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# The need for improved information flow to address safety in urban construction site deliveries

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## Preface


This master thesis is written with the Department of Civil and Environmental Engineering at the Norwegian university of Science and Technology, spring 2017, and is part of the Msc – Master of Science.

I would like to express my gratitude to my supervisors, Associate Professor Kelly Pitera and Petr Pokorny (NTNU), for patiently guiding and supporting me in so many ways, and providing valuable insights and inspiration to this research. I would also like to thank Ross Phillips at the Norwegian institute of Transport Economics for taking interest in the project and providing guidance with the research objective. Furthermore, I would like to express my gratitude to Tore Myrvold at Trondheim municipality, for facilitating construction site inspections and meetings with stakeholders.

Additionally, I would like to express my gratitude to the municipality, companies and personnel for taking the time to participate in interviews and providing valuable insight. Your participation and facilitation made it possible to conduct this research. A special thank you to the drivers and transport managers for such a warm welcome and generosity. Interviewing you guys was by far the best part of the master thesis, with excellent company and amazing trucks.

Finally, I would like to thank Sondre Lundhaug Andresen, for the support and encouragement, and voluntarily consulting me on content and quality of the whole report.

Trondheim, 20. June 2018

A handwritten signature in dark ink, appearing to read 'Lisa Tronhuus Hannasvik', written over a horizontal line.

Lisa Tronhuus Hannasvik

## Abstract

It is challenging to design and operate construction sites within space-constrained urban areas. Urban construction sites are often located in close proximity to public streets and roads with a high traffic volume, and a high share of vulnerable road users. Truck appearances generated by a construction site inject temporary risk into the urban areas, as urban roads are not primarily designed for trucks, and the truck drivers might not be familiar with local conditions. This results in safety challenges for the project owner, construction and transport companies, and their drivers. By Norwegian law, project owners and construction companies are obliged to conduct a risk assessment of the site. However, such assessments rarely include traffic safety outside of the site. Therefore, the objective of this research is to gain a better understanding of the safety considerations associated with deliveries to urban construction sites. Particularly interesting is the information flow between stakeholders involved in construction site operations, concerning the site-specific access and loading information truck drivers receive when delivering to construction sites. Based on the findings, recommendations are suggested to improve the flow of necessary information for improved safety while delivering to sites.

The qualitative research approach consists of in-depth and focused interviews. The first set of interviews was conducted with seven truck drivers and six transport company managers. Interviews were audio-recorded and summarized to identify safety problems and barriers in the safety information flow regarding access, on-site driving and loading. Based on the findings from these interviews, a construction site manager and a project owner were interviewed in a second round of interviews. The main purpose of these interviews was to gather their insights on findings identified in the first set of interviews, as well as to gather more data regarding the information flow.

The findings from the first set of interviews indicated that the drivers rarely receive more information than what and where to deliver, and often with little advance notice, making it challenging for the drivers to plan their next deliveries. Yet, most drivers stated that the site's address was sufficient to conduct a safe delivery. Furthermore, most of the interviewed company managers considered the courses required by law and having a driver's license as sufficient for the safety. However, most drivers reported the mandatory courses to have limited value regarding safety, and that the understanding of risk and learning to conduct safe deliveries is primarily gained through the everyday work experience. Despite the interviewees general agreement that the status quo was "good enough", areas for improvement were identified. E.g. plans to show where to enter and unload at delivery sites was pointed out by drivers as missing and desired information. Additionally, one transport manager highlighted that providing specific safety-related information regarding particular sites and/or routes is beneficial to drivers. However, providing too much information could make it challenging for the drivers to remember specific information.

A general safety management system of construction site truck-traffic, supported by law or regulation is suggested to address the consistency and quality of the safety information flow between project owner, construction site management, transport leaders and truck drivers. While this study is focused on urban construction operations, the results could also be applied to other urban delivery operations.

## Sammendrag

Arealbegrensinger i urbane områder medfører utfordringer vedrørende utforming og drift av bygge- og anleggsområder. I en urban kontekst er bygg- og anleggsområder ofte lokalisert nære gater og veger med høyt trafikkvolum og en stor andel myke trafikanter. Bygge- og anleggsområder i urbane områder genererer transportarbeid med lastebiler på veier som ikke primært er planlagt for tunge kjøretøy. Videre er ikke nødvendigvis sjåfører kjent i området, og denne trafikksituasjonen medfører økt risiko. Dette medfører sikkerhets-relaterte utfordringer for byggherre, entreprenører, transport firmaer og lastebilsjåfører. Etter norsk lov er byggherre og entreprenør pålagt å gjennomføre risikovurderinger i forbindelse med bygge- og anleggsarbeidet, men disse inkluderer sjeldent trafikksikkerhet utenfor anleggsområdet. Målsettingen med dette studiet er derfor å oppnå en bedre forståelse av hvilke risikovurderinger som gjennomføres i forbindelse med leveranser til urbane bygge- og anleggsplasser. Sikkerhetsinformasjonsflyten mellom interessentene assosiert med bygge- og anleggsområder er av særlig interesse med tanke på hvilken anleggsspesifikk informasjon sjåførene mottar vedrørende adkomst og lossing før leveransen. Basert på funnene i studiet er det foreslått forbedringer vedrørende distribusjon og innhold av nødvendig sikkerhetsinformasjon til lastebilsjåfører som leverer til urbane bygge- og anleggsområder.

Benyttet forskningsmetode består av fokuserte intervjuer og dybdeintervjuer. Den første intervjurunden besto av intervjuer med syv lastebilsjåfører og seks ledere av transportfirmaer. Intervjuene ble tatt opp, og sammendragene ble benyttet til å identifisere sikkerhetsutfordringer og barrierer i sikkerhetsinformasjonsflyten. Særlig relevant var funn vedrørende hvilken informasjon sjåførene og transportledere mottar vedrørende adkomst, kjøring inne på anlegget og lossing. I den andre intervjurunden var to prosjektledere intervjuet, en på byggherresiden og en på entreprenørsiden. Formålet med denne intervjurunden var innspill på funn i fra den første intervjurunden, samt en økt forståelse av sikkerhetsinformasjonsflyten mellom interessentene på bygge- og anleggsområder.

Funnene fra den første intervjurunden indikerte at lastebilsjåfører sjelden mottar informasjon utover hva som skal leveres og en adresse. I tillegg er leveransene ofte distribuert til sjåførene på kort varsel, og dette gjør det vanskelig for sjåførene å planlegge leveransen. Samtidig var de fleste sjåfører klare på at det ikke var behov for mer informasjon enn adressen om premisset var en sikker leveranse. Videre hevdet også de fleste transportlederne at de lovgitte kursene og førerkort på lastebil var tilstrekkelig for å utføre en sikker leveranse. Til tross for en utbredt enighet om at dagens situasjon var tilstrekkelig, ble noen mulige forbedringer identifisert basert på hvilken sikkerhetsinformasjon sjåførene etterspurte og løsninger de hadde gode erfaringer med. Et eksempel på slik informasjon er et oversiktskart av anlegget som indikerer område for lossing og porter for innfart og innfart. En transportleder påpekte også fordeler med å informere sjåfører om anleggs- og rutespesifikke sikkerhetsinformasjon, men for mye informasjon kan også gjøre det utfordrende for sjåførene å huske detaljert informasjon.

Et generelt sikkerhetsstyringssystem for lastebilleveranser til bygge- og anleggsområder, forankret i lov eller forskrift, er foreslått som et mulig tiltak for bedret kvalitet og innhold i sikkerhetsinformasjonsflyten mellom byggherre, entreprenør, transportselskap og lastebilsjåfører. Studiet fokuserer på leveranser til bygge- og anleggsplasser i urbane områder, men resultatet er trolig også relevant for andre leveranser i urbane områder.

