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Occupational Health and Safety (OHS) in the Mongolian Road Construction Industry
– Analysing the State of Implementation of Organizational and Technical OHS
Measures and Developing Recommendations for their Improvement

Bachelor Thesis

by

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Occupational Health and Safety (OHS) in the Mongolian Road Construction Industry – Analysing the State of Implementation of Organizational and Technical OHS Measures and Developing Recommendations for their Improvement

I did not use any sources other than those stated. In case that the work is additionally submitted on a data medium, I declare that the written and the electronic form are completely identical. The work was not submitted in the same or similar form to any examination authority.

Nalaikh, 05.01.2023

Place, Date

Signature

Acknowledgment

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Sincerely,

Ankhgerel Munkhnast

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Abstract

Occupational health and safety (OHS) management is crucial in road construction companies to prevent accidents, injuries, and fatalities, and promote a safe working environment. However, many companies in this sector struggle with implementing effective OHS policies and procedures, despite the well-documented risks associated with road construction work. The literature review was made to provide key concepts, theories, and empirical findings related to OHS to design a survey question. An online survey using Google Forms was conducted, and the collected data was analyzed to identify the current state of OHS implementation and to observe essential factors for the improvement of OHS performance in Mongolia. The researcher hopes to gain a deeper understanding of OHS practices in sampled companies and provide recommendations for enhancing the safety and well-being of workers. The results of this study can contribute to the improvement of OHS management practices in Mongolia.

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1. Introduction

1.1 Problem Statement and Background

Road construction is a complex and high-risk industry that involves numerous activities, such as excavation, paving, grading, and heavy machinery operation. These activities expose workers to various hazards, including falls, struck-by accidents, caught-in/between hazards, exposure to hazardous materials, noise, and vibration, among others. Ensuring the health and safety of workers in road construction companies is of utmost importance to prevent accidents, injuries, and fatalities, and to promote a safe working environment.

Occupational health and safety (OHS) management in road construction companies involves the identification, assessment, and control of hazards, implementation of safety policies and procedures, training and education of workers, and compliance with relevant regulations and standards. However, road construction companies face unique challenges in managing OHS due to the dynamic nature of construction sites, changing work conditions, multiple stakeholders, and tight deadlines, which can impact the effectiveness of OHS practices.

Despite the well-documented risks associated with road construction work, many companies in this sector continue to struggle with implementing effective OHS policies and procedures. This is evidenced by a high incidence of accidents, injuries, and fatalities among road construction workers, which not only has a human cost but also leads to financial losses and reputational damage for companies.

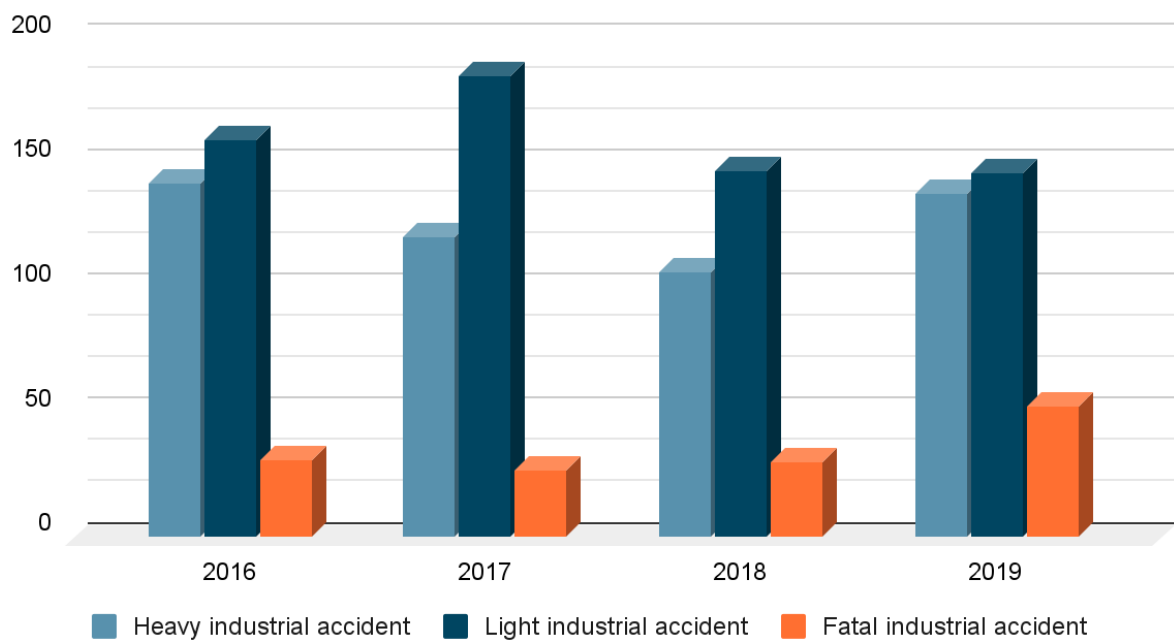


Figure 1: Industrial accidents of all sector in Mongolia (source: <http://inspection.gov.mn/>)

According to the data provided by the SPIA, there has been an upward trend in the number of industrial accidents and occupational diseases instead of a decrease in recent years in all sector.

Statistics of accidents in construction sector of Mongolia

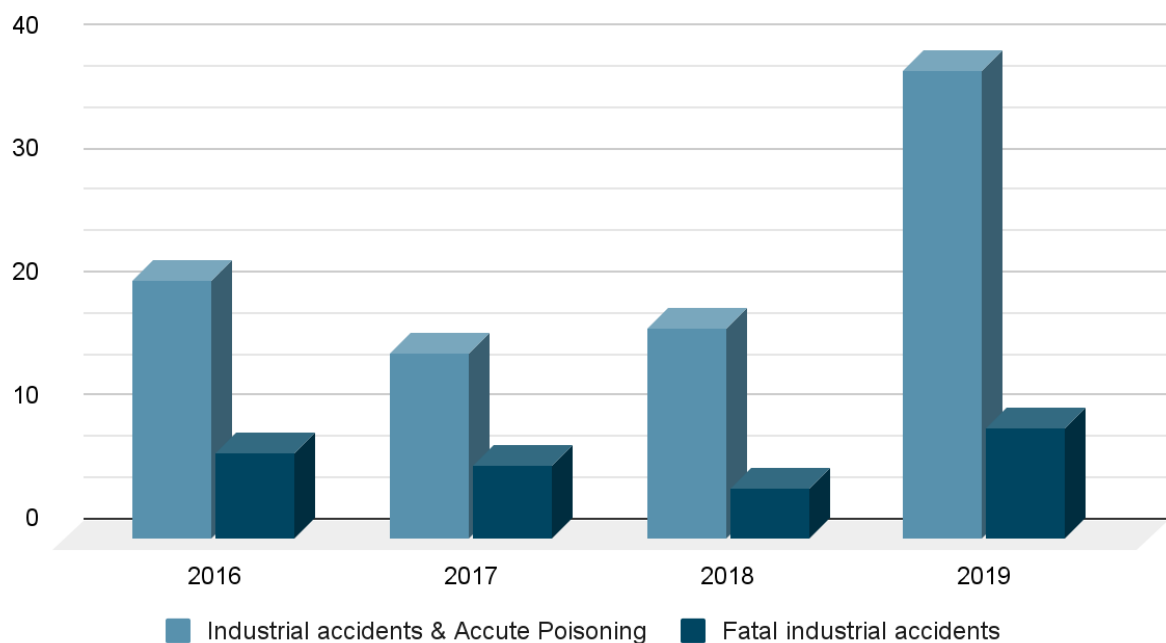


Figure 2: Industrial accidents and acute poisoning in construction sector (source: <http://inspection.gov.mn/new/>)

As the data of construction sector shown in the graph (1), the number of the industrial accidents and acute poisoning, and fatal industrial accidents have not decreased but increased. This actively demonstrates that the urge of OHS-related improvement should

be taken into account in Mongolia. Thus, further investigation and research on the causes of accident should be made.

Furthermore, the implementation of OHS practices and policies in Mongolia is often hindered by a lack of awareness, resources, and education on the importance of workplace safety. Many employers are not familiar with the principles and benefits of OHS and thus do not prioritize the implementation of necessary measures. As the result of “The national investigation of OHS law and regulation implementation” which had been held through 139 enterprises and companies and 2343 workplaces, the road construction sector had result of overall 57.9% which can be delegated to (2):

- Management and organization of OHS - 55.3%
- Safety of the machinery and equipment - 54.7%
- Working environment and condition - 63.7%

The result of the national investigation clearly shows that the necessity of the enhancement in road construction industry both in technical and organizational measures implementation.

The present state of affairs regarding occupational health and safety (OHS) warrants a need for considerable attention, not only in Mongolia but worldwide. The escalating incidence of occupational illnesses and accidents has resulted in laborers in the industry experiencing difficulties in carrying out their work efficiently and securely. Therefore, there is an imminent need to address OHS-related concerns to promote a safe and healthy work environment for workers across the globe.

1.2 Research Questions

To determine and suggest further improvement in implementing OHS measures and rules in Mongolia, it is crucial to define the current state of OHS implementation in the industry. Thus, the very first research question that should be answered by this thesis work is *“What is the current situation of OHS implementation in the Mongolian Road Construction industry from the perspective of Mongolian Road Association member companies?”*

After being able to answer the first question, the weak points of the current OHS state of the Mongolian road industry will be defined. Based on that the next question will be *“What are the weak points that should be improved for an effective and safe environment in the future?”*

Finally, this thesis work can find the improvement suggestions that can be answered *“What are the suggestions for OHS improvement in Mongolia that can lead to the successful implementation of OHS in the current state in Mongolia?”*

2. State of the art

The state of the art and literature review of this thesis aims to study the related topic of Occupational Health and Safety (OHS). This section provides an overview of the existing literature, definitions, theories, and statistics related to the topic. By examining the existing literature on OHS, this section aims to provide a critical analysis of the key concepts, theories, and empirical findings that have been developed in this field. Furthermore, this section also reviews relevant statistical data, outlining key trends and patterns in OHS. Also, the comprehensive overview provided in the state of the art and literature section will enable the researcher to design a questionnaire that effectively addresses the research question and contributes to a better understanding of OHS-related topics.

