OHS of the construction industry is a matter of discussion. Along with the fast-developing industry, regulations, standards, and laws are to be developed sensibly and effectively. Just by doing that the society can be assured that the well-developed trend of accidents decline at the construction side, may continue even further.

11. CONCLUSION

Research from the collected governmental data demonstrates the presence of a high number of accidents within the construction industry. Even though the trend for the last decade indicates a certain decline in the overall number of accidents within construction, numbers are still attracting our attention and ask for an improvement (Eurostat, 2020).

The thesis studied available resources that can eliminate the occurrence of such accidents. Occupational Health and Safety is the key aspect that is designated to control and manage adherence to pre-set rules. Previous research showed that with the support of Personal Protective Equipment, several accidents can be prevented. Refereeing to the conducted survey, construction workers are adhered to Occupational Health and Safety principles as well as to Personal Protective Equipment, to some extent.

At the same time, as mostly communication issues were uncovered judging by the obtained results from the survey, there is an evident area for improvement in regards of communicating the OHS principles towards the employees. Similarly, construction site management should be able to pay attention to employees' opinions, as they are often the ones better aware of the circumstances of the practical application of established rules.

Moreover, an interest was set in the means of the convalescence of the workers that underwent an accident. Even though there were some situations described, due to insufficient data it was not possible to examine further on this matter. On the other hand, it was discovered, that those employees that were in a contact with an accident at the site, were well aware of the seriousness and importance of coping with the OHS guidelines.

Therefore, it may be concluded, that all established guidelines are proving effective and their application in real-life scenarios makes great sense. However, its promotion and further development of the preventive measures are essential for the reduction of accidents occurring at the construction sites.

12. FUTURE WORK

Construction is a large sector, as well as safety issues related to it. As this thesis was significantly limited mainly by the data and time resources, further development of this topic is undeniable.

Firstly, the content of this thesis focuses on the overall legislative actions taken by the European Union authorities, as well as its statistical data collected by the member states. As a certain decline in non-fatal and fatal accidents at construction was noticeable, more specific research on these could take place. For instance, the EU was introducing some new safety guidelines, which were introduced at a specific date. For future research, it would be interesting to observe, whether the implementation of the new rules had a direct effect on the decline of accidents or not. In case it did in any way, how long did it take from the publishment of the new guidelines until all EU organizations emerged? What was the effect on the overall OHS being actually kept at construction sites? It would be interesting to observe, whether new guidelines which are meant to decrease accidents rate, somehow actually obtain the desired goal.

Secondly, as the survey was conducted by addressing some individuals, it is appropriate to consider whether such a sample size can be considered relevant. For the development of this research, several construction companies should be contacted and asked to assist in such data collection. Doing that will help enlarge collected data and therefore reinforce the significance of developed results. From this perspective, it would be also interesting to research whether there are any differences in the opinions (results) collected from the different age groups, genders or nationalities. It is believed that people that have established certain habits within their working routine might be harder to train for something new. On the other side, when young workers come to a construction site directly from their schools, an organization can train them in a way so they will be able to adopt these rules quicker. This is considered by the fact that they do not have any previous experience and cannot rely on something they know from the past, as they have not been in this position yet.

Lastly, this thesis aimed to investigate those that experienced an accident at work. Apart from the preparation of certain preventive measures to avoid accidents, the aim was to look at post-accident situations of people, whether they were able to come back to work, how their employer assisted after an accident? What the employer able to take him back to the previous position or

probably offer some other spot? Some of the researched workers replied in the survey that they do know someone that was in a serious work accident and often could not come back. For future work, these people might be probably taken for a campaign to those that are still working at the site, just to show them how serious can be not coping with OHS guidelines. It is done similarly to road accidents, smoking, and more. At the same time, the development of this topic could take place in a matter of employer's responsibilities for the injured one and return to working life. Nowadays, the company needs to pay compensation to the worker that got injured. But probably by making rules stricter and bringing more responsibilities on taking care of the injured employer, the company would be motivated to cope with the actual OHS rules and manage overall construction site safety more carefully. However, this topic has something to do with social insurance and other benefits after an accident and is in a need of an in-depth analysis involving several other stakeholders.

13. APPENDICES

Appendix - Survey

Question no. 1: Have you participated in an OHS training at the time of your admission to this job?

Available answers:

a) Yes

b) No

Question no. 2: Do you think that your OHS training was sufficient?

Available answers:

a) sufficient

b) quite sufficient

c) insufficient

Question no. 3: Have you received information regarding OHS at this construction site?

