# Elevating occupational safety and health through e-learning with associated risk management: Case NRC Group Finland Oy

Katriina Alfa

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**Abstract**

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The purpose of this thesis is to elevate occupational safety and health (OSH) and safety culture through e-learning with associated risk management for the case company NRC Group Finland Oy. NRC Finland provides services in infrastructure construction and engineering and operates also as the biggest rail builder in Finland with customers such as government agencies, municipalities, industrial corporations and ports.

By enhancing NRC Finland's safety culture and profile through the new e-learning platform the goal is to demonstrate more active role regarding safety to outside as well as inside the company. The process will also include creating a new safety briefing material into the new training platform which will be used to brief NRC Finland's visitors into safety procedures regarding railway industry. The theoretical background will cover and explain the definitions of e-learning, occupational safety and health, safety training, safety culture and risk management. The development task is as follows: how to develop and further improve safety culture regarding occupational safety and health.

The research methodology used in this study is the qualitative research method, the purpose was to gain knowledge and new ideas. The two data collection methods that were chosen were a workshop and a survey. The workshop was conducted at NRC Finland with the managers and the purpose was to gain insight to what is the company's goal regarding e-learning and other safety issues. The survey focused on getting the workers point of view regarding OSH e.g. safety training and safety culture, out of 44 survey recipients 18 replied to the survey.

Based on the data that was collected it was apparent that the biggest concern shared by the workers was excessive rush at work which could potentially cause dangerous situations. There is a sense that a projects schedule takes precedence over safety and because of that safety instructions are being ignored. Other concerns or potential risks were poor attitude and indifference towards OSH regulations. In general, work-related accidents are declining but certain accidents like stumbling, slipping and tripping are on the rise and from the different business unit's maintenance stands out in the accident records.

The safety briefing material was the tangible outcome of this study and with this material NRC Finland is able to enhance their OSH and add awareness of the company's safety culture outside the company. It will show that the company takes OSH seriously and generates positive reputation on the company's name and operations. Additionally, it is recommended that when designing the courses to the new e-learning platform that the different learning styles of people will be taken into consideration, making the courses visually appealing and if possible, even interactive. Also involving the workers more in the planning processes relating to OSH might bring new ideas and perspective to the table.

Keywords: E-learning, safety training, occupational safety and health, safety culture, risk management

**Laurea-ammattikorkeakoulu** **Tiivistelmä**
Turvallisuusala
Tradenomi (AMK)

Katriina Alfa

**Työturvallisuuden parantaminen verkko-oppimisen ja siihen liittyvän riskienhallinnan avulla: NRC Finland Oy**

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Tämän opinnäytetyön tarkoituksena on nostaa työturvallisuutta ja työturvallisuuskulttuuria e-oppimisen ja siihen liittyvän riskienhallinnan avulla yritykselle NRC Group Finland Oy. NRC Finland tarjoaa palveluita infrastruktuurin rakentamisessa ja suunnittelussa ja toimii myös Suomen suurimpana rautateiden rakentajana. Asiakkainaan heillä on valtion virastoja, kuntia, teollisuusyrityksiä ja satamia.

Kehittämällä NRC Finlandin työturvallisuuskulttuuria ja profiilia uuden e-oppimisalustan avulla, tavoitteena on osoittaa aktiivisempi rooli työturvallisuuden suhteen sekä yrityksen ulkopuolella että sen sisällä. Prosessiin sisältyy myös uuden turvallisuusohjeistusmateriaalin luominen uuteen koulutusalustaan, jota käytetään NRC Finlandin vierailijoiden perehdyttämisessä rautatiealan turvallisuusmenettelyihin. Teoreettinen tausta kattaa ja selittää verkko-oppimisen, työturvallisuuden, turvallisuuskoulutuksen, työturvallisuuskulttuurin ja riskienhallinnan määritelmät. Kehitystehtävä on seuraavanlainen: kuinka kehittää ja edelleen parantaa työturvallisuuskulttuuria työturvallisuuteen liittyen.

Tässä tutkimuksessa käytettiin laadullista tutkimusmenetelmää, tarkoituksena oli saada tietoa ja uusia ideoita. Kaksi valittua tiedonkeruumenetelmää olivat työpaja ja kysely. Työpaja toteutettiin NRC Finlandissa yhdessä johtajien kanssa ja tarkoituksena oli saada tietoa siitä, mikä on yrityksen päämäärä e-oppimisen ja muiden työturvallisuuskysymysten suhteen. Kyselyssä keskityttiin saamaan työntekijöiden näkökulma työturvallisuuteen liittyen esimerkiksi turvallisuuskoulutuksesta ja työturvallisuuskulttuurista, 44:stä kyselyn saaneista 18 vastasi kyselyyn.

Kerätyistä tiedoista ilmeni, että työntekijöiden suurin huolenaihe oli liiallinen kiire työpaikalla, joka saattaa aiheuttaa vaarallisia tilanteita. Työntekijöillä on tunne, että projektien aikataulu on etusijalla turvallisuuteen nähden ja sen vuoksi turvallisuusohjeita ei huomioida. Muita huolenaiheita tai mahdollisia riskejä olivat huono asenne ja välinpitämättömyys työturvallisuusmääräyksiä kohtaan. Yleisesti ottaen työtapaturmat ovat laskussa mutta tietynlaiset onnettomuudet, kuten kompurointi, liukastumiset ja kompastumiset, ovat kasvussa ja liiketoimintayksiköistä kunnossapito erottuu selvästi tapaturmarekistereissä.

Turvallisuusohjeistusmateriaali oli tämän tutkimuksen konkreettinen tulos ja tämän materiaalin kanssa NRC Finland pystyy parantamaan työturvallisuutta ja lisäämään tietoisuutta työturvallisuuskulttuurista yrityksen ulkopuolella. Se osoittaa, että yritys suhtautuu työturvallisuuteen vakavasti ja antaa yritykselle positiivista mainetta niin nimenä kuin heidän toiminnastaan. Suosituksena on myös, että suunnitellessa kursseja uuteen e-oppimisen alustaan, otetaan huomioon ihmisten erilaiset oppimistavat ja tehdään kursseista visuaalisesti houkuttelevia ja jos mahdollista, jopa vuorovaikutteisia. Työntekijöiden osallistuminen enemmän myös työturvallisuuteen liittyviin suunnitteluprosesseihin saattavat tuoda uusia ideoita ja näkökulmia esille.

Asiasanat: E-oppiminen, turvallisuuskoulutus, työturvallisuus, työturvallisuuskulttuuri, riskienhallinta

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# 1 Introduction

This study is a development project, focusing on elevating occupational safety and health (OSH) through e-learning with associated risk management for the case company NRC Group Finland Oy. NRC Group Finland Oy, from here on referred as NRC Finland, will be replacing its e-learning platform to a new platform sometime in the near future. The current training platform contains training courses relating to safety as well as other important training material. The reason for the change is desired improvement on how the courses can be designed and distributed as well as due to a merger between Norwegian NRC Group and VR Track Oy known today as NRC Finland.

The goal is to provide knowledge on how to create comprehensive, well designed e-learning courses which will serve the employees, supervisors, trainers, the employer and the customers in the best possible way. Additionally, to elevate NRC Finland's safety culture and profile through the new platform by showing and demonstrating more active role regarding safety to outside as well as inside the company. The process will also include creating a new safety briefing material into the training platform which will be used to brief NRC Finland's visitors into safety procedures regarding railway industry thus demonstrating an active role in OSH and adding awareness of the company's safety culture outside the company.