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## Abbreviations

ADR	Directives, the European Agreement concerning the International Carriage of Dangerous Goods by Road
WEA	Working Environment Act (Arbeidsmiljøloven)
HMS	Health, environment and safety (Helse, miljø og sikkerhet)
NPRA	Norwegian Public Roads Administration
SHA	Safety, health and work environment (Sikkerhet, helse og arbeidsmiljø)
UAG	Accident analysis group (Ulykkesanalysegruppe)
WZTCP	Work Zone Traffic Control Plan (Arbeidsvarslingsplan)
YM	Outer environment (Ytre miljø)

## 1. Introduction

With increasing traffic volumes and higher population density in Norwegian cities, new challenges with the execution of urban construction site deliveries are introduced. In 2001, the Norwegian government constituted “Nasjonal Transportplan” (NTP) 2002-2011, which declared that all work regarding traffic safety should originate in “Nullvisjonen” (Det kongelige samferdselsdepartement, 2000). The vision is to develop a transportation system that does not result in any fatal or severe injuries.

Data retrieved from the official reports of fatal accidents (UAG) in 2010-2016 is presented in Figure 1. There is a high representation of trucks in fatal accidents, with a truck involved in every fourth fatal traffic accident in 2016 (Statens Vegvesen, 2017). In 2010 the Norwegian Public Roads Administration (NPRA) made a case study of traffic accidents in connection to road work. Out of the 23 fatal accidents, 10 of them involved a truck, which amounts to 43 % (Statens Vegvesen, 2011). Furthermore, in two out of three cases, the construction site did not meet requirements regarding signs, markings, visibility or separation from traffic. These findings might indicate that there is a greater risk associated with construction site truck traffic. Similar findings were reported from other European countries, e.g. in UK, where construction site vehicles were reported to have an apparent overrepresentation in fatal cyclist accidents (Transport Research Laboratory, 2012).

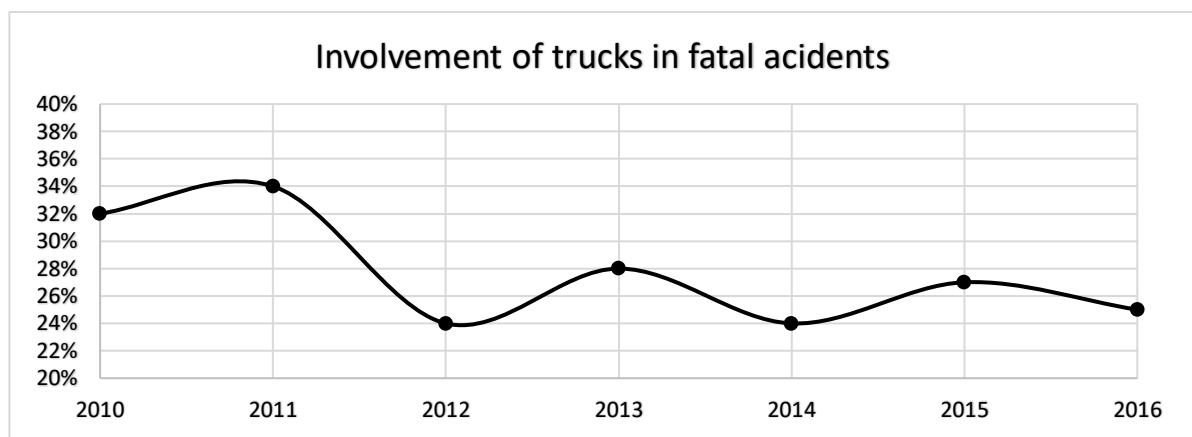


Figure 1: Percentage of fatal accidents involving a truck

Source: Statens Vegvesen, *Dybdeanalyse av dødsulykker 2010-2016* (Statens Vegvesen, 2017).

The research conducted by TRL concluded that “there is a limited ownership of road risk within the construction industry by clients and principal contractors”, indicating that the responsibility of carrying out risk assessment and safety measures is left with the truck drivers and their managers (Transport Research Laboratory, 2012). In a Norwegian context, the laws and regulations concerning safety on construction sites could contribute to a similar lack of ownership to road safety with construction site deliveries. The requirements to on-site safety are more extensive, due to the relation between the construction company and on-site workers that are employees. The construction company is required to inform their employees of risks related to their work and provide necessary training, practise and instructions. However, other workers performing on-site operations (e.g. truck drivers) are not included in these requirements (Ministry of Labour and Social Affairs, 2005).

A study of work-related accidents in Norwegian road, sea and air transport concluded that the most frequent risk factor is lack of complete, written risk assessments (TØI, 2015). However, the construction company or project owner is not required to provide truck drivers delivering to their sites with written risk assessments. Furthermore, the risk assessments required considers operations on-site, not truck drivers on-route with deliveries to the construction site. The project owner and construction company operating on a construction site are obliged to make evaluations and measures regarding outer environment (YM), however these normally only include noise, vibrations and pollution, not truck safety. Especially in urban areas, roads are not primarily designed for trucks, and unfamiliar truck drivers accessing construction sites on streets unfit for truck traffic, when there are better alternative routes, put themselves and others at unnecessary high risk. Furthermore, truck drivers that are unfamiliar with on-site truck-related safety procedures (e.g. what gates to enter, and exit, loading areas) are posing unnecessary risk to themselves and workers on-site.

The employer of truck drivers has the main responsibility to provide general information regarding risk associated with the work situation and relevant training (Ministry of Labour and Social Affairs, 2005). In a study conducted by TØI, several professional drivers stated that one of the most important factors that had to change in order to prevent accidents is the attitude and responsibility of transport employers (TØI, 2013). Furthermore, drivers interviewed in the study were under the impression that as long as the driver is holding a licence, the employers feel like no other training or instructions should be necessary.

The truck driver is responsible to follow instructions and make decisions based on training and information provided by the employer. Furthermore, truck drivers operating on roads open to general traffic are responsible for their actions, independent of being at work or not (Samferdselsdepartementet, 1965). Statistically, there are 11 fatalities within 100 traffic accidents involving a truck (Langeland & Phillips, 2016). Furthermore, accidents involving trucks are often more severe, and the damage is usually more extensive on other vehicles and drivers (TØI, 2012, s. 489). Truck drivers rarely trigger accidents (TØI, 2013). However, the truck drivers involved in fatal accidents are likely to be mentally burdened, independent of being physically harmed or triggering the accident.

### 1.1. Research objective

The objective of this research is to gain a better understanding of what truck-related risk assessments and safety measures are conducted in connection with urban construction site deliveries. Furthermore, to gain insight into the characteristics of the safety information flow between stakeholders associated with the construction site operations, in particular what site- and route- specific safety information truck drivers receive when delivering to construction sites, as well as reporting of undesirable events and conditions upwards in the safety information chain.

This research also aims to identify potential improvements regarding the content and quality of the site-specific safety information truck drivers receive.

The quantitative research approach consists of interviews with truck drivers, transport managers, construction company and project owner management to address the formulated objective:

*“To understand how information is communicated with regards to safety in urban construction site deliveries, and identify potential ways to improve the information flow to increase safety”*

Six research questions have been formulated to address the objective:

1. What general safety information do truck drivers receive?
2. What site-specific safety information do truck drivers receive, and how?
3. What safety concerns do truck drivers report at urban construction sites, and how?
4. What general safety information could increase safety in urban construction site deliveries?
5. What site- and route-specific safety information could help drivers conduct safe deliveries?
6. What measures could improve the safety information flow at urban construction sites?

## 1.2. Scope

The following paragraphs describes the scope of this research regarding the main topics.