Available answers:

a) Yes

b) No

Question no. 4: Have you been information who is a construction site coordinator or whom to contact in case of a problem or an accident?

Available answers:

a) Yes

b) No

Question no. 5: Have you received PPE before entering to the construction site?

Available answers:

a) Yes

b) No

Question no. 6: Have you seen an accident at the construction site, or do you know anyone after a site accident? If yes, did it change your perception of PPE?

Available answers:

a) Yes, and I wear more PPE

b) Yes, but I wear PPE at all times,

c) No, I have not seen an accident happen and do not know anyone like that

Question no. 7: In case you answered yes for question 6, please answer, otherwise, skip. Was that person after an accident able to return to work and to the same position? In both cases, yes or no, please specify details.
Available answers: Please specify

Question no. 8: Did you notice that the management made rules any stricter after an accident has happened? In case yes, please specify what.
Available answers:

a) Yes - specify
b) No

Question no. 9: Have you been informed about the fines or penalties for not coping with OHS rules?
Available answers:

a) Yes
b) No

Question no.10: Have you ever been motivated to wear PPE and keeping OHS rules in any form of financial or benefit compensation?
Available answers:

a) Yes
b) No

Question no.11: Are you included in the preparation of the OHS plan or do your bosses discuss possible improvements with you?
Available answers:

a) Yes
b) Sometimes
c) Never

14. BIBLIOGRAPHY

Cambrdrige Dictionary. (N/A). *Meaninf of prevention in English*. Cit. 2. January 2021. Dostupné na Internete: https://dictionary.cambridge.org/dictionary/english/prevention

Cambridge Dictionary. (N/A). *Cambidrge Dictionary.* Cit. 1. January 2021. Dostupné na Internete: accident: https://dictionary.cambridge.org/dictionary/english/accident

Certificaton of managing systems / Certifikácia manažérskych systémov. (2019). *Certification of OHS managing system based on standard ISO 45001 (ex OHSAS 18001)*. Cit. 6. November 2020. Dostupné na Internete: https://www.cems.sk/produkt/18-certifikacia-systemu-manazerstva-bozp-podla-normy-ohsas-18001-iso-45001-2018?gclid=Cj0KCQiA88X_BRDUARIsACVMYD_Xa_gcfUWtbtwoqP8PYELZolWnODlGDaNcc5oB5H29uIfziPjKUXsaAgpJEALw_wcB

Collins Dictionary. (N/A). *Definition of postaccident*. Cit. 1. January 2021. Dostupné na Internete: https://www.collinsdictionary.com/dictionary/english/postaccident

BIGRENTZ. (9. March 2020). *25 Construction Safety Statistics and Trends for 2020*. Cit. 5. September 2019. Dostupné na Internete: https://www.bigrentz.com/blog/construction-safety-statistics

Block O'Toole & Murphy. (N/A). *Causes of Construction Accidents*. Cit. 29. October 2020. Dostupné na Internete: https://www.blockotoole.com/Construction-Accident-Help/Causes-of-Construction-Accidents.shtml

Building Radar. (29. January 2020). *Data for the construction industry in Europe*. Cit. 19. September 2020. Dostupné na Internete: https://buildingradar.com/construction-blog/construction-industry-europe/

Department of Chemical Engineering, University of Rome. (27. November 2019). Risk Profiling from the European Statistics on Accidents at Work (ESAW) Accidents′ Databases: A Case Study in Construction Sites. *International Journal of Environmental Research and Public Health*.

EUR-Lex, European Union law. (11. December 2008). *European Union law.* Cit. 14. October 2020. Dostupné na Internete: https://eur-lex.europa.eu/eli/dir/2002/44/2008-12-11

European Commission. (2004). *ec.europa.eu*. Cit. 12. December 2019. Dostupné na Internete: Eurostat: https://ec.europa.eu/eurostat/documents/3888793/5832069/KS-CC-04-006-EN.PDF/1af31b4a-037e-4f60-af83-4afe5a199df4

European Commission. (2008). *Guideline of guaranteed standards for issuance of regulations (work at heights).* Luxemourg: Office for issuance of governmental publications for European Union.

European Commission. (14. December 2011). *Social Europe.* Cit. 2020. Dostupné na Internete: Socio-economic costs of accidents at work and work-related ill health.