## 1.1 Scope and exclusions

The purpose of this study is to elevate occupational safety and health at NRC Finland. The company is currently using online learning as well as face to face learning as their teaching methods, however they are in the process of replacing the platform for e-learning in the near future. The plan is to improve e-learning in a way that e.g. safety training material can be sent to visitors, who are coming to visit worksites, electronically and thus making sure that they get the necessary training. The purpose is also to show and demonstrate more active role regarding safety both outside as well as inside the company. Furthermore, the plan is also eventually to apply this to the subcontractors as well so they can also receive the necessary safety instructions and training electronically. The topics that will be covered in this study are general information relating to this study; followed by the theoretical background of e-learning, occupational safety and health, safety training, safety culture and risk management; the methodology approach of this study and finally the results.

The following will be excluded from the study. The actual introduction of the new platform, reason for that is that there is no timeframe for the introduction of the new platform so i.e. implementation is not possible within the timeframe of this study. When the company decides on the supplier, they will provide the platform, meaning that the client's ability to influence on how the platform is constructed is practically non-existent as well as any software or cyber security issues that might incur. Although there probably will be a possibility for the client to

request custom made features in the system but of course this will cost money, the supplier will most probably have readymade features in the platform. However, at this stage it is not known whether the client will use this option or not.

## 1.2 Objective and the development task

Objective is to gain knowledge on how to elevate occupational safety and health and safety culture through e-learning with associated risk management for the case company NRC Group Finland Oy. This will also include creating a safety briefing material which will eventually be part of the new training platform, thus elevating their OSH and safety culture both inside and outside the company.

Development task:

- How to develop and further improve safety culture regarding occupational safety and health?

## 1.3 NRC Group Finland Oy

NRC Finland provides services in infrastructure construction and engineering and operates also as the biggest rail builder in Finland (NRC Group n.d.). NRC Finland's customers are government agencies, municipalities, industrial corporations and ports; they are also involved in multiple infrastructure alliances and currently employ more than 1700 professionals working with various infrastructure projects (NRC Group Finland n.d.). One of them being the Jokeri Light Rail line project, a joint project of city of Espoo and Helsinki where NRC Finland operates as a planning consultant as well as a constructor in consortium with other companies (Raide-Jokeri n.d.). Jokeri Light Rail line is being built between Itäkeskus in Helsinki and Keilaniemi in Espoo, approximately 25 km long, replacing the busiest bus line number 550 (What is Jokeri Light Rail? n.d.). The tram line will be mostly operating on its own lane with traffic signal priority, additionally trams can be operated in two directions increasing the capacity, reliability and passenger comfort within public transportation (What is Jokeri Light Rail? n.d.)

Responsibility for the personnel and railway safety is the guiding principle of operations in NRC Finland. Operations cannot in any way risk the safety of passengers or freight traffic and rail traffic itself cannot endanger the safety of NRC Finland's personnel or their partners. The goal is to promote work safety and the employee's professional skills in a way that quality, productivity, corporate image and personnel's well-being are also positively affected. NRC Finland aspires to improve the overall safety of railways and therefore annual targets and indicators are set to monitor railway safety. Operations are guided by railway safety management system and the safety certificate granted by Traficom (The Finnish Transport and Communications Agency). (Safety n.d.)

# 2 Theoretical background

For the purpose of this study this chapter will explain the theoretical background and the definitions of e-learning, occupational safety and health, safety training, safety culture and risk management. What to take in consideration when designing e-learning courses and the MI framework i.e. how to utilise the different learning styles that people have. E-learning might however induce some challenges which should be taken into consideration when planning, designing, executing e-learning courses. Occupational safety and health subchapter cover the laws and regulations regarding this topic, the responsibilities and rights of the employer and employees. Safety training explains the difference between ineffective and effective safety training, construction industry particularly is extremely high-risk industry relating to work related accidents and injuries and therefore commitment of all the parties starting from the management is crucial. Safety culture subchapter describes how assumptions and beliefs affects organizations safety culture and what steps to take in order to remove the harmful and risky beliefs to create more safer working environment.

## 2.1 E-learning

One of the earliest definitions of e-learning according to American Society for Training & Development (ASTD) describe it as computer-based learning, web-based learning, virtual classrooms and digital collaboration; delivering content through interactive TV, satellite broadcast, videotape and CD-ROM (Mason & Rennie 2006). The Open and Distance Learning Quality Council UK, makes a distinction between the content of learning and the process itself: “E-learning is the effective learning process created by combining digitally delivered content with (learning) support and services” (Mason & Rennie 2006, xiv). More simple definition by Suhasini & Suganthalakshmi (2015), is that e-learning is a form of education that happens through internet, standalone computer or network utilizing electronic applications and processes educating people the necessary skills and knowledge.

When designing e-learning courses with authentic contexts, the first crucial deliberation is on how to create an authentic context in a way that it reflects the knowledge which would be used in the real world, in order for the learning to be as authentic as possible it might for example involve creating a scenario or a story in a realistic and meaningful way (Herrington, Reeves & Oliver 2010). However, providing solely real-life examples of different situations is not an adequate way to demonstrate the issue or the concept that is being taught (Herrington et al. 2010). Before the actual designing of a course can begin it is recommended that certain questions should be asked relating the course and also how and where will the knowledge be used. Questions such as:

- What are the skills, knowledge and attitudes that the learners are expected to have after they have completed the course?

- How and where would the learners apply their knowledge in real-life?
- What kind of context would be appropriate and possible in the course which would enable students to learn the skills, knowledge and attitudes of the course?

(Herrington et al. 2010).

The MI framework (The multiple intelligences) introduced by Howard Gardner of Harvard University, supposes that individuals have different kind of learning styles or independent ability areas (Carney, Wall, McNamee, Madden, Hurst, Vrasidas, Chanquoy, Baccino, Acar & Önwy-Yazici 2008). In this framework (table 1) intelligence was defined as the capability to solve problems or to create products that are valued in one or more cultural settings (Carney et al. 2008). The MI model is about a teaching and learning method which allows individual interpretation, design and implementation rather than a prescriptive model (Carney et al. 2008). By being aware of the different learning styles, the content of the course can be tailored accordingly (Carney et al. 2008). The company should focus on how individuals learn and based on that provide the right kind of learning environment using the right kind of technology; it is crucial that the designers of the courses understand the needs and learning styles of the participants, the designers need to be taught how to design the courses (Suhasini & Suganthalakshmi 2015).

| Intelligence | Examples of instructional activities |
|---|---|
| Linguistic | Discussions, writing e.g. set of instructions on how to identify risks, assessing written resources such as safety reports |
| Mathematical/ logical | Analysing statistical data, creating graphics; diagrams, charts etc., designing a strategy on how to e.g. identify risks relating to falls |
| Visual/ spatial | Matching photos, charts, illustrations or cartoons with corresponding subject categories; e.g. evaluating/creating safe workplaces/sites |
| Kinesthetic/ bodily | Simulations; e.g. analysis of workplace/site ergonomics |
| Rhythmic/ musical | Audio visual elements; e.g. power point presentations with music and video |
| Naturalistic | Computer simulated cities, maps, spaces/environments, illustrations etc. |
| Interpersonal | Learning activities designed in a way that they might e.g. include cooperative learning groups |
| Intrapersonal | Learning activities completed through e.g. reflective individual projects |

Table 1 Eight intelligence types (Carney et al. 2008)

The results gathered by Acar, Wall, McNamee, Carney & Öney-Yazici (2008) in the article Innovative safety management training through e-learning, seem to indicate that professionals in the construction industry have higher scores in spatial, intrapersonal, logical-mathematical, interpersonal and linguistic intelligences and lower scores on the rest of the intelligences. Intrapersonal type has the ability to self-reflect, can evaluate their own thinking patterns and understand their own role in relationships to other people. Spatial intelligence type relies on deductive reasoning e.g. using data and charts to plan strategies in order to achieve time, cost and quality targets of projects which requires cooperation with other actors in the project which almost always means the use of linguistic and interpersonal intelligences. It would be beneficial to consider MI profiling when designing a course, for example a group of participants who have lower score on linguistic intelligence it makes no sense to provide them solely textual material as if the group would consist of historians or lawyers. In contrast, training material which is visually poor and does not adequately incorporate reflective individual projects is unlikely to match with construction professionals. (Acar et al. 2008.)