2.1 Concepts of Occupational Health and Safety

2.1.1 History of OHS

The history of Occupational Health and Safety (OHS) can be traced back to the Industrial Revolution in the 18th and 19th centuries. During this time, as industrialization took hold, there was an increase in the number of workplace injuries and fatalities due to the lack of regulations and safety measures in the workplace. Workers were subjected to hazardous working conditions, long hours, and low wages.

In response to these conditions, labor unions and social reformers began to demand better working conditions and protections for workers. The first recorded workplace accident investigation took place in the UK in 1833, and in 1838, the UK passed the first Factory Act which established a limit on the number of hours that women and children could work in factories.

Over the years, various countries have enacted laws and regulations to protect workers' health and safety in the workplace. In the United States, the Occupational Safety and Health Act (OSHA) was passed in 1970, which established federal standards for workplace safety and health. The International Labour Organization (ILO), a specialized agency of the United Nations, has also played a major role in advancing OHS on a global scale.⁽³⁾

Today, OHS is an important concern for governments, employers, and workers worldwide. It encompasses a range of issues, including workplace hazards, occupational diseases, and mental health in the workplace. OHS standards and practices continue to

evolve, driven by ongoing research and technological advancements, and with the aim of ensuring that workers can carry out their duties in safe and healthy environments.



Figure 3: Constructing building in an early period of OHS development (source: <https://www.wikipedia.org/>)

2.1.2 Basic Definitions of OHS

As the definition of ILO for **Occupational Health and Safety (OHS)**, it is defined as the science of the anticipation, recognition, evaluation, and control of hazards arising in or from the workplace that could impair the health and well-being of workers, taking into account the possible impact on the surrounding communities and the general environment.(4)

Industrial Accident is an unexpected and unwanted event that occurs during work activities that can cause injury or damage to property. These accidents can be caused by a variety of factors, including human error, equipment malfunction, or environmental hazards.

Acute poisoning refers to the rapid onset of symptoms resulting from exposure to a toxic substance, such as a chemical or drug. This type of poisoning can occur through

ingestion, inhalation, or skin contact and can result in a range of symptoms, including nausea, vomiting, dizziness, and loss of consciousness.

Occupational disease is a chronic condition or illness that is caused by exposure to harmful substances or conditions in the workplace. These diseases can develop over time and may be related to physical, chemical, or biological agents encountered in the workplace, such as exposure to asbestos or repeated use of vibrating tools. (ILO)

Near-miss is an unplanned event or situation that could have resulted in an injury, illness, or damage, but fortunately did not. Near-misses are often referred to as "close calls," "near-hits," or "near-accidents." Near-misses are important indicators of potential hazards in the workplace and can provide valuable information for identifying and addressing safety risks. Reporting and investigating near-misses can help employers and workers identify the root causes of incidents and implement measures to prevent similar incidents from occurring in the future.

Other OHS-related theories and definitions will be explained in each section they are mentioned.

A hazard is a source, situation, or act with a potential for harm in terms of human injury or ill health, or a combination of these. (ISO 45001)

Risk is the combination of the likelihood of an occurrence of a hazardous event or exposure and the severity of the injury or ill health that can be caused by the event or exposure. (ISO 45001)

Risk assessment is a process of evaluating risk arising from a hazard, taking into account the adequacy of any existing controls, and deciding whether or not the risk is acceptable (ISO 45001)

2.2 Measures of OHS

Implementing OHS measures is significant for several reasons. Firstly, it ensures the safety and well-being of employees, reducing the risk of workplace accidents and illnesses. Secondly, it can increase employee morale and job satisfaction, as they feel valued and protected by their employer. Finally, it can improve the overall productivity and profitability of a company, as a safe and healthy workforce is more efficient and less likely to experience absences or turnover.

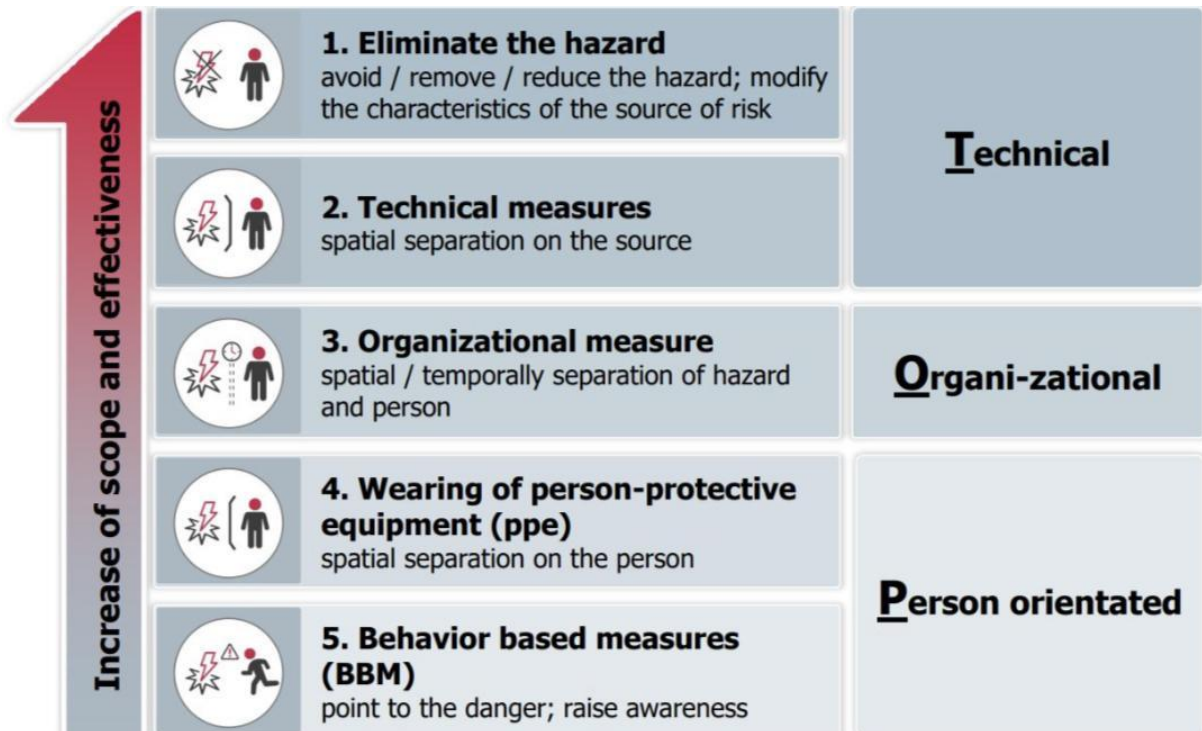


Figure 4: Hierarchy of OHS measures and its classification (source: HSE lecture slide of GMIT)

As shown in the figure above, the OHS measures can be classified into main 3 parts, which are technical measures, organizational and person-oriented measures. As the figure describes, the technical measures are most effective to eliminate the hazard risk and possibility of industrial accident occurrence. However, organizational and person-oriented measures are still important to develop and maintain a safe environment for employees from its base.

2.2.1 Risk Assessment and Tools

Risk assessment is a systematic process of evaluating potential workplace hazards and associated risks to determine the appropriate control measures to prevent or reduce the likelihood of harm. This process involves identifying hazards, assessing their likelihood and potential consequences, and evaluating the level of risk to determine appropriate control measures.

There are several tools available for conducting risk assessments, including:

- Checklists: A simple tool that can help identify potential hazards and control measures based on a set of predefined questions or criteria.
- Job Hazard Analysis (JHA): This is a detailed analysis of a specific job or task to identify potential hazards, assess their risks, and determine the appropriate control measures.
- HAZOP (Hazard and Operability Study): This is a more complex analysis used primarily in the process industry to identify hazards associated with new or modified processes, equipment, or procedures.
- Failure Mode and Effects Analysis (FMEA): A tool used to identify potential failures in a system or process, evaluate their effects, and determine appropriate control measures.
- Risk matrices: A visual tool that can be used to assess the level of risk based on the likelihood and consequences of potential hazards.

Such tools can help OHS specialists and other workplace safety professionals to identify hazards and evaluate the risks associated with those hazards. By using these tools, appropriate control measures can be identified and implemented to reduce or eliminate the potential for harm in the workplace.

2.2.2 Technical Measures

Technical or engineering measures for OHS are effective because they aim to control workplace hazards at their source. These measures involve the use of specialized equipment, machinery, and tools to eliminate or reduce exposure to hazards, such as noise, chemicals, or physical hazards.

By implementing technical or engineering measures, the risk of accidents and occupational diseases can be minimized, and the safety and health of workers can be improved. Moreover, engineering controls can be implemented systematically and are often designed to be more reliable than administrative controls or personal protective equipment.

Engineering measures can be defined as proactive measures because they are often implemented before the hazards become a problem, rather than waiting for accidents or illnesses to occur. This means that technical measures can prevent incidents before they happen, rather than responding to them after the fact.

In many countries, employers are required by law to implement engineering controls where feasible and to use other measures such as organizational controls and PPE only when engineering/technical controls are not feasible or sufficient.

Examples of technical or engineering OHS measures include

- **Machines guards** are an excellent example of engineering control in OHS. Machine guards are physical barriers that are installed on machinery to prevent workers from coming into contact with moving parts, hazardous energy sources, or other potential hazards.



Figure 5: Example of machine guard in real life (source: <https://www.wikipedia.org/>)

- **Ergonomic workstations:** An ergonomic workstation is designed to fit the worker's body and provide support and comfort, while also minimizing the risk of musculoskeletal disorders and other injuries. Examples of this can vary depending on the working condition and job. For example, anti-fatigue mats, adjustable work platforms, and tools with ergonomic handles and grips are some examples of ergonomic workstations in construction, whereas footrests, keyboard trays and wrist supports, and adjustable height desk are examples of office ergonomics.
- **Lockout/Tagout (LOTO)** refers to a set of procedures designed to protect employees from the sudden or unintentional activation or startup of machinery or equipment while performing maintenance or service activities. The lockout process involves securing an energy isolation device, such as a circuit breaker or valve, with a locking device to ensure that the equipment cannot be operated until the lockout device is removed. Tag-out involves using a prominent warning device, such as a tag or sign, to indicate that the energy isolation device and equipment are being controlled and should not be used until the tag-out device is removed. Tags or signs may also provide important information about the energy isolation of the equipment and serve as a warning to workers not to operate it.



Figure 6 Lock-Out Tag-Out illustration (source: www.safetynotes.net)

By utilizing such and other engineering measures, employers can provide a safer work environment and protect the health and well-being of their workers.