### **Safety information**

This research addresses safety information that is relevant to truck drivers conducting deliveries to urban construction sites. Information included in the term safety information within this research is:

- Information regarding requirements of personal protective equipment (e.g. helmet, protective shoes, glasses or gloves)
- Information about risks associated with on-site operations (e.g. from other on-site operations or workers, especially challenging road conditions, storage of dangerous goods)
- Information regarding on-site procedures (e.g. loading areas, parking areas, what gates to enter or exit, maximum number of vehicles on the site, required right-turn when exiting the site)
- Information regarding access roads (e.g. what route to take, location of schools, sports arenas etc., especially challenging passages)

### **Truck deliveries to urban construction sites**

The data collection within this research covers truck drivers transporting masses, machinery, construction materials, fuel and concrete. However, the results are relevant to all deliveries to urban construction sites, especially if on-site driving is required to conduct the delivery.

### **Stakeholders in urban construction site deliveries**

The stakeholders addressed in this research are the project owner, project owner representative, construction company management, transport company management and truck drivers hired to deliver goods to urban construction sites. The research is based on organization of stake holders within construction conducted with a construction company in general contract. Thus, dynamics in the safety information flow that are different in projects with shared enterprises are not addressed.

### **Urban construction site**

Within this research, an urban area corresponds to the city centre and residential areas in close proximity to the city centre. Urban construction sites are addressed specifically due to the higher density of infrastructure and people, introducing space limitations and access gates in public streets, providing close and frequent interaction between construction site traffic and vulnerable road users.

### 1.3. Structure

Other than the introduction, the thesis consists of six chapters in addition to references and appendix. The chapters are listed in Table 1 together with short descriptions of the content.

*Table 1: Structure of thesis*

<b>Chapter</b>	<b>Content</b>
Introduction	Introduction of relevant motivation for this research together with the description of this research objective and questions.
Background	Context is provided with relevant laws and regulations, together with an organizational description of positions and responsibility.
Methodology	Description of the quantitative research approach, validity and reliability.
Results	Presentation of the results from interviews with truck drivers, transport managers, a construction company manager and a project owner representative.
Discussion	Discusses the relevant results with regard to the research objective through addressing each research question in paragraphs.
Conclusion	Conclusion with purposed improvements, based on the findings.
Further research	Discussion of relevant findings fit for further research

In the appendix, the interview guides utilized in the interviews are presented.

## 2. Background

The chapter covers relevant laws, regulations and guidelines. Furthermore, explanations of relevant terms, organizational positions and responsibilities within the urban construction site deliveries are presented.

### 2.1. Terms

This paragraph provides definitions of the most relevant terms used within this research. These definitions are not necessarily official, however represent how they are utilized in this research.

#### **ADR - Directives, the European Agreement concerning the International Carriage of Dangerous Goods by Road**

European directives concerning dangerous goods (e.g. explosives, gases, flammable liquids and toxics). The directive covers requirements to infrastructure, vehicles and personnel used in transport of dangerous goods (Justis- og beredskapsdepartementet, 2009).

#### **Continuing educational course for professional drivers**

Mandatory course for every professional driver delivering goods with heavy vehicles. Must be renewed every fifth year and has a duration of 35 hours covering the same modules as the education of professional drivers in vocational schools (Samferdselsdepartementet, 2008).

#### **General contract**

Construction contract in which one prime contractor is responsible for the entire project. In the context of this research, it implicates that the project owner orders one construction company. If sub-contractors are hired, these are in contract with the construction company in general contract, and not the project owner.

#### **Heavy vehicle**

Vehicles heavier than 3500 kg. Include vehicles utilized to transport goods (C1, C1E, C, CE) and passengers (D1, D1E and DE).

#### **HMS – Health, environment and safety**

Based on requirements in the Working Environment Act (WEA), an Act relating to working environment, working hours and employment protection. In the construction business, the plans regarding HMS is split into two plans. One to secure security, health and work environment on-site (SHA) and another regarding the surrounding environment (YM).

#### **Project owner**

Corresponds to the term Construction Client and the Norwegian term “byggherre”. The project owner orders and finances the project.

#### **Public institutions**

Umbrella term to cover infrastructure characterized by high activity of vulnerable road users in the vicinity of the building or arena. Furthermore, infrastructure connected to road users that are less rational than what one usually expects in traffic (e.g. children and elderly) are included. Infrastructure included in this term are: schools, kindergartens, hospitals, elderly homes and sports arenas.

### **Rig plan**

An overview of construction operations with respect to laws and regulations. Includes:

- Areas to place machinery and work equipment
- Areas of barracks used as storage and offices
- Areas for loading and unloading
- Overview of on-site gates, roads and routes for pedestrians and traffic

### **SHA coordinator**

A person responsible for coordination of SHA in the project preparation or execution on behalf of the project owner.

### **SHA plan**

A plan that covers HMS on the construction site. Based on WEA and the regulations of safety, health and work environment on construction sites. Required at every construction site, and considers safety, health and environment with:

- The architectonical, technical and organizational choices.
- Description and consideration of the risk factors that are of importance to the work that is going to be carried out.
- Providing enough time to plan and execute the different work operations.

### **Trucks**

Within this research, the term trucks are used as category of all heavy vehicles utilized to transport goods. With Norwegian Requirements for license, this corresponds to single unit trucks (CI and C), and trucks with trailer (C1E and CE) (Samferdselsdepartementet, 2004).

### **Vulnerable road users**

Road users of soft modes, like pedestrians and cyclists.

### **Work Zone Traffic Control Plan**

The WZTCP includes the temporary traffic solutions, safety measures and risk assessments regarding traffic that interacts with the site (Statens Vegvesen, 2014).

### **YM-plan**

A plan that covers HMS outside of the construction site. Normally considers noise, vibrations and pollution that affects the outer environment.



## 2.2. National laws, regulations and guidelines

There are several laws and regulations relevant to urban construction site deliveries. The most relevant of these, with regards to truck safety are:

- Road Act (Vegloven)
- Road traffic Act (Vegtrafikkloven)
  - Regulations of public signs, road markings, traffic light signals and instructions (Skiltforskriften)
  - Regulations of education and continuous education of professional drivers (Yrkessjåførforskriften)
  - Regulations of land transport of dangerous goods
  - Regulations of education of drivers of vehicles transporting dangerous goods and ADR-certificate of competence
- Working Environment Act (Arbeidsmiljøloven)
  - Construction client Regulations (Byggherreforskriften)
  - Regulations of systematic health, environment and safety processes in occupations (Internkontrollforskriften)
- Handbook N301 Work on roads and in the vicinity of roads (Arbeid på og ved veg)

The relevance of these laws and regulations is described in the subsequent paragraphs. The translated citations are footnoted on the relevant page with the original Norwegian wording.

### Road Act

The purpose of the road Act is to make sure that planning, construction, maintenance and operations of public and private roads ensuring a traffic flow that is beneficial for the road users and society<sup>1</sup> (Samferdselsdepartementet, 1963) (§1 a). The act has jurisdiction of roads open to the public, independent of the road owner (§1). Within this jurisdiction is the regulation of construction in the vicinity of the road. Respectively, 50 meters on national and county roads, and 15 meters on roads owned by the municipality (§29). Thus, construction within these areas needs approval by the road authorities.

### Road traffic act

The act has jurisdiction of all traffic with motor carriages. It also applies to other traffic modes, but only on roads or other areas that are open to regular traffic with motor carriage<sup>2</sup> (Samferdselsdepartementet, 1965)(§1). The law does not differ between drivers that are driving as part of their work and not. Thus, truck drivers are personally responsible for their actions, independent of being hired to make the delivery or driving for private purposes. The state and use of vehicles is also covered by this law. Vehicles should be constructed, adapted, equipped and maintained so that they can be utilized without posing unnecessary danger or disadvantage and without damaging the road<sup>3</sup> (§13). With some construction sites, there is a need to

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<sup>1</sup>Formålet med denne lova er å tryggje planlegging, bygging, vedlikehald og drift av offentlege og private vegar, slik at trafikken på dei kan gå på eit vis som trafikantane og samfunnet til ei kvar tid kan vere tente med.

<sup>2</sup>Denne lov gjelder all trafikk med motorvogn. Den gjelder også annen ferdsel, men da bare på veg eller på område som har alminnelig trafikk med motorvogn.