Educational training is expensive and in order to reduce the costs organizations have started to introduce e-learning training (Ho & Dzeng 2010). Organizations generally spend more money with traditional way of training i.e. classroom teaching (Suhasini & Suganthalakshmi 2015). In today's competitive business world companies can no longer afford to spend money on extensive training budgets, travel and lodging, time spent away from work affects productivity and revenue (Suhasini & Suganthalakshmi 2015). There are quite a few advantages with e-learning. E-learning can often minimize the costs and training time by delivering the material and platform functions via internet (Ho & Dzeng 2010). The learner can decide where and when to log on to the system, how to work through the course materials, what kind of resources to use and if needed collaboratively working with others (Mason & Rennie 2006).

## 2.2 Challenges with e-learning

Despite all the positive praise on the benefits of e-learning some criticism have been raised surrounding this topic. Kirkwood (2009) goes to argue that although ICT (information and communications technology) can bring new form of teaching and learning methods to educational practices, but it cannot ensure that the attained outcome regarding learning will be appropriate and effective.

Generally, e-learning is used to improve learning, develop skills, enhance performance and increase motivation; it is usually perceived to be cost-effective than other forms of corporate training as well as to be more accessible and efficient. It also offers the opportunity for ongoing learning and even sharing information between organisations despite on their geographic location. However, traditional organisations and industries that have mostly older workforce who are not using computers as an essential part of their daily work, are unlikely to embrace opportunities that e-learning can provide. While many rail organisations are using or

considering using e-learning options to provide training programmes, the challenges are how to engage the younger workforce who are very comfortable learning with technology and then in the other hand how not to alienate the older workforce who may prefer to learn in more traditional ways. (Becker, Fleming & Keijsers 2012.)

There are several challenges which should be taken into consideration when implementing e-learning. Some learning styles still require certain amount of human interaction i.e. there are course materials which are not suitable for e-learning (Suhasini & Suganthalakshmi 2015). The following can create challenges when implementing e-learning. Reinforcing the studied material and giving feedback to the participants can in practice be difficult (Suhasini & Suganthalakshmi 2015). Slow or limited bandwidth can create a situation where videos, sound or intensive graphics can take a long time to download, this is particularly an issue with the public Internet, and thus creating frustration among participants (Suhasini & Suganthalakshmi 2015). Embracing new technologies can be challenging for people which in turn can mean that the company needs to invest in training and support regarding the new technology (Suhasini & Suganthalakshmi 2015). Ensuring the participants confidentiality and detection of cheating can also turn out to be difficult (Suhasini & Suganthalakshmi 2015). Additionally, some organisations only target certain groups of employees rather than the whole workforce when planning for the use of e-learning, due to e.g. problems with accessing technology (Becker et al. 2012).

## 2.3 Occupational safety and health

As stipulated in the Occupational safety and health act (738/2002, 8 §), employers have a general duty to exercise care at work by taking care of their employees safety and health; employers shall take into consideration the working conditions, work related circumstances, personal capacities of the employees and any other aspects related to the working environment and continuously monitor it. The employer has the responsibility to choose, design and also put in the practice the measures that shall be taken to improve the working conditions (Occupational safety and health act 738/2002, 8 §). Well-being is crucial in order to increase productivity at a workplace (The centre for occupational safety n.d.). Well-being consist of safe, healthy and productive work which is done by competent workers and work communities in an organization that is being run smoothly (The centre for occupational safety n.d.). Employees should find their work meaningful and rewarding, not forgetting that the work should also support the overall management of their lives (The centre for occupational safety n.d.).

There are so called structural and functional aspects which need to be taken into consideration, the former refers to workplace lighting, safety of the passageways, sound environment and the quality of air indoors (Work environment n.d.). Latter refers to keeping offices and workspaces organized and clean, as well as how the traffic and transportation will be organized (Work environment n.d.). Cleanliness and order shall be ensured in the workplace and

the cleaning shall be executed in a way that it does not cause any hazards or risks to the safety and health of the employees (Occupational safety and health act 738/2002, 36 §).

Special attention must be given to chemical, biological and physical health hazards specifically in a way how they are being identified and managed (Work environment n.d.). Necessary training and instructions shall be given to the employees in case of major accident relating to substances handled and stored in the workplace or in case of any major accident in the workplace, so employees have the necessary skills to control the hazard and procedures to follow in case of an accident; exercises shall also be arranged if required (Occupational safety and health act 738/2002, 44 §). Employees have a right to receive guidance and instructions of work-related hazards and risks, appropriate orientation to work including working conditions, work equipment used in the work, safe working practices, working and production methods (Occupational safety and health act 738/2002, 14 §). Protective equipment and other auxiliary equipment shall be provided by the employer in compliance with the requirements of the law in a case the risk of illness or injury cannot be avoided or reduced (Occupational safety and health act 738/2002, 15 §). Employees are obligated to follow the instructions and orders of the employer within her or his competence; employees shall also see to it that order and cleanliness as well as care and caution are taken into account in order to maintain safety and health in the working environment (Occupational safety and health act 738/2002, 18 §).

Equipment, tools, work machinery, personal protective equipment and assistive devices must be in good condition and only to be used for their intended use and under intended conditions (Work environment n.d.). People working with heavy lifting must be given proper instructions and guidance to make sure that they are using proper technique to do it (Work environment n.d.). Additionally, it should be made sure that the load remains reasonable to avoid neck, shoulder, back and lower limb illnesses (Work environment n.d.). The centre for occupational safety (Work environment n.d.) states, that tripping and slipping produces vast amount of workplace accidents due to untidiness or disorder which is why cleanliness should be the top priority in a workplace. Big factor contributing to accident occurrence is lack of awareness regarding hazards (Sacks, Perlman & Barak 2013). When securing a safe and healthy working environment the most important thing is to identify the dangers and risks in the workplace and the measures that can be used to manage the identified risks (Work environment n.d.).

Following principles shall be complied with as far as possible: preventing and eliminating hazards and risks or when elimination is not possible selecting the least harmful option, safety measures that has an overall general impact shall be given priority over individual measures and taking in consideration technological developments and other available resources (Occupational safety and health act 738/2002, 8 §). Identification, assessment and analysis of the risks at the workplace shall be done systematically and in a proper manner; if the hazards or risks caused by the work itself, working conditions, premises or other aspects of the working

environment cannot be eliminated the consequences to the safety and health of the employees shall be assessed (Occupational safety and health act 738/2002, 10 §). An external expert shall be used if the employer does not have the adequate expertise for the decided action and it also the employer's responsibility to see that the external expert has the adequate competence and the necessary qualifications to perform the required tasks (Occupational safety and health act 738/2002, 10 §).

Good leadership creates well-being at work, managing people and issues is part of the workplace strategy (Management leadership n.d.). People management is about getting the employees to work in desired manner in order to achieve the company objectives, working with the staff as well as getting results through them (Management leadership n.d.). Issues management is when the operations are supported by systems and objectives i.e. planning, managing, organizing, evaluating and controlling the operational processes (Management leadership n.d.). As a conclusion, management plays a crucial role in occupational safety and health.