2.2.3 Organizational and Person-Oriented Measures

The Significance of Organizational and Person-Oriented Measures:

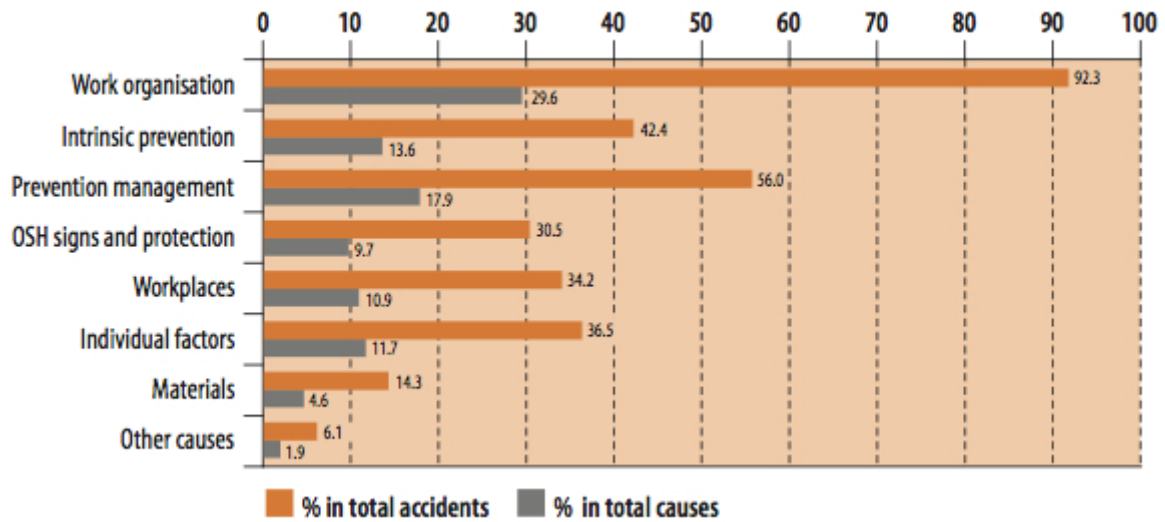


Figure 7 Occupational accidents investigated causes in Spain, all sectors, 2003-2004 (5)

Data on the causes of fatal occupational accidents investigated in Spain in 2003-2004 reveal that most occupational accident causes are organizational (Figure 7 above). Work organization defects accounted for around 30% of all accident causes, although investigation of actual accidents revealed similar defects in more than 90% of the total incidents analyzed.



Figure 8: Areas routinely considered in risk assessment in percentage of establishment (source: EU-27)

As a result, it is true that detrimental factors are governed to a large extent by the nature of the processes, technologies, goods, and equipment in the workplace, but they may also be governed by how the job is organized. (6)

Although dangerous variables will always be present in the human working environment due to the limited possibility of elimination and substitution, or technical measures of OHS, organizational safety measures could be considered also the effective solution for accident prevention. (7)

Organizational measures can include:

- **Working and rest time schedule**

Long working hours, high work intensity, rushing, and other factors are closely related to mistakes, unperformed or delayed action, insufficient use of control, and so on. The adverse risk elements (such as noise, heat, etc.) also contribute to the occurrence of errors and oversights. The aforementioned working conditions alter the physiological state of the individual. Because the worker must use more energy in his work, he may require more oxygen and his heartbeat may accelerate. On the other hand, it is true that exceeding working time limitations causes fatigue. Furthermore, shift employment makes it difficult to maintain a regular sleep schedule. If this continues over an extended period of time, the chance of injury increases.

As stated in an article by European Agency for Safety at Work, the following working and rest time should be scheduled in European countries (8):

- a minimum daily rest period of 11 consecutive hours per 24-hour period
- a rest break where the working day is longer than six hours;

- a minimum uninterrupted rest period of 24 hours for each seven-day period which is added to the 11 hours daily rest;
- maximum weekly working time of 48 hours including overtime
- **Job enrichment**

According to the empirical research, accident rates are adversely connected to a delegation of authority, increased worker autonomy and involvement, and high levels of mutual commitment (9). In some circumstances, beneficial benefits can be obtained by implementing work rotation, allocating jobs and responsibilities on a regular basis, expanding the role of the operators at work, and meeting or assessing their expectations. Job enrichment can be obtained by adding activities of a similar level to the job or by augmenting it with duties of a higher level. Both of these methods are often linked with enhancing job motivation by increasing employees' responsibility, passion, independence, and adequate feedback. Rotating workers through different tasks or providing them with opportunities for skill development and advancement can help reduce the risk of musculoskeletal disorders, repetitive motion injuries, and other occupational injuries.

- **Consultation and training (Increase the awareness of OHS)**

To implement the OHS measures in the organization, it is crucial to ensure that employees have an awareness of OHS-related topics and information which can be built up by the personal experience of individuals or training and instruction of the supervisors.

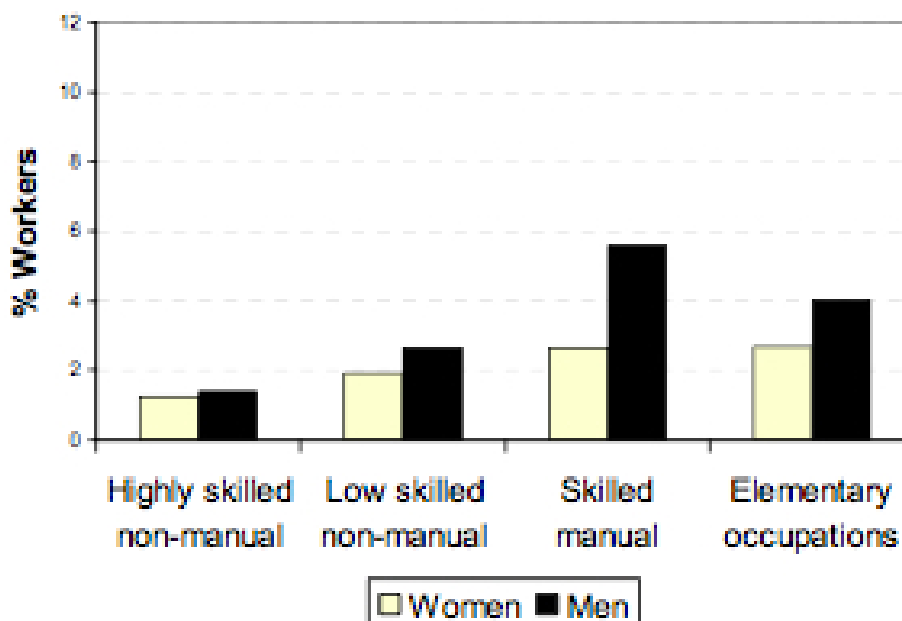


Figure 9: Accidents at work among different occupations in EU -27 (%)

As shown in the graphic above, the more skilled and experienced the employee is, the fewer accident chances he or she has. Due to the reason that having information and knowledge about OHS and how it goes, the employee understands how to work safely. Also, consultation between the employer and employee will have a positive value in ensuring hazards are identified and workable remedies are employed.

Effective communication and training are not only legal requirements in the EU, but also vital components of any occupational safety and health (OSH) program. These practices help workers recognize hazardous situations, work-related illness symptoms, and potential risks. A strong management commitment to communication, worker participation, and consultation is critical for the successful implementation of an OSH program and a safer working environment (10).

- **Accident registration to prevent accidents**

All types of accidents and incidents including light, heavy, fatal, and even near-miss should be registered in the accident registration of the company. The registration must define the accidents and incidents as precisely and accurately as possible to provide some insight and direction to prepare prevention measures appropriately.

2.3 Standards & Legislation of OHS

2.3.1 Legislation of OHS in Mongolia

Laws and regulations

As stated in Article 16, Chapter Two of the Constitution 1992, Human Rights and Freedoms, citizens of Mongolia shall enjoy the right to suitable conditions of work, health protection, and medical care, and material and financial assistance in case of old age, disability, childbirth, and childcare (11).

Ministry of Social Welfare and Labour (MOSWL) is responsible for the application of the following OSH laws and regulations (12):

- Labour Law
- Social Insurance Act
- Law on Pensions and Benefits provided from the Social Insurance Fund against Industrial injury and Occupational disease

- Law on Pensions and Benefits for military personnel
- Government Resolution adopting a new program on reproductive health (No. 288 of 2002), MNG-2002-R-71488
- Government Resolution adopting a National Program on Prevention of Accidents and Injuries (No. 156 of 2002)
- Parliament Resolution endorsing state policy on social health (No.81 of 2001)
- Government Resolution adopting National Programme on Improvement of Occupational Safety and Health Conditions (No. 153 of 2001)

Labour law of Mongolia has content that determines the labor condition classification, workplace requirements, requirements for machinery, equipment, personal protective clothes and devices, ways to handle chemical explosives, radio-active and bio-active substances, right and responsibilities of employers. These contents can be a guide for general OHS measures and requirements that should be implemented in the workplace for creating a safe environment for workers (13).

Mongolia had the first independent law on OHS on May 22, 2008, with the name of “Occupational Health and Safety Law”. The law has included the main aspects and concepts of OHS in 9 chapters and 37 items (14). A total of 7 changes were added from 2008 until 2021 including

- 2011-01-20 /Working conditions and protective equipment/
- 2012-12-21 /Changes related to the employee responsible for HSE issues of provinces, capitals, sums, districts, and committees/
- 2015-05-14
- 2015-12-04 /Rights, duties, and responsibilities regarding fire safety/
- 2016-09-01, 2018-06-27 Scope of the law /temporary and contract military servicemen, military personnel participating in mobilization schools and gatherings/
- 2021-07-02 /Changes related to the update of the Labor Law/

2.3.2 Standards and Regulations of Road Construction Sector:

Mongolia has not any specific legislation that should be followed sector by sector in the case of OHS. However, the industry experts and OHS specialists in the sector can build up the standards and norms which are based on their experience and knowledge, to implement the OHS legislations and laws more concretely in their sector. As for the road construction industry, there is a standard and norm under the name of “Mongolian

Occupational Health and Safety Norms and Rules in road construction” which has in total of 20 chapters that covers all the road construction processes and explains its standards in each process. The mentioned standard is formulated based on the OHS law 2008 with the additional change of 2015, MNSOHSAS 18001:2012 and MNSOHSAS 18001:2015 standards, and the Occupational Safety and Health Convention, which are currently implemented and followed in the Mongolian Road Construction Industry.