<sup>3</sup> Kjøretøy skal være bygget, innrettet, utstyrt og vedlikeholdt slik at det kan brukes uten å volde unødige fare eller ulempe og uten å skade veg.

temporarily regulate or stop the traffic past the site, and this process is under the jurisdiction of the road traffic act (§7). However, the applications are approved by the regional road administration regarding national and county roads, and by the municipality on municipality roads.

#### Regulations of public signs, road markings, traffic light signals and instructions

These regulations are within the road traffic act and describes regulations regarding sign authorities and temporary signing, markings etc. during construction on public roads (Samferdselsdepartementet, 2005). The law has jurisdiction of the requirements of the content and approval of the Work Zone Traffic Control Plan. On national and county roads, the regional road administration is appointed as sign authority, and the municipality on municipality roads<sup>4</sup>(§32.2). In the approval of the WZTCP, the sign authorities set criteria for the follow-up on the approved plan<sup>5</sup> (§33.1). At the same time, the responsibility of controlling the signs and markings is transferred to the executing department or entrepreneur<sup>6</sup> (§33.2). Furthermore, at every construction site, the executive department or entrepreneur is required to appoint someone to be responsible of making sure that the signs and markings are in coherence with the WZTCP at all times<sup>7</sup>(§33.3).

#### Regulations of education and continuous education of professional drivers

The regulations apply to drivers that wants to acquire or renew the right to transport goods or passengers for remuneration with heavy vehicles on roads open to regular traffic<sup>8</sup> (Samferdselsdepartementet, 2008)(§1). The right must be renewed every fifth year with an approved course and instructor. The course has a duration of 35 hours with the main objectives that the truck driver shall<sup>9</sup>:

- Drive optimally and safe in traffic
- Show professionalism in the execution of the profession
- Maintain the safety of the driver and others when the vehicle is parked

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<sup>4</sup> For riks- og fylkesveg er regionvegkontoret skiltmyndighet for varslingen, og for kommunal veg er kommunen skiltmyndighet.

<sup>5</sup> Skiltmyndigheten der varslingen skal utføres skal godkjenne skiltplanen og treffe nødvendige vedtak.

<sup>6</sup> Ansvaret for gjennomføring og oppfølging av planen på arbeidsstedet skal tillegges utførende etat eller entreprenør.

<sup>7</sup> Utførende etat eller entreprenør skal for hvert enkelt arbeidssted utpeke en som er ansvarlig for å påse at varslingen er korrekt og i henhold til planen.

<sup>8</sup> Forskriften gjelder for fører som vil erverve eller fornye retten til mot vederlag å utføre person- eller godstransport med kjøretøy i førerkortklassene C1, C1E, C, CE, D1, D1E, D eller DE på veg åpen for alminnelig trafikk.

<sup>9</sup> Eleven skal

- a) kjøre optimalt og trafiksikkert
- b) vise profesjonalitet i sin utførelse av yrket
- c) ivareta egen og andres sikkerhet ved arbeid når kjøretøyet står i ro.

### Regulations of land transport of dangerous goods

The purpose of the regulations is to safeguard life, health, environment and materials from accidents and intentional undesirable events concerning land transport of dangerous goods<sup>10</sup> (Justis- og beredskapsdepartementet, 2009). The regulations address the responsibilities of any undertaking to make risk assessments both regarding internal and external conditions and implement measures to reduce risks concerning the transportation of dangerous goods to an acceptable level (§5). Furthermore, any transport manager is obliged to make sure that the handling of dangerous goods is not delegated to personnel that has an obvious lack of knowledge, skills or materials relevant to a safe transportation of goods (§4). The truck driver's responsibility is addressed through general demands directed towards everyone handling dangerous goods, with requirements of markings on the vehicle and goods, making sure containers of goods are in order and to be alert and careful (§4).

### Regulations of education of drivers of vehicles transporting dangerous goods and ADR-certificate of competence

The regulations address requirements to the education of drivers handling ADR (Samferdselsdepartementet, 2001). The certificate of competence is valid for five years, and it has a duration of 46 hours if the candidate is acquiring the competence for the first time. The course for renewal of the certificate has a duration of 8 hours (§2). To receive the certificate, the candidate is required to pass an exam with the roads administration after completing the course, both with acquiring or renewing the certificate (§3).

### **Working Environment Act (Arbeidsmiljøloven)**

This Act is translated to English and published by the Ministry of Labour and Social Affairs, and references to the Act corresponds to paragraphs and sections in the translated version. Parts of the purpose of the Act is to “secure a working environment that provides a basis for a healthy and meaningful working situation, that affords full safety from harmful physical and mental influences” (Ministry of Labour and Social Affairs, 2005) (§ 1-1.a). Furthermore, “to provide a basis whereby the employer and the employees of undertakings may themselves safeguard and develop their working environment in cooperation with the employers' and employees' organisations and with the requisite guidance and supervision of the public authorities” (§1-1.d). “The Act apply to undertakings that engage employees unless otherwise explicitly provided by the Act” (§1-2.1). Thus, the law describes the responsibility the employers have towards the truck driver and vice versa. The requirements do not necessarily apply to the relation between the construction company ordering delivery of goods and the truck driver carrying out the delivery unless the truck driver is an employee at the construction company.

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<sup>10</sup> Forskriften har som formål å verne liv, helse, miljø og materielle verdier mot uhell, ulykker og uønskede tilskjedne hendelser ved landtransport av farlig gods

### Construction Client Regulations

These regulations are translated to English and published by the Ministry of Labour and Social Affairs, and references to the regulations corresponds to paragraphs and sections in the translated version. The purpose of the regulations is to “protect employees from risks by paying regard to safety, health and working environment on construction sites in connection with planning, project preparation and execution of building or civil engineering works” (Ministry of Labour and Social Affairs, 2009). The requirements in these regulations are primarily addressed to project owners, coordinators, and designers. Both the project owner and designers are obliged to make SHA plans. However, there are more requirements addressed to the project owner.

### Regulations of systematic health, environment and safety processes in occupations

The purpose of the regulations is to “ensure that undertakings are improved through demands of a systematic implementation of measures to achieve the goals of the Acts concerning health, environment and safety<sup>11</sup>” (Arbeids- og sosialdepartementet, 1996). These requirements concern work environment, safety, protection of outer environment, prevention of accidents connected to own legal activity and prevention of intentional undesirable events (§1). The requirements are addressed to all undertakings addressed in the WEA. Thus, the requirements apply to the project owner, construction company, engineering companies (designers) and transport companies.

### **Handbook N301 “Work on roads and the vicinity of roads”**

The handbook summarizes and categorizes most of the relevant laws and regulations within road construction. Additionally, guidelines from the NPRA are introduced. Requirements regarding the WZTCP are specified together with the introduction of purposed solutions for the temporary regulation of traffic (Statens Vegvesen, 2014).

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<sup>11</sup> Gjennom krav om systematisk gjennomføring av tiltak, skal denne forskrift fremme et forbedringsarbeid i virksomhetene slik at målene i helse-, miljø- og sikkerhetslovgivningen oppnås.

### 2.3. Organization

The organizational description of contractors is provided in the context of a general contract, with one prime contractor being responsible for the entire project, and without any other companies in contract with the project owner. In Figure 2, an illustrative example of a construction company with a general contract is presented. The links between the boxes represents the connections between the contractors. Based on the interviews conducted in this study, this way of organizing construction site contractors seems to be the common.