## 2.4 Safety training

The purpose of safety training is to train and strengthen the professional knowledge of safety behaviour in order to prevent the occurrence of occupational accidents (Ho & Dzeng 2010). Construction workers tend to suffer the most severe occupational injuries and the construction industry deviates from other industries in a way that the safety of the working environment depends whether the construction project is e.g. a bridge, building, plant etc; thus education and safety training must be provided onsite because tools and machines differ in different sites (Ho & Dzeng 2010). Construction business in particular remains as an industry which involves dangerous activities, potentially causing very high-risk injuries and poor health (Carney et al. 2008). Even with the technological advances i.e. modern machinery and plant, construction projects nevertheless contain many dangerous activities (Carney et al. 2008).

Ineffective safety training can lead to injury, pain, suffering, death and loss of profits; two factors differentiate ineffective training from effective training which are lack of objectives and failures in evaluation. Effective training requires that training needs are pinpointed, objectives are set, that the program is secured and developed and that the training is conducted and evaluated. The course content and how it's been delivered must be tailored according to the trainees needs and within financial constraints. The first step is to figure out what kind of training is needed, and it starts with listing all the occupations in the workplace and then separating them to tasks performed. Next step is to identify the critical tasks i.e. tasks that either have the potential or have created significant personal harm or property damage; then followed by viewing the accident records in order to understand what kind of training is needed. It is also important to conduct a survey or an interview for the employees to gain insight on what they think what kind of training would help them perform their jobs

more safely and efficiently; and lastly, reviewing legislation for training needs. (Robotham 2001.)

Low engagement training (videos, demonstrations, lectures) has been shown to be minimally effective compared to more engaging type of training; high-engagement training such as hands-on practice in a realistic setting or some kind of training that involves behavioural modification is on average three times more effective. High-engagement training such as VR (virtual reality) is a technology that uses computers, software and peripheral hardware to generate a simulated environment; IVE (immersive virtual environment) is an environment which is computer generated, it gives a person a sense of being immersed in the virtual environment and affects the persons senses in a way that makes the reality disappear. (Sacks et al. 2013.)

Onsite training is very difficult due to the dangerous nature of construction sites and certainly any experimental training of failure cannot be conducted onsite. One solution could be constructing a training facility which would physically simulate a construction site, VR and IVE could offer the opportunity for workers to be exposed to different kind of dangerous situations and accidents as part of their safety training. The benefits of the VR or IVE training would be that the workers could assess the situation, decide and implement the needed action and instantly observe the results. Other solutions could be a generic industrial safety VR game or safety training which would be carried through a virtual software program e.g. through program called Second Life. However, immersive virtual training in construction environment is rare and the effectiveness and knowledge regarding their use is extremely limited. Nevertheless, VR training might be underestimated since the degree of reality and sophistication of built VR scenarios have been limited. Disadvantages of VR training includes primarily the following, the time consumption of preparing VR scenarios which requires attention to fine details and the cost of developing the training materials and virtual construction site. (Sacks et al. 2013.)

Health and safety must remain as the main concern all the way to the top of construction industry including stakeholders such as clients and end-users, for there to be a real change in the health and safety records. The key idea is to provide a comprehensive safety training program throughout the construction process involving all the parties and the program should be tailored in a way that it meets all the roles and responsibilities of those involved. Competing in an increasingly competitive and dynamic world economy, a construction industry that can control their health and safety records has a strong competitive advantage. (Carney et al. 2008.)

## 2.5 Safety culture

Often the most important skills listed for leaders are communication skills and the ability to generate trust. Communication, however, can present challenges particularly when people

tend to automatically filter and interpret what a speaker is saying according to their own experiences. In order to create trust among employees a leader must have integrity, ability (technical competence) and benevolence. One of the biggest issues regarding safety improvement efforts is lack of trust. Staff must perceive leaders trustworthy i.e. that the leader will act on the employees' best interest and that the leader cares about the person as an individual. Punishments, guilt and blame only increase resistance; mistakes are necessary, and people learn through action. When mistakes occur, it needs to be recognized so the message that the leader wants to convey can be rephrased so that actions can be clarified, in this way the trust level which is needed to influence the culture can be maintained. (Carrillo 2010.)

The definition of safety culture means the underlying values and assumptions that guides behaviour in an organization (Goncalves, Anastacio & Waterson 2018), consisting of behavioural, psychological and situational components (Ardeshir & Mohajeri 2018). Safety leadership starts with examining assumptions meaning that the leader should first start with the culture change by correcting her/his own false assumptions hence creating opportunities for others to follow (Carrillo 2010). When inserting new assumptions, a leader introduces a new process to address a problem according to his/her own assumptions of what is right or wrong (Carrillo 2010). Once a group takes action and realizes that this process repeatedly turns out to be success, a shared belief develops that this is the correct action to take in this kind of a situation - desired results reinforces beliefs (Carrillo 2010). Gradually this belief develops into a shared assumption which might become so automatic by nature that acting against it would be unthinkable (Carrillo 2010). Once assumptions are established, they are extremely difficult to change, the process is very time consuming and creates anxiety as one has to admit that some long-held belief might have been faulty (Carrillo 2010).

Culture change which is adaptation of new beliefs and assumptions happens in groups, for leaders the challenge is how to facilitate the adoption of those successful beliefs. To achieve long-lasting change, it requires changes in the company's learning systems and in the theories of action that people use, however ultimately the desired behaviour needs to be self-motivated. A belief might be correct or incorrect. When it is correct the action happens automatically without having to make a decision ending with good results thus making life easier but there is also a possibility for experiencing good results which leads to the wrong belief i.e. avoiding using protective clothing because it is hot, smoking or speeding. In the moment it might seem like a good idea and even ending with good results, but the person is unaware of the bigger picture that in any moment the situation can turn dangerous causing harm to a person or persons. (Carrillo 2010.)

The reasons for workers to engage in unsafe work practices are due to extreme pressure of production, insufficient lack of time and resources, lack or training and lack of safety culture. The goal is to shape the workers beliefs, behaviours and attitudes as well as improving the

physical working environment. Relating to safety and planning, one of the best ways to measure company's safety culture is to study the workers perception on attitudes and behaviour of all management. Applying safety methods such as safety culture decreases the probability of accidents and in addition has an impact on the project's financial and economic profits in the long run. A reflection of a good safety culture can be seen through these four elements: commitment to safety of the senior management; shared concern and care for risks and for the impacts that they have on people; flexible and realistic rules and norms about the risks and; continuous monitoring, feedback and analysis systems. (Ardeshir & Mohajeri 2018.)

## 2.6 Risk management

Risk management is about identifying risks and how an organization or a company responds to them in an adequate way; the process includes identification, assessment, planning and management of risks. Vast majority of failures are caused by human errors and by the absence of adequate risk management controls. It is important that all levels, meaning all the stakeholders, of the company are been made aware of the risks and that they are included in the process for risk management to be effective. Risk, however, does not always create a negative impact it can also have a positive impact, particularly if the risk is being managed in the correct way i.e. controlling risks can many times have positive impacts. (Merna & Al-Thani 2008.)

Hazards and risks are often interchangeably used as if they mean the same thing, hazard is more of a condition that can cause injury, death, damage or loss e.g. environmental damage (Merna & Al-Thani 2008). Hazard is normally perceived as a result of a component or system failure even though this is not always the case; a hazard can exist without anything failing (Merna & Al-Thani 2008). As where a hazard regards to severity and the end-result, a risk on the other hand combines the concept of severity of the consequences and the likelihood of an accident happening (Merna & Al-Thani 2008). According to Merna & Al-Thani (2008), the construction industry includes the following hazards (figure 1):


Figure 1 Hazards in the construction industry (Merna & Al-Thani 2008)

ISO 31000 (the International Organization for Standardization) is developed to help organizations to identify, assess, evaluate and manage risks; the goal is to create a risk management culture where the organizations staff as well as other stakeholders are aware of the importance of monitoring and managing risks. Adapting ISO 31000 helps an organization to comprehend the negative and the positive possibilities and consequences of risks. ISO 31000 can be used by all kinds of organizations regardless of the industry, the size of the company or its location. The standard is intended for anyone, not just for professionals, who are managing risks within their tasks and persons who are part of the decision-making process regarding risks, however it is important to note that the ISO 31000 standard is not intended to serve as a basis for certification. (ISO 31000 n.d.)