Examples of OHS measures mentioned in the OHS Regulation of Road Construction Sector:

The Policy and Plan of OHS in an enterprise: The administration of the company should have a policy and yearly plan of OHS which aligns with the vision and mission of the company to create a safe environment for the employees.

The OHS Specialists or OHS department:

- The company or enterprise that has 50 employees or above should hire the OHS Specialist who has knowledge and profession of OHS whereas the company or enterprise that has fewer than 50 employees can make a contract with a freelancer of OHS in the position of OHS Specialist.
- The OHS Specialist has the following responsibilities:
 - To ensure the implementation of OHS Regulations, Norms, and Laws
 - To introduce and implement the OHS administrative system in the company
 - To conduct an internal audit on OHS implementation and correct or take action on the breach of OHS regulations
 - To conduct a risk assessment and take control actions on the assessed risks to minimize it.
 - To document, analyze and report risk-related situations and register accident-related cases (including near misses, accidents, incidents, acute poisoning, etc).
 - To define, plan and conduct the necessary OHS training, etc.

Training should be conducted in the frame of MNS4969:2000.

- The content of the training should be developed by OHS Specialist and approved by the company administrations and related sector administration.
- There are 3 types of training including induction training for new employees, refresher training, and preliminary instruction.

- The training with specialized content should take place in units once a year from November 11 to April 1, and the employees who passed the OHS test will be eligible for work.

Personal Protective Equipment (PPE)

- Employers should provide each employee with PPE which are suitable for the working conditions. The PPE of summertime must have provided by April 1 of each year.
- OHS Specialists have a control role in PPE proper use by employees.
- Employees should use PPE properly, whenever it is required by the Safety Regulations or Safety Signs.

(source: Occupational Health and Safety Regulations, Ministry of Road and Transport Development of Mongolia,2016)

3. Methodology

3.1 Data Collection Methodology

Data for this study was mainly collected through a survey that was developed by the researcher. The survey instrument consisted of a set of questions designed to elicit information on various aspects of OHS implementation in road construction companies in Mongolia. The questions were developed based on a review of the relevant literature and input from OHS experts in the field.

The survey was distributed to member companies of the Mongolian Road Association (MRA), a leading industry association that represents road construction companies in Mongolia. The MRA members were chosen as the survey population as it is a well-established and representative organization in the sector, with a membership that spans a range of company sizes and types.

In Mongolia, Mongolian Road Association (MRA) is an association that most road construction companies are aligned with their interest as members of the association to contribute to the future development of the road construction industry. MRA with 198 members from the industry is a platform for managers also can exchange information on state-of-the-art occupational health and safety (OHS) protection as well as for driving the increase of OHS standards in the industry.

The survey was administered using an online platform - Google Forms, and participants were provided with a unique link to access the survey. Respondents were informed that their participation was voluntary and anonymous and that their responses would be kept confidential. The survey was available in Mongolian to ensure accessibility to all respondents.

A total of 45 participants completed the survey, representing a response rate of 45% among the active 100 members. The findings from the survey were used to answer the research questions and address the research objectives of this study.

3.2 Survey questionnaire development

Survey questions were designed based on the literature review that is reviewed in chapter two. Mainly the questionnaire aims to evaluate firstly whether the companies effectively implement the OHS measures and whether they have certain base knowledge and understanding about the OHS standards and rules that should be followed in the industry, and to determine the possible improvement which can be made in the future based on the current phase.

The survey consists of two parts. The first one is dedicated to collecting general information and characteristics of the company in order to analyze the responses later based on the size and length of time the company has been in operation, while the second part is intended for the analysis of the current state of OHS implementation within the company and to define the weak points based on the response of the staff.

The second part played the main role to determine and analyze the implementation of OHS measures and rules in road construction companies from the perspective of staff, who work in the real field of the working processes. The question in the second part are generally guided by the Guidance and Note by the Ministry of Road and Transport Development of Mongolia (MRTD) and the literature review of OHS. To have analyzable responses that can be resulted from the answer of participants, most of the questions were created as closed-ended questions and answers could be chosen from the multiple choice. Although the possible outcomes or reasons of the questions are inserted as an answer option, the researcher also includes the “other” option in her questionnaire answer section to provide participants the opportunity to mention or suggest any other additional essential idea or information that may not have been not included as an answer option.

Furthermore, some of the questions that are included in both parts of the questionnaire could serve as the control questions to define the reliability of the respondents by checking whether they know about what they are completing and answering. Those questions were necessarily included in the questionnaire to encourage realistic and accurate responses from participants.

The result of this thesis will be also contributed directly by the academic studies and articles that are reviewed on the topic of OHS in general and OHS in road construction. So that this thesis can suggest improvement recommendations based on the current state of Mongolia combined with the experience and best practices of other countries.

3.3 Data Evaluation Methodology

The data collected from the developed questionnaire will be thoroughly evaluated based on the key points that the researcher finds essential for the improvement of Occupational Health and Safety (OHS) performance. Through the analysis of the survey data, the researcher aims to identify real-life numbers and possible causes for accidents that have occurred in the respondents' companies. Additionally, the researcher aims to uncover hidden factors that may contribute to accidents and identify weak points that should be improved to enhance OHS practices.

To guide the data evaluation process, the researcher has defined four key points that will serve as the primary focus of analysis. Firstly, the researcher will examine whether the companies in the sample are following the basics of regulations and laws related to OHS. Secondly, the most possible cause of accidents that occur in the field will be identified and analyzed. Thirdly, the background reasons that lead to accident-causing situations will be investigated. Finally, the sufficiency of training and machinery will be assessed to determine their effectiveness in reducing the likelihood of accidents occurring. By analyzing these key points, the researcher hopes to gain a deeper understanding of the OHS practices in the sampled companies and provide recommendations for improvements that can enhance the safety and well-being of workers.

4. Survey analysis

4.1 Characteristics of the respondents

In the first part of the survey, respondents were asked to provide general information about themselves and their companies. The data collected from these questions were used to investigate the characteristics of the respondent companies.

Ownership of the respondent companies:

The majority of respondents (77.3%) reported that their organization ownership is private, while 22.7% reported that they work as a state-owned company.

The period of time the respondents been in business:

In the road construction industry, the companies has been running their operations for at least 10 years are considered as an experienced enterprise. The most of the respondents company (70.4%) has been in operation for 10 years and more, while 29.6% of the respondents have experience of up to 10 years.

Size of the companies:

When asked about the size of their organization, respondents reported a range of company sizes. The majority (49%) worked for companies with number range of 20-50 employees, while 33.6% reported working for companies with more than 50 employees and 20.4% respondents worked for an organization with up to 20 employees.

Job title of the respondents:

The survey results show that the majority of respondents (50%) hold a engineering position, followed by administrative people (31.8%), and HSE specialist (9.1%). The remaining 9% reported holding general staff or field masters positions.

Overall, the data collected in the first part of the survey suggests that the respondents represent a diverse group of companies from various experince and company sizes. The majority of respondents work for private companies and hold engineering positions within their organizations.

4.2 Analysis on implementation of OHS

Size of the companies that does not have OHS specialist/department

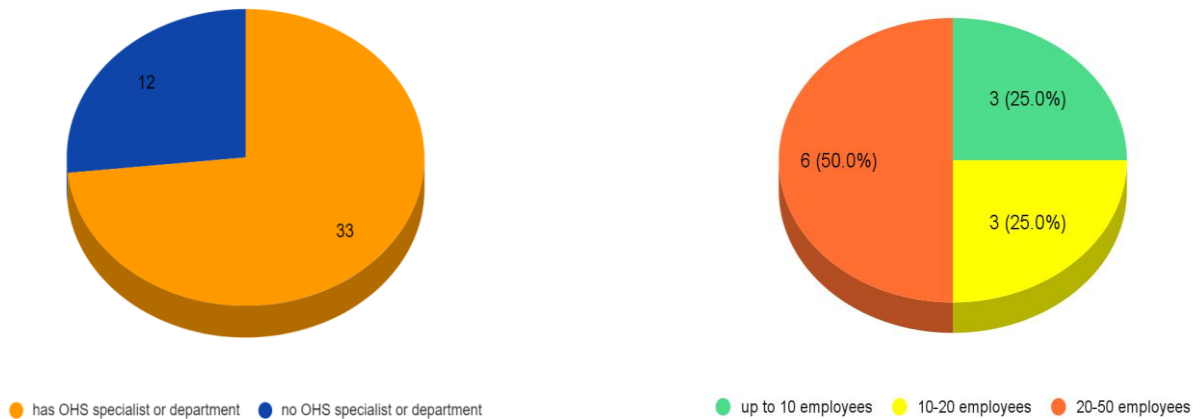


Figure 10: Companies do and do not have HSE specialist

Figure 11: Number of employee in the respondent companies

According to the survey, a large majority of the respondent companies (33 companies-73%) have dedicated OHS/HSE specialists who oversee the implementation and monitoring of OHS-related activities and measures. This is in line with the resolution A/114, 2015 (15) [\[source\]](#), issued by the Labor Minister, which requires companies operating in high-risk industries such as mining, energy, and road construction, to have at least one HSE specialist, regardless of the number of employees. However, there are still a significant number of companies (12 companies-27%) that do not have any HSE specialists or departments. Although in the mentioned resolution, the companies that have above 20 employees should have contractual or freelance OHS Specialists, it does not necessarily mean that the road construction companies that has up to 20 employees can run their business without HSE Specialists.