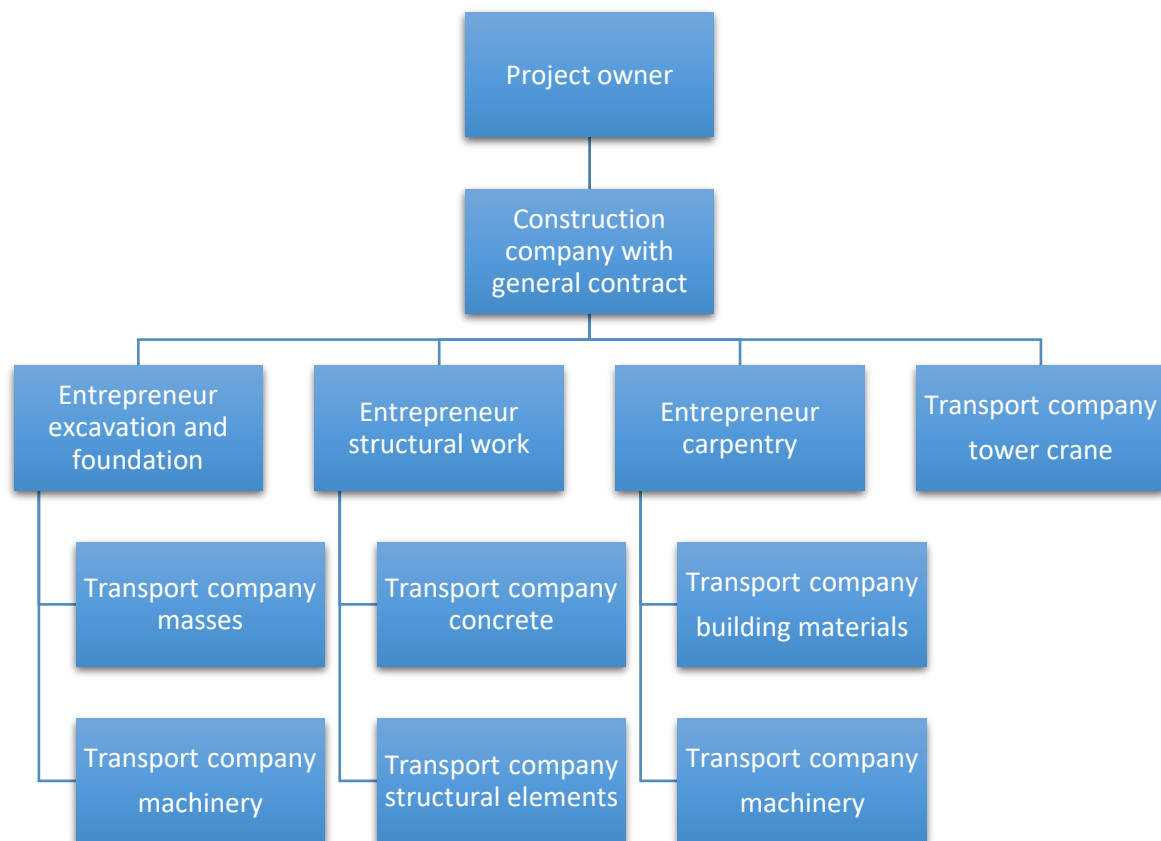


Figure 2: Organization map corresponding to the safety information chain

## 2.4. Positions and responsibility

### **Project owner**

By law, the project owner has a responsibility to make written risk assessments and safety plans (SHA and (YM) as part of the project description on which construction companies base their offers on the job (Ministry of Labour and Social Affairs, 2009). These risk assessments and requirements should also include parties operating on or in close proximity to the site, like truck drivers. Furthermore, the project owner is obliged to follow up on the safety procedures by meeting with the construction company and inspections on-site, making sure that the construction company is carrying out the operations and following safety-procedures according to what is agreed upon in meetings and in contracts.

### **SHA coordinator**

A SHA coordinator is hired in every project, to ensure that safety procedures are followed and observe the ongoing construction. Furthermore, the coordinator initiates risk assessments and safety measures if situations or personnel are not maintaining safety, health or environment in the SHA coordinators opinion.

This responsibility is usually handled by an external party, hired by the project owner. The SHA coordinator can be an employee with the construction company or project owner. However, this can be unfortunate because on some occasions, it might be in the construction company or project owners interest to let minor security issues pass unnoticed and unhandled.

### **Construction company**

In general, the construction company is dependent on upholding the requirements described in the contracts with the project owner, to avoid sanctions or under especially grave circumstances gets released from the contract. In addition to the safety requirements and procedures given by the project owner, the Norwegian laws clearly states the construction company management's commitments to locate dangers and safety issues, carrying out risk assessments within the organization and making sure that the work environment is in correspondence with the Norwegian laws (Ministry of Labour and Social Affairs, 2009). This is to be revised and followed up, to see that the measures set in place are working, and that the work environment is within the requirements at all times. Furthermore, the law clearly states any company management's responsibility to make sure that all employees are made familiar with dangers concerning accident and health risks associated with their work, and that they receive necessary training, practice and instructions. Regarding the on-site operation of other persons than employees of the construction company, the construction company is obliged "ensure that his own activities and those of his own employees are arranged and performed in such a manner that persons other than his own employees are also ensured a thoroughly sound working environment" (Ministry of Labour and Social Affairs, 2005).

Regarding traffic risk assessments, the construction company is obliged to apply for approval of start-up of on-site operations with the municipality. In addition, a Work Zone Traffic Control Plan (WZTCP) needs approval by the Norwegian Public Roads Administration. Both plans consider traffic adjacent to the site, with signs, markings and the regulation of traffic. The process of design and application of the WZTCP may also be carried out by the project owner.

### **Transport company**

The transport company is required to make sure that all employees are made familiar with dangers concerning accident and health risks associated with their work, and that they receive necessary training, practice and instructions (Ministry of Labour and Social Affairs, 2009). Within transport of dangerous goods, the manager is responsible to have documentation and certificates of approved ADR-courses and exams of all employees that handle dangerous goods.

### **Truck driver**

The truck drivers employed by a transport company are responsible to participate in the making and implementation of the safety processes to establish and maintain a healthy and secure work environment (Ministry of Labour and Social Affairs, 2005)(§2-3.1). The employee shall use the demanded safety gear and contribute to avoid accidents and health issues (§2-3.1.a). If the employee becomes aware of a fault or defect that might cause the endangerment of life or health, he is obliged to notify the employer and the safety representative and if necessary, other employees, if the issue cannot be remedied by the employee (§2-3.1.b). Furthermore, the employee is also obliged to stop his work if he is under the impression that continuing might endanger life or health (§2-3.1.c).

Furthermore, the truck driver is required to bring documentation and certificates of approved continuous educational courses in the truck (Samferdselsdepartementet, 2008) (§34).

### 3. Methodology

The evaluation and choice of methods in this research are presented in the subsequent paragraphs. Furthermore, the execution of interviews and data analysis is described together with the evaluation of reliability and validity of the methods.

#### 3.1. Choice of methodology

The study was conducted during one semester, and the choice of data collection was based on what methods could provide sufficient data within the time limited frame. A qualitative research approach was chosen, as the objective of this research is to understand how information is communicated and how the different stakeholders interact with each other.

With strongly delimited topics that are not particularly sensitive or challenging to approach, so trust can be established early in the interview, focused interviews could be considered (Tjora, 2017, s. 126). The topics addressed in this research are not particularly sensitive, and the relevant questions to ask has low complexity, providing the possibility to have short questions and answers with little reflection on the topics. Furthermore, sufficient capacity to conduct all interviews with the same interviewer was desirable, to make the interviews as similar as possible. Thus, focused interview with single respondent was chosen as the research approach to collect data regarding truck drivers and transport managers.

Focus group interviews also present an efficient way to collect data, with several interviewees having an unstructured conversation on topics set by the interviewer who facilitates the conversation (Tjora, 2017, s. 113). This research approach was considered, but because of the limited time available, it was originally decided not to conduct such interviews. However, a spontaneous focus group interview was conducted with truck drivers and a machinery driver concerning the same topics covered in the focus interviews.