Risk management is an essential part of everyday business processes. The organization should have it integrated into their operations, structure and processes, applied at the organizations operational, strategic, programme or project levels (SFS-ISO 31000:2018). In the process depicted in figure 2, communication and consultation refer to that all the integral stakeholders are helped to comprehend what is a risk and furthermore the basis of which decisions are made on and why certain actions are required (SFS-ISO 31000:2018). Communication is about promoting awareness and understanding of risks, consultation about acquiring information and feedback to support decision-making (SFS-ISO 31000:2018). As previously referenced, risk management can be applied to different levels in business operations and therefore it is

important that the scope is clear; what the relevant objectives are and that they align with the organizational objectives (SFS-ISO 31000:2018). Important things to take into consideration are objectives and the decisions that have to be made; expected outcomes; specific inclusions and exclusions, location, time; the appropriate tools and techniques to perform risk assessments; needed resources, responsibilities and records that need to be kept; other processes, projects and activities in connection to it (SFS-ISO 31000:2018).

At the beginning of the risk assessment process risk criteria needs to be established; this means that the organization needs to specify the type and amount of risk which it may or may not take as well as define the criteria on how to evaluate the significance of a risk and support the decision-making processes. Risk identification, risk analysis and risk evaluation are at the centre of the risk assessment process (figure 2), it should be carried out systematically, collaboratively and continually taking into account the views and knowledge of stakeholders. Risk identification is about finding, recognizing and describing risks which would possibly prevent or help an organization to reach its objectives. Risk analysis helps to comprehend the nature of the risk and its characteristics as well as the level of the risk where appropriate. Following factors should be considered e.g. likelihood and consequences; nature and magnitude of consequences; instability and time-related factors and how effective the existing controls are. Risk evaluation is about whether the result of the risk analysis requires additional action, the decision might be that nothing needs to be done or to consider possible risk treatment options; maintaining the controls that are currently in effect; reconsider the objectives or conduct further analysis to better understand the risk. (SFS-ISO 31000:2018.)

If the decision is to consider risk treatment options then it is about selecting whether to avoid, remove, share, retain or increase the risk; it can also mean including one or more risk treatment options and then choose the ones that will be implemented. It is also possible that risk treatment can create new risks which then needs to be managed therefore monitoring and reviewing risks are crucial part of the risk treatment implementation to make sure that the selected methods become and remain effective. Monitoring and reviewing should be done throughout the whole process i.e. planning, gathering and analysing information, results should be recorded, and feedback given. Documenting and reporting the risk management process and its outcomes is important; the point is to communicate the activities and outcomes of risk management for the whole company, improve activities regarding risk management, share information for decision-making and assist interaction with stakeholders. (SFS-ISO 31000:2018.)

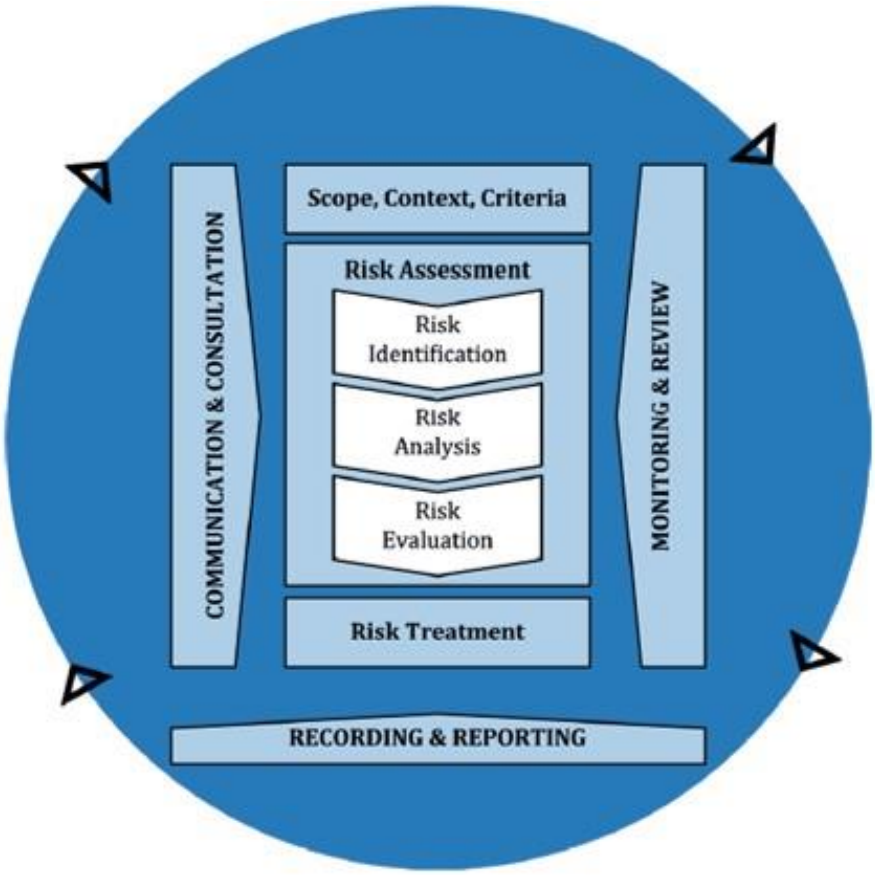


Figure 2 Risk management process (SFS-ISO 31000:2018)

# 3 Methodology

In this chapter the methodology of this study will be covered, starting with the definition of it and then moving on to the data collection methods which will be used and finally how the collected data will be analysed. Methodology is about how we approach problems and how we search for answers; the interests, assumptions and purposes mold which methodology we choose (Taylor 2016). Essentially, research methodology is about systematically solving the research problem; the methodology needs to be designed according to the problem (Kothari 2004). There are basically two types of research methodologies that can be chosen: qualitative and quantitative approach (Kothari 2004). The methodological approach taken in this study is based on qualitative research method.

Qualitative research method is about subjective assessment of opinions, attitudes and behaviour (Kothari 2004). This type of research focuses on discovering the underlying desires and motives, using e.g. interviews, story completion tests, research on to find out how people feel or what they think about certain subjects (Kothari 2004). Qualitative research method produces descriptive data, people's own spoken or written words or it can be behaviour which can be observed. There is no inherent hierarchy of credibility in qualitative research, in other

words all perspectives are valuable meaning of course that there is something to be learned from them. The study should be entered with an open mind, having well-formulated ideas and interests beforehand can turn out to be very frustrating; it is important to explore the phenomena as it emerges during the study, all people and settings are interesting and can raise important issues relating to the study. (Taylor 2016.)

The reason for the qualitative research approach is that this study focuses on acquiring knowledge and opinions i.e. descriptive data instead of statistical data. The two data collection methods chosen for this study are a workshop and a survey. The workshop will be conducted with the managers of NRC Finland and the purpose with this is to have a discussion on what the company considers to be important regarding OSH and safety culture and specifically safety training, how it can be improved and in what way should it be implemented through e-learning. The other method is to have employees answer a survey with open-ended questions relating to safety culture and safety training. Finally, analysing, combining and explaining the findings of these methods as well as the literary review in the results.