European Agency for Safety and Health at Work. (N/A). *National legislation on safety and health at work*. Cit. 4. December 2020. Dostupné na Internete: https://osha.europa.eu/en/safety-and-health-legislation/national-legislation-safety-and-health-work

Eurostat. (2018). *File:Non-fatal and fatal accidents at work, by working environment and economic activity, EU-28, 2017*. Cit. 16. November 2020. Dostupné na Internete: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Non-fatal_and_fatal_accidents_at_work,_by_working_environment_and_economic_activity,_EU-28,_2017.png

Eurostat. (November 2020). *Accidents at work statistics*. Cit. 12. December 2020. Dostupné na Internete: https://ec.europa.eu/eurostat/statistics-explained/index.php/Accidents_at_work_statistics#Number_of_accidents

Eurostat. (November 2020). *Accidents at work statistics*. Cit. 4. January 2020. Dostupné na Internete: ec.europa.eu: https://ec.europa.eu/eurostat/statistics-explained/index.php/Accidents_at_work_statistics#Analysis_by_activity

getsmarter®. (5. December 2016). *What is occupational health and safety? | FAQs*. Cit. 22. September 2020. Dostupné na Internete: https://www.getsmarter.com/blog/career-advice/occupational-health-and-safety/#:~:text=OHS%2C%20or%20Occupational%20Health%20and,focus%20on%20preventing%20workplace%20hazards.

Health and Safety Executive. (N/A). *Risk at Work - Personal protective equipment (PPE)*. Cit. 24. September 2020. Dostupné na Internete: https://www.hse.gov.uk/toolbox/ppe.htm

HoldRite. (N/A). *THE FATAL FOUR: WHAT THEY ARE AND HOW TO AVOID THEM*. Cit. 8. October 2020. Dostupné na Internete: https://www.holdrite.com/the-fatal-four-what-they-are-and-how-to-avoid-them/

Jørgensen, K. (January 2016). Prevention of “simple accidents at work” with major consequences. *Elsevier*, s. 46-58.

La S Aracema Scussiato, V. E. (2013). Description of work accidents in serious condition paraná - Southern Brazil . *BMJ Publishing Group Limited*.

Law for people.sk / Zákony pre ľudí. (9. March 2006). *Law about health and safety at work and changes in the additions to some law*. (G. o. republic, Producent) Cit. 18. December 2020. Dostupné na Internete: https://www.zakonypreludi.sk/zz/2006-124

Lorko. (2009). *Safety and hygiene at work / Bezpečnosť a hygiena práce.* Kosice, Slovakia: MaF s.r.o.

Miklos. (2011). *Stavebníctvo / Construction.* Bratislava.

Monash University. (2007). *Occupational Health & Safety*. Cit. 29. September 2020. Dostupné na Internete: https://www.monash.edu/ohs/OHS-structure-responsibilities/management-system

NiDirect Government Services. (N/A). *Accidents in the workplace*. Cit. 1. January 2020. Dostupné na Internete: https://www.nidirect.gov.uk/articles/accidents-workplace

Ondavsky. (2013). Management at construction site / Manažmenst na stavbe. In Ondavsky. Kosce.

Pacaiova. (2009). *Safety and risks of technical systems / Bezpecnost a rizika technickych systemov.* Kosice: Technical University of Kosice.

PlanRadar. (28. August 2019). *An insightful look on the dailies of the construction project coordinator*. Cit. 1. January 2020. Dostupné na Internete: https://www.planradar.com/construction-project-coordinator/

Statista. (12. November 2020). *Construction industry in Europe - Statistics & Facts*. Cit. 3. October 2020. Dostupné na Internete: https://www.statista.com/topics/5137/construction-industry-in-europe/

United States Department of Labor. (2020). *OSHA Data & Statistics*. Cit. 8. December 2020. Dostupné na Internete: https://www.osha.gov/data/commonstats

Victor Hrymak, D. J. (February 2007). The costs and effects of workplace accidents. *Health and Safety Authority Ireland*.

Wahab, H. A. (20. March 2017). Relationship between non-standard work arrangements and work-related accident absence in Belgium. *Journal of Occupational Health*.

Work Inspections of the Slovak republic - Inšpekcia práce. (may 2019). *Work accidents.* Cit. 15. October 2019. Dostupné na Internete: https://www.ip.gov.sk/wp-content/uploads/2019/05/Pracovn%C3%A9-%C3%BArazy-v-kocke_bro%C5%BE%C3%BAra-NIP.pdf

WorkSmart.org.uk. (N/A). *What is the difference between a 'hazard' and a 'risk'?* Cit. 1. November 2020. Dostupné na Internete: https://worksmart.org.uk/health-advice/health-and-safety/hazards-and-risks/what-difference-between-hazard-and-risk