The main objective of interviews with the project owner and construction company was to gain insight on specific solutions, with a holistic evaluation covering as many aspects as possible. Enough time for the interviewees to gather their thoughts concerning the process of implementation, possible effects and reflect on associated past experiences was paramount. In-depth interviews are conducted in a wider time frame, usually an hour or more, to create a situation of relatively free conversation, where the interviewee is reflecting on his own experiences and opinions associated with the topic of the research (Tjora, 2017, s. 113). The quality was considered as most important regarding the data collection of the project owner and construction company managers perspective, thus in-depth interviews were chosen as research approach with these stakeholders.



### 3.2. Qualitative research approach

The qualitative research approach consists of focused and in-depth interviews, conducted in two rounds as presented by Figure 3. The first set of interviews was conducted with truck drivers and company managers. Seven interviews with truck drivers were conducted and audio recorded, using the same interview guide. Five transport company managers were interviewed and audio recorded, using another interview guide, concerning the same topics addressed in the guide used in the interviews of the drivers. In addition, one transport manager was interviewed with the same guide, but not audio recorded.

Based on the findings from the interviews conducted in the first round, a construction site manager and a project owner were interviewed to gather their insights on findings identified in the first set of interviews, as well as to gather complementary data on the topics covered in the first round.

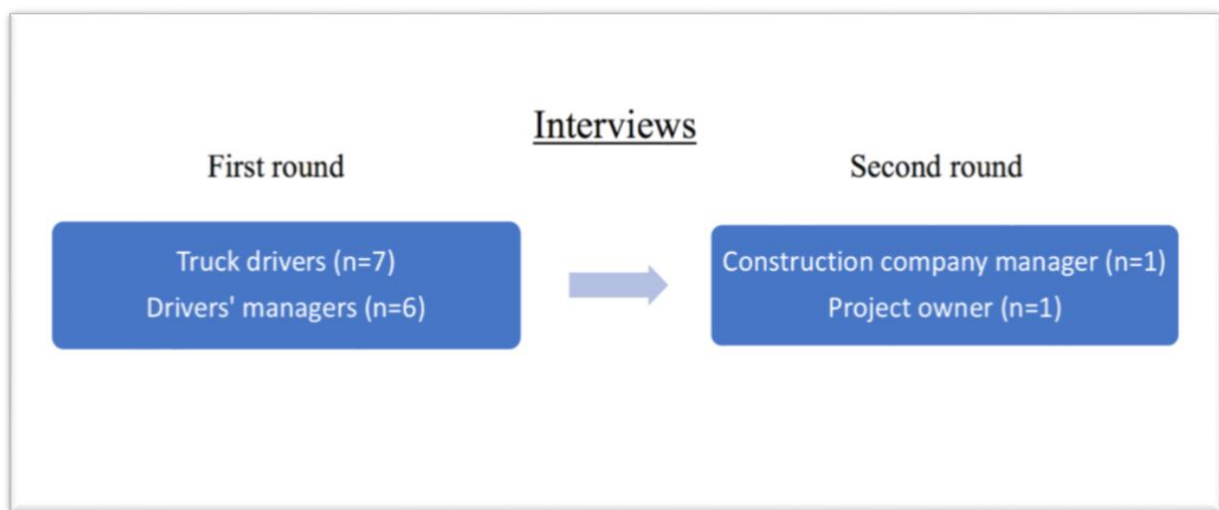


Figure 3: Organization of interviews in two rounds

#### First round of interviews

In the first round of interviews, focused interview was originally chosen as the research approach, and the interview guides were produced as focused interview guides (see Appendix (I)).

The same guides were used throughout the first round of interviews. The first two interviews with truck drivers and the first interview with a transport leader were conducted as a focused interview, characterized by quick questions and answers. These interviews were conducted in approximately 10 minutes. The rest of the interviews both with managers and drivers were carried out as in-depth interviews, where interviewees spontaneously started reflecting on the topics and covering all questions as a conversation and not as short questions and answers. Three of the interviews with truck drivers were also carried out as ride-along interviews during deliveries to construction sites, where several topics were discussed based on situations that occurred during the interview.

A focus group interview was carried out with three truck drivers and a machinery driver. Except details on how many years of experience each driver had, every topic in the guide was discussed while notes were taken. These drivers are not included in Figure 3.

## Second round of interviews

In the second round of interviews, in-depth interviews with a construction company manager and a project owner were conducted. The questions in the interview guides were developed to cover the same topics as the first round (see Appendix ( I )). Additionally, possible solutions based on findings from the first round were presented and discussed.

### 3.3. Identification of interviewees

In the first round of interviews, the selection of interviewees was based on the idea that different types of goods delivered to construction sites should be represented. Information regarding what companies transport different goods was collected through an online research and within the first interviews.

Companies were contacted by phone, and no company declined interviews with their drivers or managers. All drivers and managers had positive attitude towards the research, and there was no problem to get enough interviews. The situation was quite the opposite, with several volunteering drivers within the same companies when there was no need for more than one or two drivers. In Table 2, the interviewees in focused and in-depth interviews of truck drivers and transport managers are listed according to the goods primarily transported.

Table 2: Number of interviewees within transportation of different goods

Goods	Truck driver	Transport manager
Fuel	1	2
Concrete	2	2
Masses	2	2
Machinery	1	-

The focus group interview was carried out spontaneously during a lunch break and included in the findings. The drivers transported different goods and used different machinery, providing the opportunity to address the interaction between different stakeholders with both parties present. Additionally, the topics covered in the interview guide could be addressed together with the difference dependent on which goods that is delivered. The interviewees in the focus group are listed in Table 3.

Table 3: List of interviewees in focus group

Goods	Truck driver	Machinery driver
Masses	2	1
Construction materials	1	

### 3.1. Analysis

The interviews were analysed in two rounds. First, every interview was listed in a spread-sheet with answers to each question from the interview guide, based on notes and recordings. Findings that were not directly connected to the questions from the guide or research objective were also collected and included. Based on the spread-sheet, the interviews with truck drivers and managers were summarized in topics most commonly addressed in the interviews, and recordings were played once more to transcribe quotes stating general opinions or specific situations of particular interest.

Interviews with the construction company manager and project leader were not listed in a spread-sheet since there was only one interview of each. The interviews were first summarized in topics, prior to another walkthrough of the recordings with the transcription of relevant quotes.

Some particular situations are included in the results because they are related to purposed measures or provide good examples that support the general opinions expressed in the interviews. Otherwise, the focus of the analysis has been to uncover common opinions and experiences that indicate general characteristics of the safety information flow and the stakeholders involved in urban construction site deliveries.

The interviews with the construction company manager and project owner representative were singular, therefore without the possibility to compare different statements from managers in the same positions. The interviewed managers were connected to the same ongoing construction site and participated in the same weekly meetings. Because of this, the discussion regarding their interaction and what safety information was transferred between the two parties was somewhat controlled by their individual statements.

### 3.2. Validity and Reliability

Focus interviews, focus groups and in-depth interviews have been utilized in the collection of data. Each method has unique challenges regarding validity and reliability. The respective qualities are discussed in the following paragraphs.

#### **Validity**

The validity of this research is evaluated by the relevance of the collected data. Validity is often divided into two aspects; internal and external.

#### Internal validity

Internal validity is evaluated by how the method measures what it is supposed to measure. This is reflected by how the findings are relevant to the objective and research questions. The process of designing and testing the interview guides was carried out with several persons. The guide was designed together with two researchers and a PhD candidate at NTNU and tested with a truck driver and two students. This process was conducted multiple times, to make the questions easy to understand and to make sure every research question was covered.

Based on the first interviews, several topics that were not originally included in the objective and research questions were added, indicating that some methods provided more data than originally intended. This was especially relevant with the interviews of truck drivers and transport managers where most interviews exceeded the expected level of reflection and details, and some additional topics were covered.

Before every recorded interview, the interviewee was acknowledged about the right to stop the interview at any time, and that the interview was anonymous. The interviews were made anonymous to create an interview setting that made the interviewees willing to speak more freely about their opinions and experiences, since interviews are self-reported data and might be affected by social desirability<sup>12</sup>. Especially if the actions in question are undesirable, the frequency or severity of encountered situations might be underreported (Sullman & Taylor, 2010).