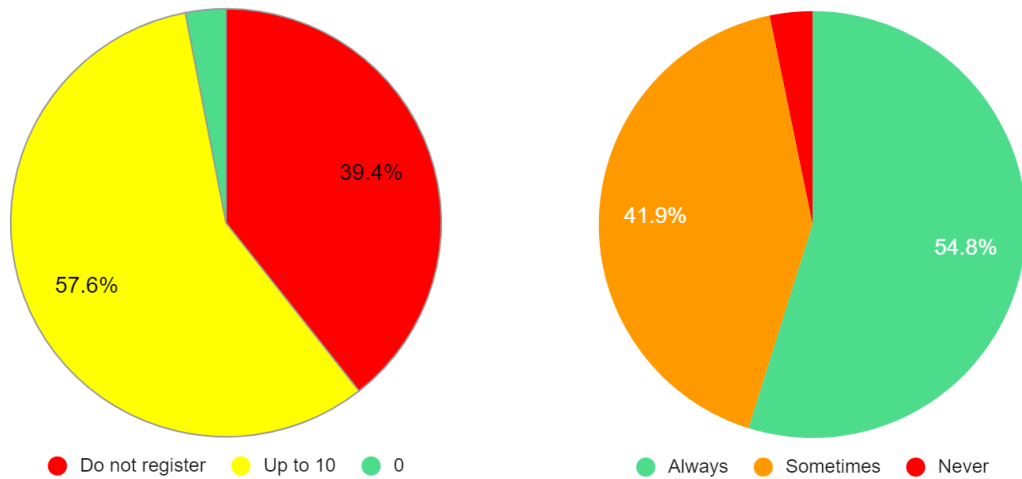


Figure 12: Accidents registered in the companies that have HSE specialist

Figure 13: Technical passport registration in the companies that have HSE Specialist

As previously discussed in the literature review, HSE specialists play a crucial role in implementing effective OHS measures and ensuring a safe working environment for employees. However, the results of the survey regarding accident and acute poisoning recording practices, as well as the registration of technical passports for equipment and machinery used in company operations, were unexpected. Despite the presence of HSE specialists in most companies, the survey revealed that a significant proportion of them (39.4% for accident recording and 41.9% for technical passport registration) do not fulfill their responsibilities as HSE specialists.

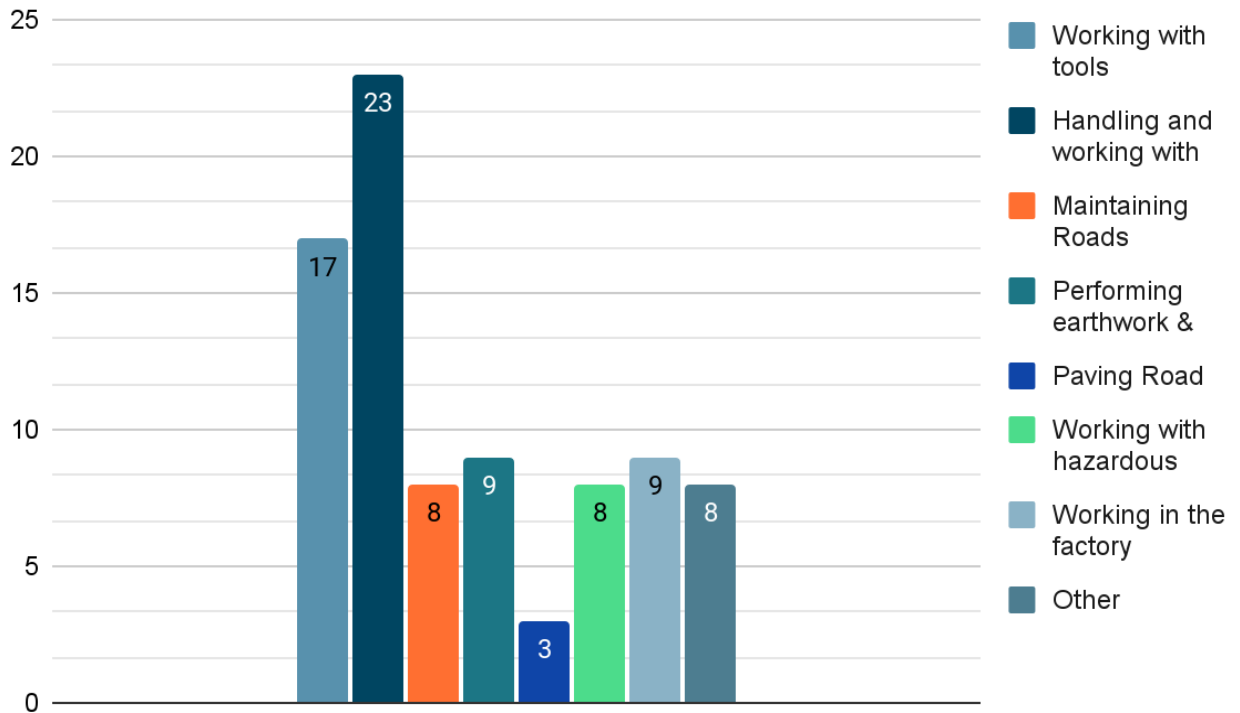


Figure 14: Work stages where the most accidents happen

One of the questions in the survey asked participants to select up to three stages during which accidents commonly occur. The results indicated that the majority of the accidents recorded in the respondent companies occurred during two stages of work: handling and working with machinery (23 vote) and working with tools and equipment (17 vote).

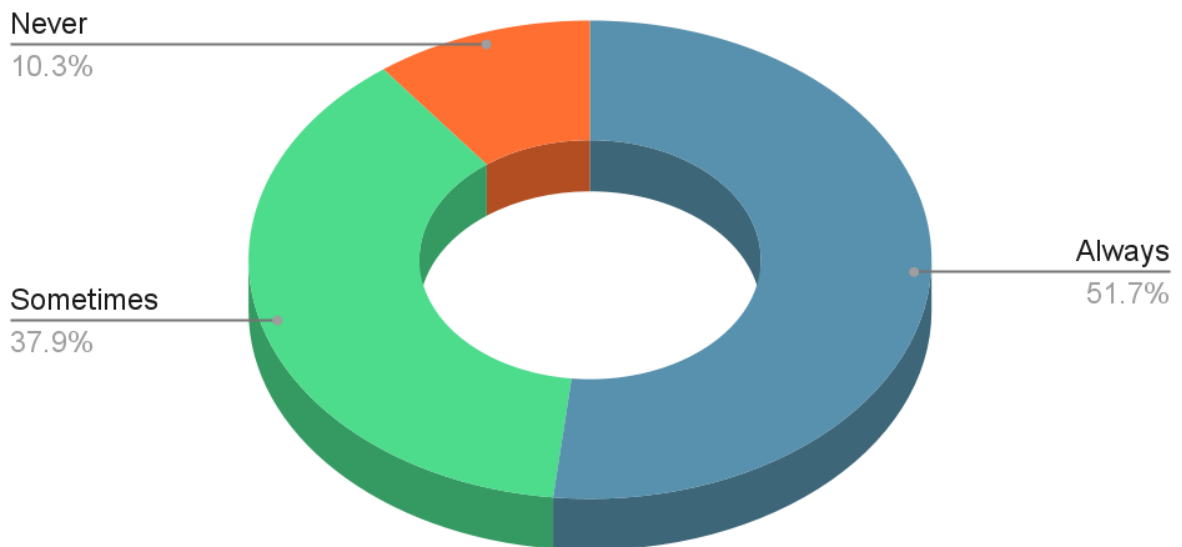


Figure 15: Technical Passport registration in respondent companies

As depicted in the graph above, a significant proportion of companies (48.3%) do not regularly register their technical passports, and some do not even have one at all. This indicates that there is a potential risk of accidents caused by a lack of access to accurate and up-to-date information about the safe operation and maintenance of the machinery and equipment. The lack of a technical passport, or the failure to regularly register it, can be a contributing factor to accidents that occur when working with machinery and equipment.

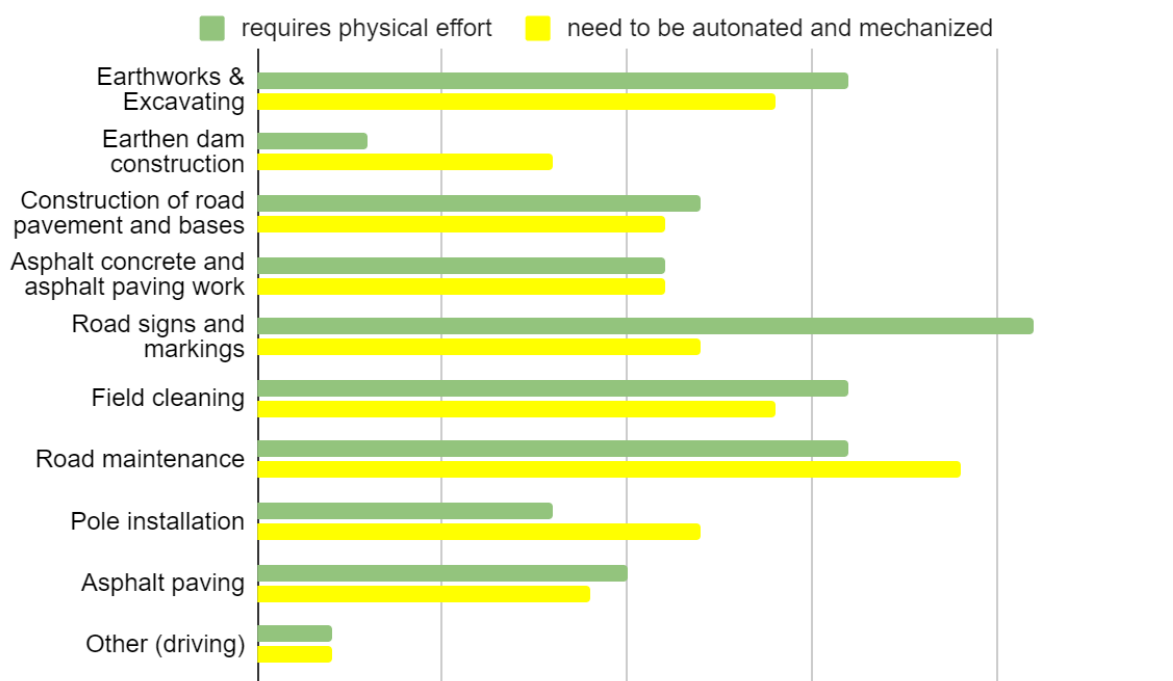


Figure 16: Work stages that require most physical effort and need to be automated

As a result of survey question “Which working stages require the most physical effort?” and “Which working stages should be more mechanized or automatized for the better OHS performance?”, the working stages of earthworking and, roadsigns and marking stages requires a lot physical effort and need to be improved with mechanization or automatization to increase the OHS performance.