### 3.1 Workshop and survey

The purpose of a workshop is to solve identified problems, exploring specific topics or creating something new (Sufi, Nenadic, Silva, Duckles, Simera, De Beyer, Struthers, Nurmikko-Fuller, Bellis, Miah, Wilde, Emsley, Philippe, Balzano, Coelho, Ford, Jones & Higgins 2018). The article by Sufi et al. (2018), focuses on three different types of workshops: exploratory, learning and creating. Exploratory is about analysing ideas to better understand the topic, problems associated with it, current solutions and challenges that the company might face in the future so the company can identify the actions that need to be taken or getting an experts advice on certain topic; miniworkshops and discussion sessions are examples of exploratory workshops (Sufi et al. 2018). Learning workshop, as the name indicates, is about teaching a skill set, technique or application; main focus is on increasing knowledge, confidence or competence in certain area (Sufi et al. 2018). Creating workshops are about solving a specific problem or problems by building something together such as software's, resources, standards etc. (Sufi et al. 2018). The workshop that will be conducted in this study will be focused on exploratory type, it is about having a discussion regarding new ideas, procedures and finally developing a solution to the task at hand.

Surveys can have two types of questions: qualitative and quantitative (Sufi et al. 2018). Qualitative are more of open-ended questions, seeking information and identifying concepts (Sufi et al. 2018). Quantitative questions are usually answered by large number of respondents and the questions are more definitive where the respondents verify a certain statement by using a linear scale from strongly disagree to strongly agree (Sufi et al. 2018). The survey in this study will have open-ended questions for the respondents i.e. seeking new ideas and identifying concepts. It is however important to keep in mind that there are some pitfalls to avoid

being bias. The questions should not be too complex or compound, these kinds of questions can be hard for the respondent to answer and for the researcher to interpret, it is recommended to keep the questions simple and straight to the point (Sufi et al. 2018). Another thing to avoid is leading questions which are guiding the respondent to a certain response, this is one of the easiest ways of getting a biased response (Sufi et al. 2018). The overall goal is to keep the questions as straightforward as possible so that the respondents have no trouble of understanding and answering them, the respondent will not complete the survey if there are any barriers which would prevent him or her answering the questions whether it is due to technical issues or confusing questions (Sufi et al. 2018).

## 3.2 Analysing the data

After the data has been collected from the workshop and survey it needs to be analysed in order to get insights from the data. Analysing qualitative data can be challenging, Bhatia (2018) states that since the data consists of words, images, observations etc. it is nearly impossible to conclude absolute meaning from it unlike in quantitative research. For the data preparation and analysis there are few steps that can be taken (Bhatia 2018). These steps are illustrated in figure 3 and they consist of the following phases. Since most qualitative data consists of words it is important that one familiarises with the data by reading it multiple times, including transcribing the data, to look for patterns and observations (Bhatia 2018). The workshop will be recorded during the meeting with the managers at NRC Finland and then transcribed afterwards. The survey, done with Microsoft Forms webtool, is sent to the respondents by e-mail containing a link to the survey, therefore the survey works as a transcription on itself. Next step reread the research objective and check the questions which can be answered through the collected data (Bhatia 2018). The third step is about coding the data e.g. important phrases, words, ideas, concepts etc., so it is easier to structure and label the data (Bhatia 2018). Finally, when the data is coded the researcher can start to identify patterns and connections i.e. research questions that can be answered by patterns in the data and/or most common responses and if there are any areas that could be explored even further (Bhatia 2018).


Figure 3 Analysing the data (Bhatia 2018)

# 4 Results

The results of this study will be presented in this chapter and will be explained more thoroughly on the following subchapters. The workshop which was conducted with the managers was essential in order to understand the current situation at NRC Finland regarding OSH in general and also about the company's goal to replace their e-learning system. The surveys purpose was to collect data on what the workers considered to be important relating to OSH, the risks, concerns and new ideas. Safety briefing material for the visitors was requested by the company for the following reasons, NRC Finland did not previously have this course material and in the future, it will be part of the new e-learning system. The material can be sent to the visitors beforehand so they can pass the course before entering the worksite thus giving NRC Finland the opportunity to spread awareness about OSH outside the company to clients, business partners, visitors, other organizations i.e. adding awareness to their safety culture. This will show that NRC Finland takes this matter seriously thus generating positive reputation on the company's name and its operations. The whole process of this study is depicted in figure 4.

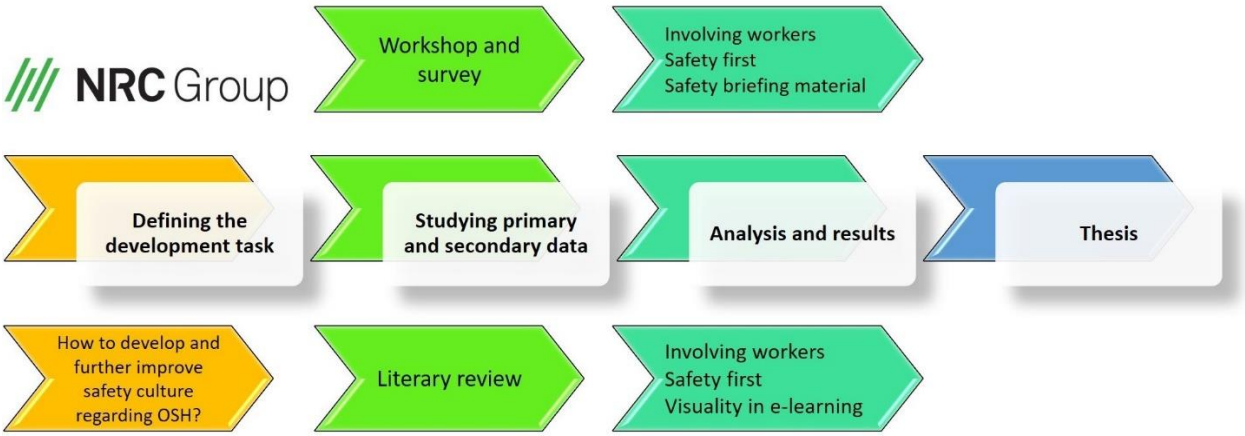


Figure 4 Process description

## 4.1 Workshop

The workshop was conducted at the head office of NRC Finland in Helsinki and had the following participants: HSEQ director (health, safety, environment and quality), training manager, safety-, quality- and environment manager, quality manager, railway safety manager. These persons were chosen for the workshop because of their knowledge and expertise on safety related issues. The workshop started with presenting the thesis plan, explaining the goal, framework, development task, timetable and the methodology of the study. The purpose was to get everyone acquainted with the study and its purpose. The topics of the workshop are shown in appendix 1.

The discussion started with the survey about its timeframe and who the respondents of the survey would be. It was decided that the sampling will be narrowed down to specific persons, the managers handpicked the participants for the survey during the workshop because in this way the likelihood that they survey will get respondents would increase (Workshop 2019). Relating to the development task (chapter 1.2) the company requested that a new safety briefing material would be planned and designed. The training manager stated that this material would be targeted for visitors who are visiting a railroad worksite so that they would know how to move around safely onsite and for e.g. what the visitors are allowed and not allowed to do and at the very end there would also be a small exams so visitors can test themselves if they have understood the instructions and regulations (Workshop 2019). Regarding training in general the purpose is not to have all the material online; some training require face to face teaching, railroad environment is a dangerous and risky working environment and some training still requires human interaction to make it as safe as possible (Workshop 2019). Like stated in the literary review in chapter 2.1. by Suhasini & Suganthalakshmi (2015), there are some topics which cannot be taught online specifically regarding safety, some training sessions needs to happen face to face.