### External validity

The external validity is evaluated by how the findings can be generalized beyond the immediate study. Within this research, external validity can be evaluated by how the results correspond to procedures typical for urban construction site truck deliveries in general.

The study was conducted with interviews in Trondheim and Kristiansund, and some characteristics of stakeholders and conditions might be geographically dependent. However, the findings and results are likely to correspond to general characteristics of urban construction site deliveries in Norwegian cities because the requirements by laws and regulations to project owners and construction companies are the same.

The construction company manager and project owner were both hired by highly regarded and serious traders in the construction industry, and their statements are not likely to be representative for all traders.

Another aspect of the validity is the present and future characteristics of the construction industry. If the laws and regulations are changed regarding the construction industry, these changes are likely to change requirements regarding safety as well. Thus, the results indicating lack of safety measures might be outdated if conditions and requirements are changed.

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<sup>12</sup> Interviewees answering according to what they think is the desired or “right” answer.

### Reliability

The reliability of the findings is evaluated by the trustworthiness of the findings, and how likely a repetition of the study would provide the same results. All methods of data collection were qualitative, with different kinds of interviews conducted.

The interview guide was designed to avoid phrasing of questions in a way that indicates a desired answer, and to be as neutral as possible. The process of designing and testing the interviews also provided training in having a neutral position as an interviewer. However, most interviews were conducted as a conversation, and the questions were not cited but asked somewhat differently dependent on the conversation. Furthermore, some interviewees addressed questions in the interview guide without being asked specifically. This way of conducting the interviews increased the inconsistency in the chronology and phrasing of questions.

All interviews were conducted by the candidate, and even with training on a neutral position, the interviewer's personal bias or expectations might have affected the interviewees. In the analysis of the results, the focus on different findings might also be affected by the expectations of the candidate. However, the process of writing down each respective answer to the relevant research questions and having the answers of each respective interviewee easily accessible, made it less likely that singular statements or interviews were given too much weight. Thus, the reliability of the analysis of interviews with truck drivers and transport managers should be high.

## 4. Results

The following subsections summarize the interviews with truck drivers, transport company managers, a construction company manager and a project owner representative. Interviews with truck drivers and their managers were conducted in the first round of interviews. A construction company manager and a project owner representative were interviewed in the second round of interviews, covering the same topics and providing their insight on possible solutions and thoughts concerning key findings from the first round. Several situations were selected from the interviews, to demonstrate the main issues. These quotes are all translated to English, with the original, Norwegian text footnoted on the relevant page.

### 4.1. Truck drivers

Seven truck drivers were interviewed based on the interview guide in Appendix ( I). These were one driver of a concrete mixer truck, one of a concrete pump truck, two mass transport drivers, one machinery transporter, one tank driver and one construction site driver conducting multiple kinds of on-site transportation. In addition to this, several truck drivers were interviewed in a group. This focused group interview included a crane driver, two mass transport drivers and a machinery driver.

Findings from interviews with truck drivers are summarized under the following topics:

- Experience and exposure to different construction site traffic
- What site and route specific safety information is provided and how
- Internal safety measures
- Reporting undesirable events and conditions on route and at construction sites
- Frequent and most severe safety challenges during deliveries
- Improvements

#### **Experience and exposure to different construction site traffic**

The interviewed truck drivers had experience as such in the range from 1 to almost 40 years. Some of the more experienced drivers had been driving different kinds of goods during their careers. Somewhat depending on the season, the drivers reported between 2 to 25 trips to construction sites daily. These were either deliveries, pick-ups or both, which corresponds to 4 to 50 trips daily (if driving to and from the construction site is counted as two trips). The daily average of the trips was 6 or 7 deliveries and/or pick-ups to a construction site, which corresponds to 12-14 trips daily. The drivers transporting masses like gravel, soil, crushed rock etc. would often transport masses both to and from the site. The typical mass driver would have regular trips to one or two big sites, and singular trips to smaller contractors a few times during each week.

On larger sites, the same mass transport drivers would typically return to the same sites throughout the entire project. One of the reasons is that sometimes drivers would have to participate in online courses regarding safety, and start-up meetings. Thus, a potential replacement driver would require additional hours of facilitation with courses and briefings. Transporters of more special deliveries, like concrete, machinery or construction materials usually visit several different sites each day. The transport companies will always strive to avoid trips with no cargo. The drivers shared the opinion that this was the companies' main priority, and thus the closest vacant driver would be contacted to carry out a delivery.

### What site or route specific safety information is provided and how

The distribution of safety information differs depending on what kind of goods the truck drivers were transporting. Almost every interviewed driver was equipped with a digital tablet, provided by the transport company, where details on the deliveries were provided on a specialized application. Details on deliveries of oil, gas, machinery or concrete were reported to be distributed on these tablets at least one day before delivery. In contrast, deliveries of masses are distributed by a combination of planned deliveries scheduled on the tablet at least one day before delivery, and on-the-go distribution by phone without any written description. Every driver reported that independently of being digitally distributed or verbally, all of these delivery descriptions rarely included more information than the address, goods description and a contact phone number. Furthermore, a contact number was usually only distributed on the digital delivery descriptions, and the drivers were frustrated with construction companies providing contact information to persons that knew little or nothing about the delivery.

Drivers shared the opinion that they are responsible for collecting the necessary information to conduct a safe delivery. Drivers reported getting distributed to sites dependent on vacant trucks in the vicinity of the site. Because of these on-the-go deliveries, some drivers would be sent to unfamiliar sites on a weekly basis without sufficient time to prepare more than what cargo to bring and plotting the address on the GPS. This does not allow the truck drivers the possibility of checking weight or height limitations along the route, or identifying ongoing road construction or nearby schools, kindergartens etc., if this information is not distributed as part of the delivery information. In general, the drivers were under the impression that familiarity with a site is not an important criterion of companies when distributing the drivers. Furthermore, unfamiliarity with a site did not influence what kind of information that was conveyed to the driver. During one of the ride-along interviews, an interesting situation occurred when the driver received a call to do a delivery to a new site. The driver received a description of the site location and information about what cargo to bring, but after picking up the cargo the truck driver had forgotten the site location and had to call the leader once more.

“I just have to get some information from the leader afterwards, regarding where we are going, I just can’t remember what the place was called [the sites location].”<sup>13</sup>

Truck driver #1

Some of the drivers stated clearly that the first trip to a new site was always the worst. The drivers would often share and discuss their experiences and warn each other about challenges at different sites informally during their lunch breaks or staff meetings. The majority of site-specific information was thereby provided by co-workers, but without any guarantee of getting it before the first delivery to a new site. Several drivers also pointed out that the site might change over the course of construction, and information might be outdated after a while.

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<sup>13</sup> «Jeg må bare få meg litt informasjon av han lederen etterpå om hvor vi skal hen også, jeg husker faen meg ikke hva det het for noe heller [anleggets lokasjon]».

“The first trip to a construction site is always the worst, because you never know where you are going, and it is especially challenging if you bring goods of 50 tons that you drive around in small streets, and then there might be some illegal manoeuvres because you can’t turn when you have gotten that far. Sometimes you have to bend the rules, but that is mostly the first time.”<sup>14</sup>

Truck driver #2

«Generally, if you are the first one on a construction site it is important to convey information to the office and other drivers regarding how it is at the site.»<sup>15</sup>

Truck driver #3

One of the challenges regarding the information flow is the managements understanding of what information is important. One driver exemplified this with the difference of 8- and 10-ton roads. A secretary might not know what this means or not regard it as important information to convey, but this is critical and necessary information to drivers when loading the truck before delivery. If the driver does not know or investigate this before delivering to the site, he will not be made aware before seeing the sign along the road. If the truck is too heavily loaded, he will have to return to the loading site to unload some of the goods before returning to the construction site for the second time. Thus, some of the drivers asked their administration to get more information regarding the site. However, this often did not result in desired information before the trip either.