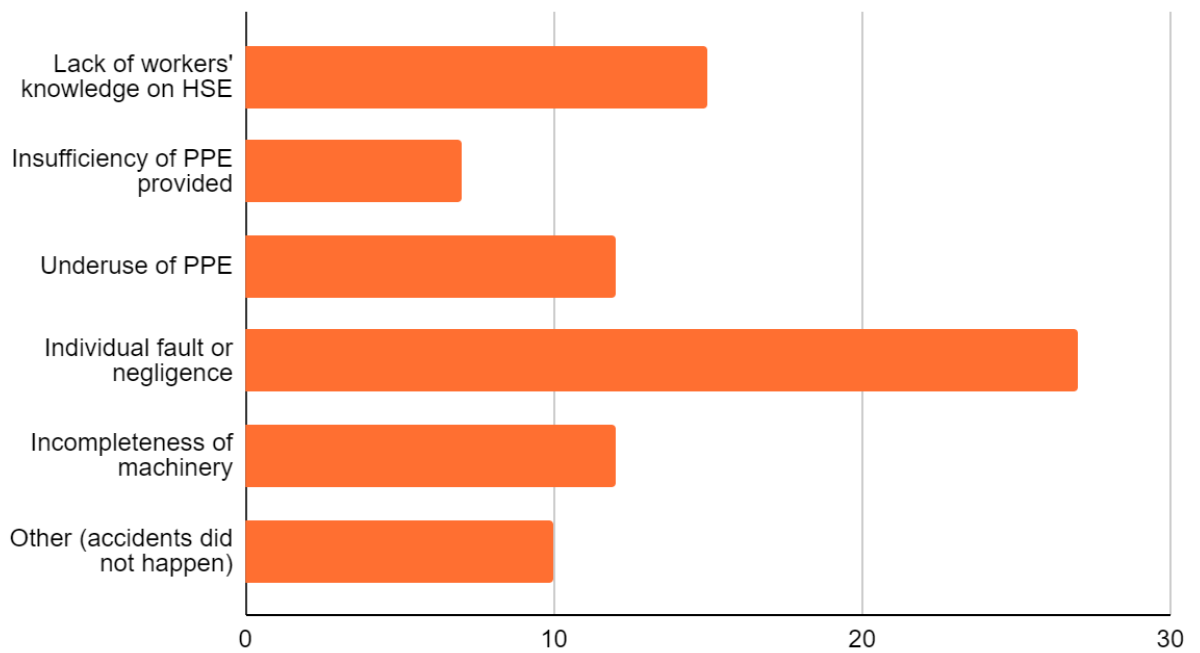


Figure 17: Causes of the accidents

Also, the participants were asked to choose up to 3 reasons that causes most of the accidents and the result shows that besides the machinery-related reason mentioned above, the most significant reason that resulted from the responses of the companies are mostly the human-based factors, such as individual negligence during operation, lack of OHS knowledge and underuse of PPE etc. Thus the next question which asks the sufficiency of training may contribute to reveal the underline factor.

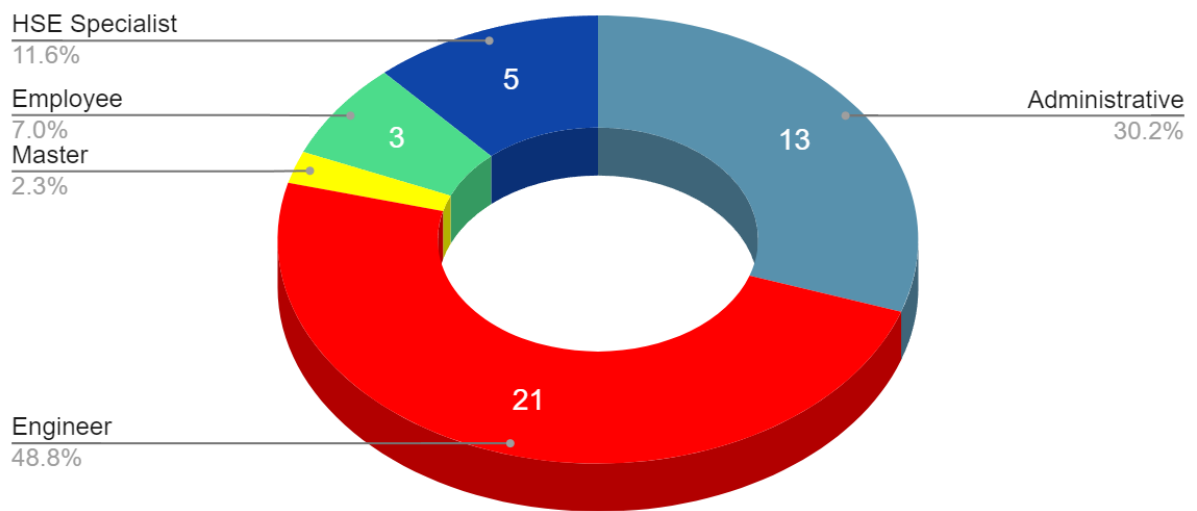


Figure 18: The working positions that are not completely satisfied with the training

The survey included a question asking participants to rate the sufficiency and effectiveness of the training they received on a scale of 1-5, where 1 indicated that the training was extremely insufficient, and 5 indicated that it was sufficient enough. Only three companies rated their training as sufficient, while the other 42 companies expressed varying degrees of dissatisfaction, with none of them giving their company a rating of 5.

Interestingly, the majority of respondents who were not completely satisfied with the training were engineering and technical employees (48.8%), followed by administrative personnel (30.2%). This is surprising because even the administrative staff are not completely satisfied with the training and see that training should be improved. Nevertheless, these results suggest that many employees, regardless of their role in the company, feel that their training could be improved to better prepare them for their work and minimize the risk of accidents.

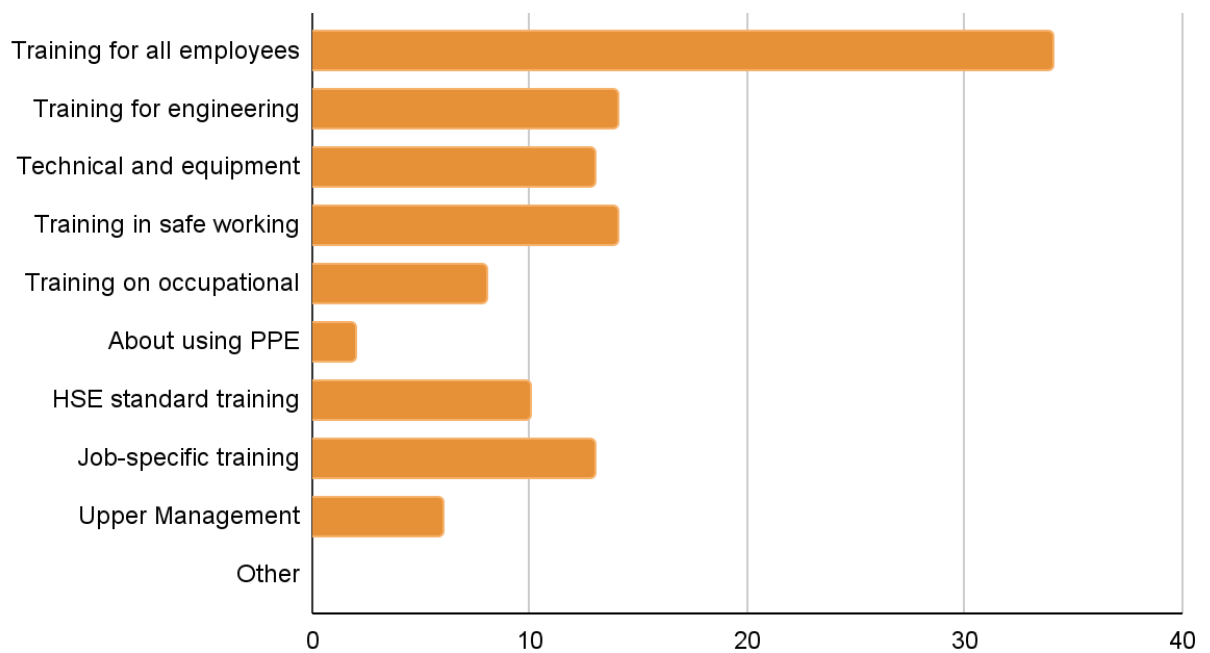


Figure 19: Trainings that should be improved

Continuing from the previous questions, the survey participants were asked to choose up to three types of training that they believed should be improved for better performance. The results revealed that training for all employees was the area of highest need, followed by training for safe working practices, and training for engineering.

These findings are consistent with earlier assumptions, as high demand for training among all employees suggests that companies need to prioritize providing comprehensive and inclusive training programs. Additionally, the high demand for technical equipment and engineering training further underscores the importance of equipping employees with the skills and knowledge necessary to work safely and effectively with machinery and equipment, which is critical for maintaining a safe work environment.

The survey included an open-ended question where respondents were asked to provide their opinions on what activities or measures should be implemented or improved to enhance OHS performance in their company. This approach aimed to gather genuine responses from participants. The following points were mentioned most frequently by respondents:

- Increase the sufficiency and effectiveness of the training
- Increasing the awareness of employees about the OHS policies and its benefits
- Hiring professional as a HSE specialist
- Conducting internal and external audit, reward and punishment system

5. Conclusion and Recommendation

Since this thesis work defined the general characteristics and state of the road construction companies in Mongolia, the specific solutions to improve cannot be suggested. However, the following recommendations and conclusions could be made from this research work:

Upon analyzing the survey results, it can be concluded that the implementation of Occupational Health and Safety (OHS) laws and regulations in road construction companies is relatively inadequate. This conclusion is supported by the absence of HSE Specialists or departments in many companies, and the failure of those professionals who do exist to carry out their basic duties. The poor implementation of OHS measures is a matter of concern, as it highlights the need for companies to prioritize the safety and well-being of their employees. To ensure that workers are protected from accidents and injuries, it is essential for companies to implement robust OHS policies and procedures.

It is worth noting that accidents in the workplace are frequently caused by the incompleteness of machinery and equipment, as well as human factors such as individual negligence, underuse of PPE, and a lack of knowledge.

The inconsistency of technical passport registration is one of the primary causes of equipment incompleteness in the working environment. A technical passport of OHS is a document that contains information about the equipment, such as its design, technical characteristics, and maintenance history. It is an essential tool that ensures equipment is adequately maintained and serviced, reducing the risk of malfunction or breakdown, which can lead to accidents and injuries. Therefore, companies must recognize the importance of the technical passport of OHS in maintaining equipment and reducing the risk of accidents.

As mentioned in the literature review, the organizational and human-oriented measures are the core to minimize the possible risk in the future. It also approved by the result of the survey that conducted in frame of this thesis work, because most of the answers of respondents indicates that major reasons for the accidents happened in the working field are human-factors, such as human negligence, mis- or under-use of PPE and lack of knowledge etc.