Work-related accident records were one of the topics of interest. The HSEQ director explained that more than half of the work-related accidents are related to stumbling even though the frequency and number of work-related accidents has been decreasing; stumbling, tripping and slipping related accidents are on the rise (Workshop 2019). From the different business units within NRC Finland maintenance particularly represents a significant proportion of work-related accidents and it is also on the rise (Workshop 2019). This is confirmed by The centre for occupational safety (Work environment n.d.) in chapter 3.1, reporting that most work-related accidents are caused by slipping and tripping. Indicating that this is not just a problem for a one company, but this is the current trend for many companies and organizations. NRC Finland has only in recent times began enhancing their resolution processes of finding the causes of work-related accidents (Workshop 2019). Subcontractors do not present any significant issues regarding safety training, there are not so many currently working in the company partly due to the fact that there are certain qualifications that one needs to have in order to work in the railroad industry, if however needed an interpreter shall be used in case of a language barrier (Workshop 2019). Risk management specifically how to conduct risk assessments, according to the safety-, quality- and environment manager, was one of the issues that would require further training; the whole process should be clear for everyone, what is meant by risk and how to anticipate them (Workshop 2019). This definitely correlates with the development task and it is very important that the management recognizes the possible deficiencies that the risk management procedure might have. Like stated in chapter 3 it is very important that the whole company is included in the risk management process, everyone knows what a risk is and how to identify, assess and manage them (SFS-ISO 31000:2018).

## 4.2 Survey

The link to the survey was sent by e-mail to 44 recipients and out of those 18 responded. The survey questions can be found in appendix 2 and the main points from the results are depicted in figure 5. The respondents where from different business units, construction, maintenance, materials, employees from the safety, quality and environment unit and occupational safety and health representatives; half of the respondents were from construction. First noticeable common concern to the respondents is the constant and excessive rush at work (Survey 2019), this is repeated in several answers throughout the survey, particularly in responses regarding questions four and seven. There is a concern that due to excessive rush at work safety instructions are being ignored (Survey 2019). One of the reasons is that in a project there are sanctions set in place by the client if there are delays in the schedule, meaning that if the job is delayed the contractor must pay penalty for it (Survey 2019). There is a sense that the schedule takes precedence over safety (Survey 2019). If the job can be done without rushing it will lower the accident records significantly (Survey 2019). Absolute support from the management was requested for the project workers and supervisors if it so happens that the schedule was exceeded instead of it resulting in penalties, because safety should come first (Survey 2019). In overall, excessive rush was given as the main reason for the biggest OSH risks at work followed by indifference, poor attitude, wrong or old working procedures, difficult working environment e.g. during night-time and weather conditions e.g. snow or ice (Survey 2019).

Concern for others and for the respondent's own health was the main reason for complying with occupational safety regulations as well as setting an example for others; cannot expect others to comply if one does not follow the regulations him or herself. Regarding the most important occupational safety practices at worksites, introduction and guidance to work practices are considered to be very important including the appropriate attitude, abiding by safety instructions and regulations, protective clothing and gear, making safety observations and risk assessments. Occupational safety and health should be part of everyday work, not a separate entity but integrated into every aspect of the working environment. Improving occupational safety at work is to intervene when coming across any dangerous working methods, giving guidance on how to asses risks in InstaAudit (an application for assessing risks), taking care of the protective gear, safety tours on the worksites and being as an example relating to safe working methods. (Survey 2019.)

Question six in the survey was intended to ask whether the respondents would need more training on how to assess risks regarding larger concepts e.g. assessing risks for entire facility and the working methods within it by using a risk matrix. However, the way the question was formulated might indicate that the question is about assessing risks in smaller scale i.e. using InstaAudit for quick risk assessments and this was not the purpose. Regarding the replies, it is

unfortunately impossible to know how the question was perceived and understood by the respondents, meaning that the results regarding this question are inconclusive. Nevertheless, majority of the respondents stated that they do not necessarily need any further guidance regarding this matter (Survey 2019). There were couple of respondents who stated that they would benefit from further training e.g. when to update risk assessments and one who stated that he/she never done any risk assessments thus guidance would be appreciated (Survey 2019). Regarding safety training in general, there is a concern for the workers well-being and their ability to withstand ever increasing stress i.e. some form of training is wanted concerning how to support colleagues in their well-being (Survey 2019). Additionally, training on relating to lifting and how to check that the lifting aid equipment are in accordance with the regulations; environmental things; investigating accidents; safety instructions relating to track maintenance (Survey 2019).

The last question about how to develop safety culture at NRC Finland brought up a lot of comments and ideas how to achieve that. Like previously mentioned rushing through work tasks was perceived as a very negative and harmful thing and the same subject continues here. It should also be made sure that projects have adequate resources to perform work tasks safely (Survey 2019). Some of the ideas on how to improve safety culture was e.g. giving a gift card for those who have managed to avoid sick leave (per year) caused by work related accident or some kind of reward on successful implementation of safe working methods; taking up topics in weekly meetings such as risk assessment, using new equipment/machines, changing weather conditions, working environment, work-based processes from safety perspective; involving the workers in the planning relating e.g. with working methods, working time, equipment (Survey 2019). The replies contained some criticism also. The current compensation for projects that manages to avoid work-related accidents does not work and the reason is that the compensation is calculated and combined according the whole years projects instead of the compensation going to the workers of that one project (Survey 2019). Documents seem to be scattered, meaning that different documents can contain the same things which can be confusing, it would be more logical to combine them in order to avoid repetition. The same thing applies to different events as well, to have them more structured and avoid repetition so the message remains meaningful (Survey 2019). There was one comment where the respondent at times feels that OSH takes precedence over everything which should not happen (Survey 2019). The competitive situation in the market requires companies to be cost effective, moderation is the key in everything, competitiveness must be maintained, and contracts must be profitable (Survey 2019).


Figure 5 Survey results (Survey 2019)

### 4.3 Safety briefing material

One task was to plan and design a safety briefing material for NRC Finland. This safety briefing material is targeted for visitors who are coming to visit worksites. The company requested it for the purpose of elevating their safety culture by demonstrating it outside the company as well as making sure that visitors understand the importance of safety, so they know how to conduct themselves at worksites. The course was constructed on PP (PowerPoint) since the new e-learning platform does not exist yet. Designing this course on PP meant that it could not be as visually appealing as it could have been with the new e-learning platform which has more features on it and the software is specifically build for online learning. When the new e-learning platform is in use and working the purpose is to construct this course there. The duration of this course is approximately twenty minutes.

When planning and designing the course there are certain things which need to be taken into account. One of the most important things to remember is that nowadays trains run mostly on electricity which makes them extremely silent and it is crucial to stay alert while round railway tracks (Course material 2019). The railway area may only be visited when it is regarding work-related issues or if other necessary tasks need to be performed (Väylä 2019). Visitors are not required to have qualification on railway safety or introduction to the worksite, however visitors must have a host when visiting a worksite (Väylä 2019). The host has a responsibility to brief visitors on safety matters and is in general responsible for the visitor's safety in the worksite (Väylä 2019). It is also important to note that visitors are not allowed to move around in the railway area without supervision (Väylä 2019). Visitors must have appropriate protective clothing and gear e.g. safety helmet and if deemed necessary other protective clothing as well; the host is responsible that the visitors have the necessary protective clothing and gear at their disposal and that they are being used in a proper way (Väylä 2019).

The course is divided into four main sections (table 2), introduction; information security and confidentiality; worksite safety and railway safety. It will also include three short exams and at the end participants have a possibility to give feedback. Introduction contains information about the course, what it entails, how long the course will take, course objectives and the long-term goals for NRC Finland. Information security and confidentiality will explain what is meant by access control and that everyone including visitors have to carry their ID card in a visible place at all times (Course material 2019). This is followed by instructions and restrictions regarding photographing and social media, certain things are not allowed to be photographed e.g. computer screens, working methods, tools, machines and ultimately it is up to the site manager to decide whether something is allowed to be photographed or not (Course material 2019). Caution is advised when sharing pictures in social media, one can only share pictures that one has taken him or herself and always to ask permission from people in the picture before publishing (Course material 2019).