The hidden factor for those reasons could be the lack of the company policy that do not make their employee aware about the importance of OHS as the researcher of this thesis work see. Companies should prioritize the OHS and even should make OHS policy that

aligns with their mission and vision to accomplish their future goal with safe and effective working environment. At least, the OHS policy of the company should be created to involve all employees in certain level to motivate and inspire them to implement OHS measures and rules.

In addition, the lack of sufficient training for employees is the main cause of human-based factors that lead to accidents. Training programs should be implemented in companies to prepare employees to understand the importance of OHS measures and motivate them to implement them consistently. Companies should prioritize the training of employees to ensure they have the knowledge and skills necessary to implement OHS measures effectively and they should find the ways that implies to them to conduct effective training based on the employee behavior and attitude, and the system they implement.

Certain work stages, such as earthworking, road signs and marking, require significant physical exertion and should be automated or mechanized to ensure safe working conditions. Employee fatigue during these stages can lead to a lack of concentration, potentially resulting in individual negligence and unsafe work practices. Thus, the relevant technology advancement should be made not only for those work stages but also the all the work stages that a company is in urge to improve.

The further research and detailed study should be conducted as a next stage of this thesis work to provide company specific solutions and suggestions.

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Appendix

A - Survey Questions

Introduction:

This research survey is conducted by the Mongolian Road Association. It aims to define the weak points and problems that are faced by road construction companies and to find solutions and develop suggestions for them. No name or address will be recorded, and the responses to the survey will be kept strictly confidential. Thus, please cooperate with us by providing accurate information.

First Part:

1. What is the ownership of your company?
 - a. State-Owned
 - b. Private
2. How long have the company you working for been in business?
 - a. up to 5 years
 - b. 5-10 years
 - c. 10-15 years
 - d. 15-20 years
 - e. over 20 years
3. How many employees does your company have?
 - a. up to 10 employees
 - b. 10-20 employees
 - c. 20-50 employees
 - d. 50-100 employees
 - e. over 100 employees
4. The job title of your working position
 - a. Administration
 - b. Engineering and technical worker
 - c. Field master
 - d. HSE specialists
 - e. Employee

Second Part:

1. How many percentage of the overall planned budget is dedicated to OHS activities in your company?
 - a. 0%
 - b. 0.1-1%
 - c. 1-2%
 - d. 2-2.5%
 - e. over 2.5%
 - f. Do not know

2. Please rate the budget and expense for OHS activities of your company
 - 1 - Insufficient
 - 2 - Fairly insufficient
 - 3 - Moderate
 - 4 - Fairly sufficient
 - 5 - Sufficient

3. Does your company have HSE specialist or department?
 - a. Yes
 - b. No

4. How many occupational accidents and acute poisoning cases were registered in your company during the last years of 2019-2022 averagely?
 - a. Not registered
 - b. Up to 10
 - c. 11-30
 - d. 31-50
 - e. over 50 cases
 - f. Do not register

5. During which of the following work periods did the majority of accidents occur at your organization? (You can choose up to 3 appropriate options and write your answer in the "other" option)
 - a. Working with tools
 - b. Handling and working with machinery
 - c. Maintaining roads

- d. Performing earthwork and Excavating
- e. Paving road
- f. Working with hazardous substances
- g. Working in the factory
- h. Other

6. What are the most common causes of accidents in your company? (You can choose up to 2 options, if you would like to answer with the case not mentioned below, write in the “other” section)

- a. Workers lack knowledge of HSE
- b. Insufficiency of personal protection equipment is provided
- c. Underuse of personal protecting equipments
- d. Human negligence or fault
- e. Incompleteness of machinery
- f. Other

7. From the options below, please choose the 3 work steps or periods that require the most manual labor and physical effort. (to answer the case not mentioned below, write in the “other” section)

- a. Earthworks and Excavating
- b. Earthen dam construction
- c. Construction of road pavement and bases
- d. Asphalt concrete and asphalt paving work
- e. Road signs and markings
- f. Field cleaning
- g. Road maintenance
- h. Pole installation
- i. Asphalt paving
- j. other

8. Please rate your company for the sufficiency of machinery and equipment used for road construction

	A. Sufficient	B. Normal	C. Insufficient
a. Earth works	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Base construction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- | | | | |
|----------------------|--------------------------|--------------------------|--------------------------|
| c. Asphalt paving | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d. Signs and marking | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e. Road maintenance | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

9. In your opinion, which working step(s) will be improved by mechanization or automation for better HSE and quality of road construction work? *(You can choose up to 3 appropriate options, if you would like to answer with the case not mentioned below, write in the “other” section)*

- a. Earthworks and Excavating
- b. Earthen dam construction
- c. Construction of road pavement and bases
- d. Asphalt concrete and asphalt paving work
- e. Road signs and markings
- f. Field cleaning
- g. Road maintenance
- h. Pole installation
- i. Asphalt paving
- j. other

10. Does your company have and register technical passports for each machine, mechanism, and equipment used in the construction of roads?

- a. Yes
- b. No
- c. Sometimes

11. In your opinion, what is the availability and quality of HSE training of your organization?

- 1 - Insufficient
- 2 - Fairly insufficient
- 3 - Moderate
- 4 - Fairly sufficient
- 5 - Sufficient

12. Please write what OHS-related measures and activities are taken place in your organization.

13. Please choose the cases that your company conduct risk assessment

- Everyday
- Once a year
- Every occurrence of near-miss and industrial accidents
- When new technology is installed
- Do not conduct risk assessment

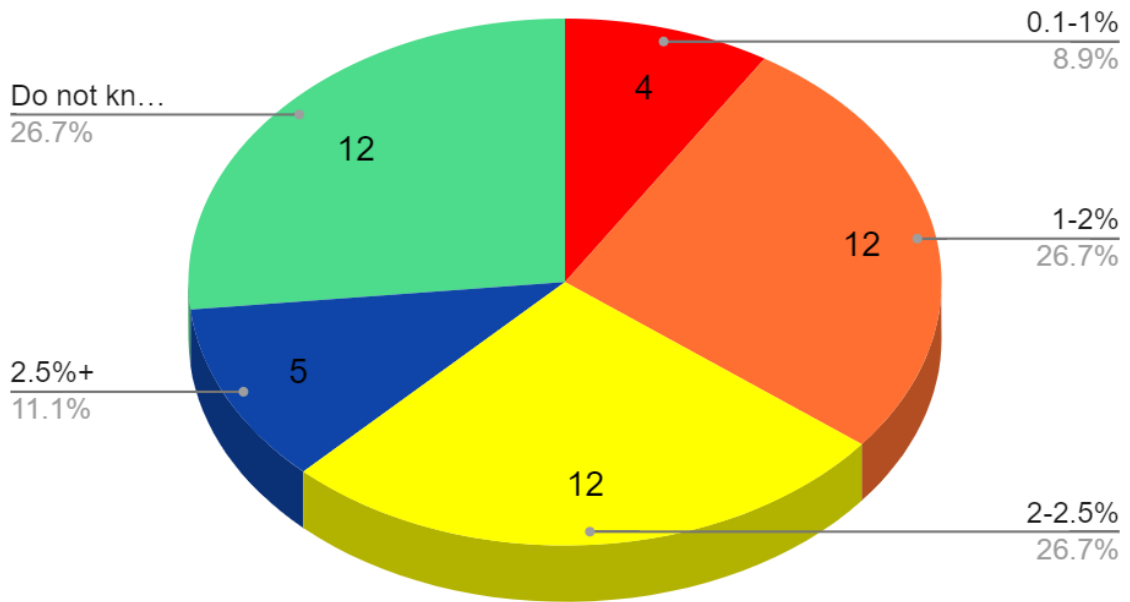
14. What type of training do you think is needed to improve HSE performance in your organization? *(Choose the 3 options that you think are important from the options below and write your thoughts in the other section)*

- a. Training for all employees
- b. Training for engineering and technical workers
- c. Technical and equipment training
- d. Training in safe working methods
- e. Training on occupational health
- f. About using PPE
- g. HSE standard training
- h. Job-specific training
- i. Upper Management training
- j. Other

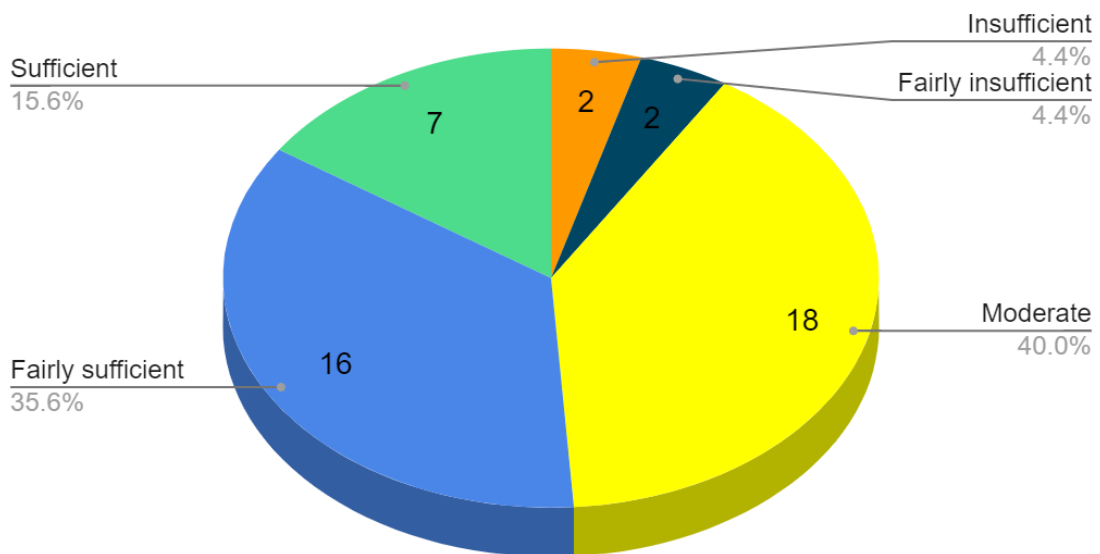
15. In your opinion, what improvements should be made to enhance the current OHS state in road construction industry?

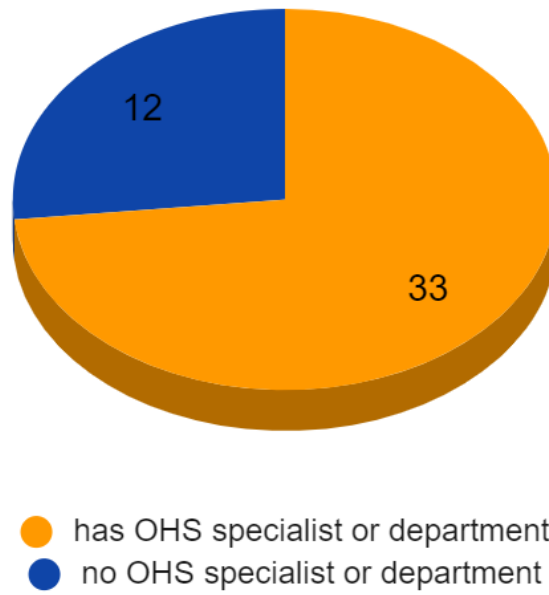
B - Survey Result

Budget percent that is dedicated for OHS

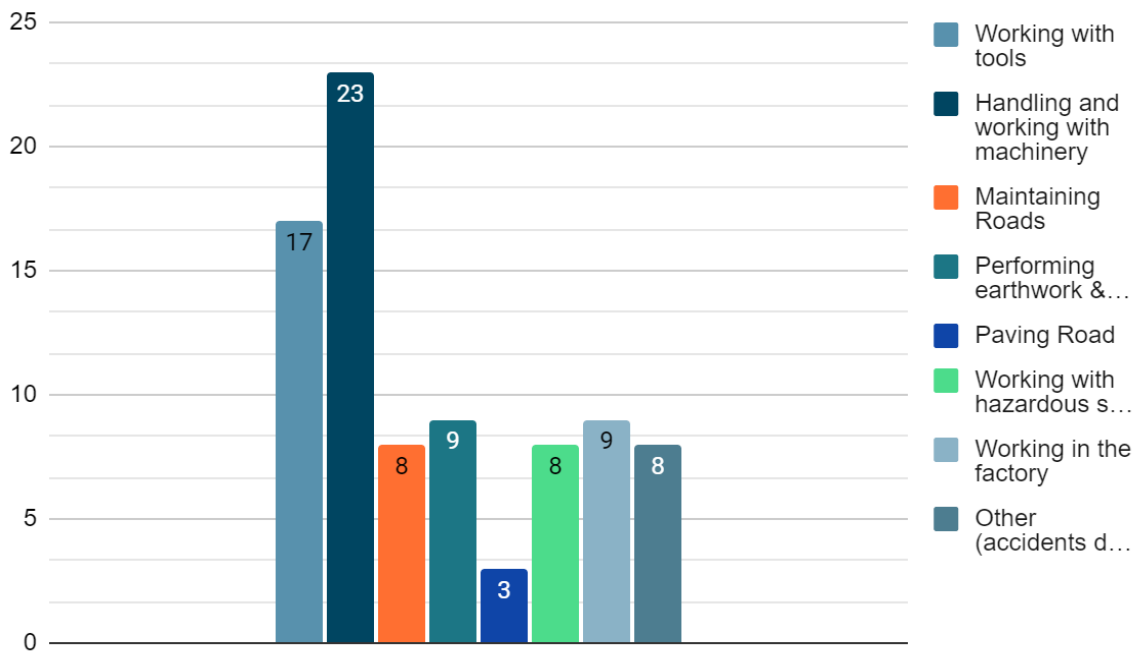


Rate of OHS dedicated budget

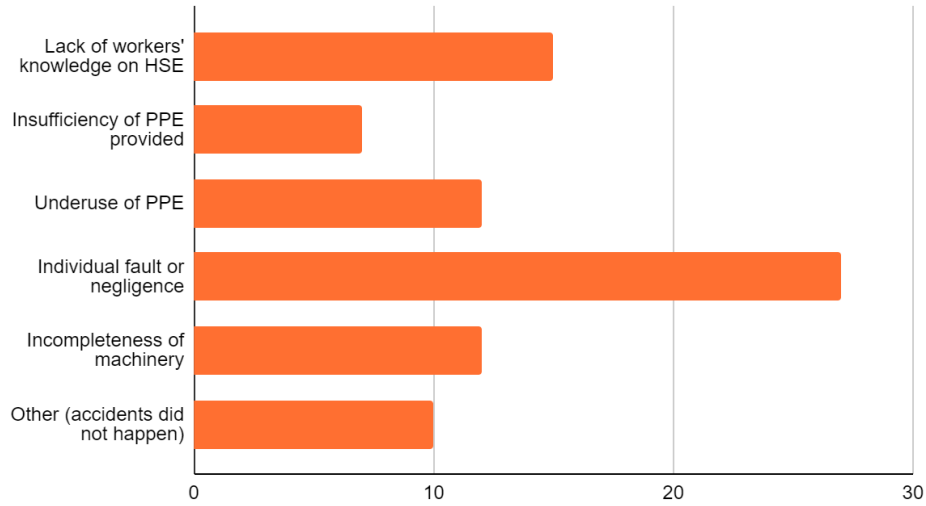




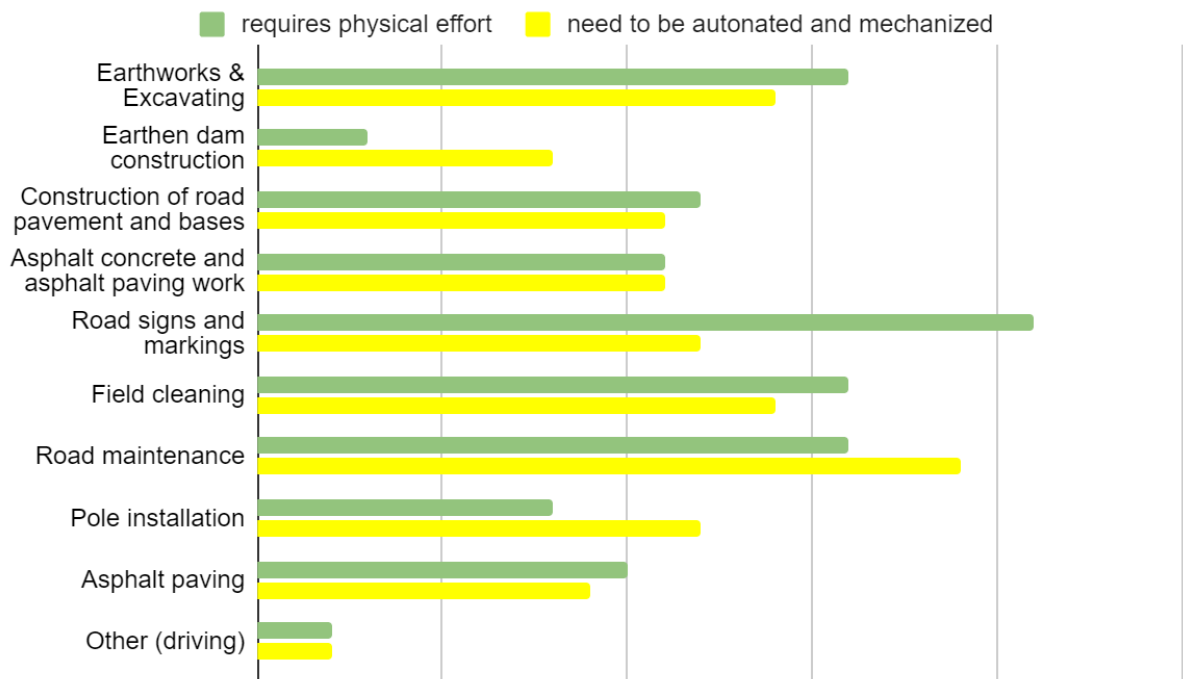
Work stages where the most of the accidents happen



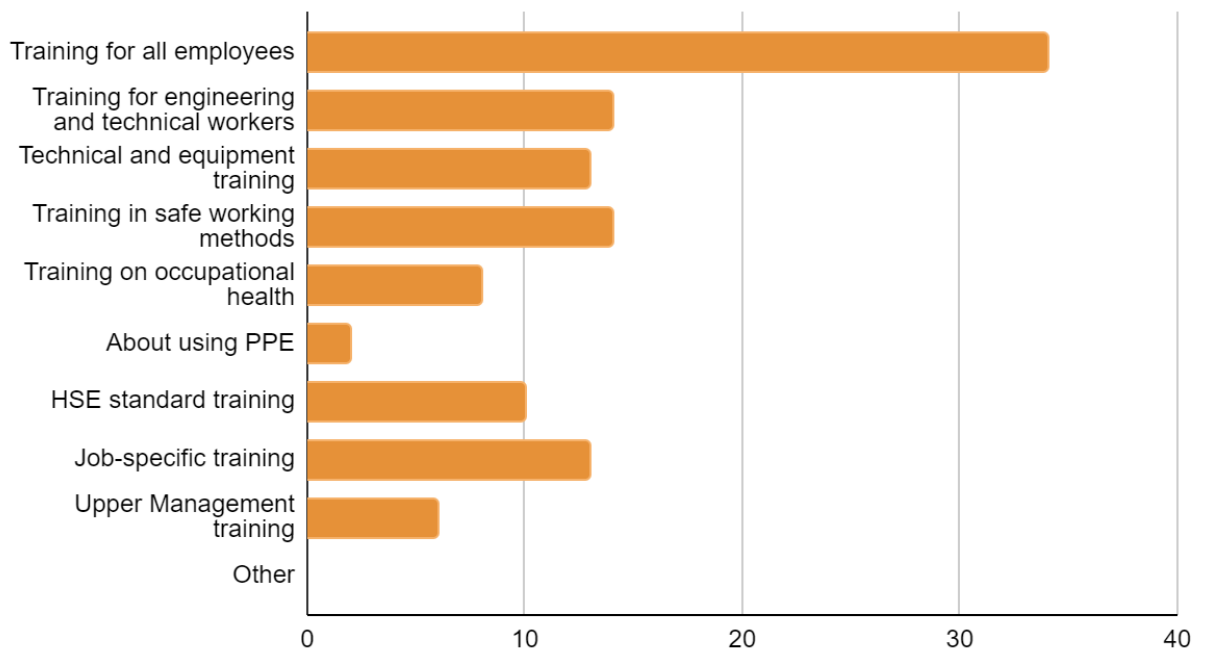
Causes of the accidents



Work stages



Training that should be improved



Risk Assessment

- Everyday
- Once a year
- Every occurrence of near-miss and accidents
- When new employee is hired
- When new technology is installed or the position of the technology is changed
- Do not conduct risk assesment