Worksite safety explains the importance of using protective clothing and gear – a safety vest, helmet, glasses, headphones, safety boots. Using one's own headphones is strictly forbidden and it also strongly advised to avoid texting while at the worksite, because that might be a distraction thus losing focus on what is going on in the surroundings. Smoking is only allowed outside in designated area, using alcohol or other intoxicants is strictly forbidden. Worksite cleanliness explains how untidiness at a worksite is a serious risk to safety and how everyone has a responsibility to uphold the cleanliness and order at the worksite. The railway safety section addresses safety in the vicinity of the tracks. The course participant will learn what is the safe distance for track work (RSU = ratatyön suojaulottuma), meaning one has to stay 2,5 meters from the rail to keep safe distance from the tracks. Tracks should only be crossed along designated roadway or pedestrian crossings and to never step on the rail itself because it might be slippery. One should also be aware of the electricity that runs through the overhead contact line and what is the safety procedure in case that line drops on the ground, because it has voltage of 25 000 and thus making it lethal. Lastly, if there is crane work at the worksite, never step or walk under the load that is being lifted. (Course material 2019.)

| Introduction | Information security & confidentiality | Worksite safety | Railway safety |
|---|---|---|---|
| Course information | Access control | Protective clothing and gear | Safe proximity distance from the tracks |
| Course objectives | Photographing | Smoking & intoxicants | Crossing tracks |
| Long term goals | Social media | Worksite cleanliness | Overhead contact line system |
| | | | Crane work |

Table 2 Course structure

## 5 Conclusion and recommendations

The objective in this study was about enhancing OSH and safety culture through e-learning and the objective of this study was reached by the creation of the safety briefing material and the recommendations given in this chapter. NRC Finland has a huge responsibility for the safety of their staff, passengers and for the rail freight and therefore takes occupational safety and health and other safety related issues very seriously. It was requested by the company to produce a safety briefing material for visitors who visit worksites to demonstrate more active role regarding safety. Since the new e-learning platform was not yet enabled the safety briefing material was constructed on PowerPoint presentation. The chosen methodology produced the needed data although one of the questions in the survey was formulated incorrectly but nevertheless both workshop and survey gave the needed information for the purpose of this study.

E-learning is becoming more and more popular among organizations due to the fact that it is more fordable than traditional face to face teaching even though it does present some challenges. Lack of interaction between the instructor and trainee is probably the most negative aspect of it thus making it more difficult to confirm whether the taught material have been internalised by the participants of the course. Specifically, work-related safety is a topic that cannot entirely be taught through e-learning, which was also confirmed by the training manager at NRC Finland. Worksites are different, different equipment, machines, procedures, risks, which makes it necessary to conduct at least some part of the safety training face to face. When designing the courses, it might be beneficial to take into account the different learning styles individuals have, regarding construction industry this probably means that the

training material would have more visual elements in it and if possible, it could be more interactive.

Even though safety and well-being of the staff is highly important and even mandated by law, the challenging task for businesses today seems to be how to maintain adequate level of safety and at the same time not to increase costs so contracts will still stay competitive and profitable. This, however, is not necessarily the workers or managers primary concern. Rushing through work tasks can lead to taking unnecessary risks and ignoring safety procedures which are set in place for the purpose of protecting the employees. Nonetheless, all risks cannot be avoided so it comes down to the organization to decide which risks can be accepted and which require a treatment plan while still making sure that everything is done in accordance with the law. Assessing risks is important in every business but it is particularly important in businesses like the construction industry which is very prone to work-related accidents like e.g. slipping, tripping, falling. Involving the workers more into the planning processes might bring new ideas or different perspective into the table, this might be something worth considering for.

## 5.1 Reliability and validity of the study

There were time constraints on this study which had an effect on the planning phase and the results. Originally the plan was to design and implement the e-learning courses to the new e-learning system, however, this was not possible because the whole project would have taken a considerably much more time to complete. NRC Finland was still on the process of choosing the right system platform and there was no time estimation on when that decision would have been made. Regarding the survey, the respondents were chosen by the managers which naturally creates a shadow on the reliability. Time had a factor in this also and there was a concern that there would have not been enough respondents so the decision was made that the best solution was to choose the individuals who will be more likely to respond to a survey. However, it is important to note that the respondents replied anonymously to the survey questions and the identity of a single respondent cannot be deciphered, as the results shows (4.3) the replies were summarized.

The methodology chosen in this study was the qualitative research method which was the appropriate method considering that the purpose was to gather information and new ideas instead of statistical data, which was successfully achieved. Workshop and survey were chosen as the two data collection methods, both brought up valuable information which was needed in order to elevate NRC Finland's OSH both inside as well as outside the company. The safety briefing material makes the results tangible by providing the training material for the visitors, so they get the necessary OSH briefing. Timewise it has to be acknowledged that with more time the survey could have been sent to more recipients even though there is no guarantee that it would have generated more responses.

## 5.2 Future research

Future research topics could relate to e.g. why certain accidents are on the rise and why maintenance from the business units is overrepresented in the accident records. This research could also include measuring the company's safety culture by studying the workers perception on behaviour and attitudes of the management. This approach would give a comprehensive outlook on the company's safety culture as well as investigating on why certain accidents are increasing. For the research methodology this would mean that both qualitative and quantitative would be used. For one to get statistical data i.e. number of accidents and separate into what kind of accidents and into different business units and qualitative data to find out reasons behind the accidents including the data from the safety culture research. Then figuring out a solution or solutions to halt the accidents or at very least reduce the number of accidents and adjusting or improving the company's safety culture if deemed necessary.

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Course material. 2019.

Survey. 2019.

Workshop. 2019.

Figures



Tables

Appendices

Appendix 1 Workshop topics

20.11.2019

# WORKSHOP

- Is safety training going to focus entirely on e-learning or is it going to be blended learning?
- When you say that you want to elevate safety culture - need to be elaborated what is meant by this?
- What topics should be included in the safety briefing material; what kind of briefing/training is needed?
    - To whom is it targeted for? Visitors, subcontractors etc.?
    - Is the context about briefing or training?
    - Would the material focus on OSH or also other fields relating to safety?
- Max. length of the safety briefing material? (On PP or which platform)
- Accident records, from where do I get them? How detailed are they? Are there certain groups or professions which are more prone to work related accidents?
- How big of an issue are the subcontractors and their understanding of safety training when it comes to OSH? How are they trained? How is the language barrier been dealt with?
- Instructions on how to assess risks – for who is it for and is there a particular reason for why it is needed? (specifics)
- In order to get workers to participate in the survey, is there a possibility to have a lottery to reward them somehow? Or any other ideas how to get workers to participate in it? Or can it be connected to some training session or some other event whether it is online or face to face?
    - Which work groups would be recommended being included in the respondent group?

Appendix 2 Survey questions

# Occupational safety and health survey

1. What do you consider to be the most important occupational safety practices at work sites / workplaces?

Enter your answer

2. What are the factors that make you want to comply with occupational safety regulations?

Enter your answer

3. What can you do and / or have done to improve occupational safety at your work?

Enter your answer

4. What do you think are the biggest risks regarding occupational safety?

Enter your answer

5. Is there some area regarding occupational safety that you would like to have more training?

Enter your answer

6. Do you feel you need guidance on how to carry out risk assessments? If so what kind?

Enter your answer

7. How would you develop safety culture at NRC Finland?

Enter your answer