“What kind of safety information do you receive when you deliver to a construction site?”<sup>16</sup>

Interviewer

«Really, it’s very little, I get nothing. I try to tell the ones sitting here [in the office], that they have to ask a little regarding how it is where I am delivering. If there are something special I should be more careful about, or where they want to have the cargo so that it does not stand in the way of other things. But this is rarely done, so usually I call them myself when I am leaving with the cargo and tell them: “I will be there in 15 minutes, can somebody meet me there [at the site]?””, I ask if somebody there receives the delivery or where I should park.”<sup>17</sup>

Truck driver #4

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<sup>14</sup> «Den første turen på anlegg er alltid den verste, for man vet aldri hvor man skal og det er spesielt ille hvis man har med lass gjerne på 50 tonn som man turer rundt i små gater og da hender det at det blir noe ulovlig kjøring fordi man ikke får til å snu når man først har kommet så langt. Må ta noen spanske av og til, men det er jo stort sett første gangen.»

<sup>15</sup> «Veldig mye at er du første mann på et anlegg så er det om å gjøre å gi informasjon videre til ordrekontolet og andre sjåfører hvordan det er da [på anlegget].»

<sup>16</sup> «Hvilken sikkerhetsinformasjon mottar du når du skal levere til et anlegg?»

<sup>17</sup> «Det er egentlig veldig lite, får egentlig ingen ting. Jeg prøver å si til de som sitter her da [på kontret], at de må spørre litt om hvordan det er der jeg skal levere. Om det er noe spesielt jeg skal ta hensyn til eller hvor dem vil ha ting levert så ikke det står noen ting i veien for noe annet og sånne ting. Men det blir veldig sjelden gjort da, så jeg pleier å ringe selv når jeg kjører ut og si at: «Nå er jeg der om 15 minutter, er det noen som kan møte meg der», spør om noen tar imot leveransen eller hvor jeg skal plassere meg.»»



In transportation of masses or other goods that often demand a large number of trips, often with returning drivers, the common way to communicate at the site is in person or via radios installed in the trucks and construction vehicles. The drivers are distributed to different sites by their managers, but usually they get the remainder of the delivery information from the construction site, especially from the excavator drivers. When the drivers are loading or unloading at the site they, communicate with the worker in the excavator, who tells them what they need to transport next, and where. This information is often provided via radio, which drivers use to reach out to someone at the site if the information about accessibility and delivery is insufficient or missing. These radios are mostly tuned to the same frequency independent of sites, and most construction trucks have radios installed. Thereby, when the drivers are close enough to the site, all broadcasted messages will be picked up by the driver's radio and the other way around. However, not every site has radio communication installed in the excavators, and some drivers experienced construction sites without radio communication in the excavators as challenging.

#### Online site-specific courses

On large or challenging sites (e.g. construction close to high-voltage infrastructure), almost all of the drivers had experienced mandatory online courses. With a duration of 1-3 hours, these would usually provide general information about safety, which most drivers experienced as unnecessary because it was considered as known. However, site-specific information in these courses was generally mentioned as helpful and desirable information. Usually, time spent on these courses is not compensated for, and some of the drivers pointed out that if they were to be more common, the drivers would have to be compensated.

To summarize, the most commonly reported ways to receive site and route-specific safety information were:

1. From co-drivers in lunch breaks or by radio.
2. From workers on-site (mostly driver of the excavator) by radio.
3. Information provided by transport company management on tablets or by phone.
4. Mandatory online courses regarding safety in general and site-specific safety challenges and procedures.

#### Information regarding public institutions

Several drivers reported that they usually received information about public institutions close to construction sites, and that this was valuable information. This was in correspondence with the project owner and construction company manager statements that this information was supposed to be conveyed in every project.

#### Graphics of the site

The content of these graphics seemed to vary between different types of sites and goods. The most common information indicated on these maps were location of gates and description of which gates to enter and exit. Truck drivers delivering special materials or machinery stated that the location of loading might also be indicated on these maps. All drivers reported knowledge of this kind of information and expressed it as helpful and desired information. However, no driver reported receiving this information regularly.

### Internal safety measures

In most companies, the manager was responsible to make sure that all drivers participated in the mandatory courses and that the trucks were sent to mandatory controls each year. In addition to the courses that are mandatory by Norwegian law, only one of the 5 companies represented in the interviews had campaigns to improve safety, and only one company had a safety handbook made specifically concerning the company's ways of delivering goods, but none had both. In general, none of the interviewed drivers was interested in any campaigns or courses in addition to the mandatory ones. The shared opinion was that there was already too much general safety information with just the mandatory courses. One driver was positive to arrange a course if it was a matter of safety culture, e.g. drivers bullying other drivers into quit wearing helmets, and leaving them in the truck. In such cases, the culture among drivers would have a specific safety-challenge, which might be addressed with a course specifically addressing the issue.

“I think much about this when I drive, on the safety. It's like, I don't need someone to tell me so much about it. Courses are boring.”<sup>18</sup>

Truck driver #4

### Safety information in mandatory courses

As described in the section on background, all professional drivers are obliged to participate in a continuing educational course every fifth year, corresponding to the topics covered in the professional driver's education on Norwegian schools. All the interviewed drivers were frustrated with the content and quality in the course and gave the impression that this was not making them better equipped to conduct safe deliveries. One driver stated never learning anything useful in these courses, and that they were just something truck drivers had to get through to be allowed to continue working. Another driver also stated that all the courses required both by law and construction companies had been part of the reason why some co-workers had stopped driving trucks.

If the drivers only participate in the part regarding freight transport, the course normally has a duration of four whole workdays. One driver reported that the four hours of first aid and firefighting training was useful. In contrast, several drivers reported safety-awareness topics to be almost patronizing when these risks were part of their everyday work. Most drivers stated that the understanding of risk and learning to recognize dangerous situations is primarily provided through experience. When asked about safety awareness on the practical part of the course, one driver stated that this had never been a topic in these driving lessons. The only focus of these lessons was competing on who could finish the route with fewest stops, shortest time and the smallest fuel consumption, with focus on the environmental benefits.

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<sup>18</sup> «Jeg tenker jo mye på det når jeg kjører, på sikkerheten selv. Det liksom, trenger jo ikke at noen skal fortelle meg så mye om det. Kurs er kjedelig det.»

“You would have to drive like an idiot if the sensor is going to report that he should not have a license. The evaluation was primarily reduced diesel consumption, use shortest time, and to have as few stops as possible [...] The whole course was characterized by taking too long.”<sup>19</sup>

Truck driver #5

Drivers were frustrated with having to wait for others to finish their rounds, and the general critic was that there was too much waste of time during these courses. Drivers stated that if the teacher saved semi-relevant stories and got to the point, these courses could be consolidated into two days. If something new would be identified regarding safety, they would just want this information provided informally in the lunch breaks or from other drivers. However, the drivers believed that it is unlikely that someone could come up with something that was worth the time to participate in a course.

Truck drivers transporting dangerous goods (ADR), is obliged to participate in mandatory ADR-courses every fifth year, in addition to the general courses of continuous education of professional drivers. These courses are general, and covers all kinds of dangerous goods, ways of transportation and storage, truck driver and manager responsibilities. Thus, the main issue reported by the drivers was concerning lack of adjustment. Drivers have to pass an exam with questions covering all types of dangerous goods (ADR) and demands of infrastructure. One truck driver argued that if you only transport gasoline, you only need to know the rules associated with this specific type of goods. Similar to truck drivers reporting a lack of motivation due to the content and quality of the general educational courses, ADR-drivers were less motivated to repeat laws and regulations regarding goods they were likely to never encounter.

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<sup>19</sup> «Du må jo kjøre som en idiot altså, hvis sensoren skal rapportere at han burde ikke ha førerkort. Evaluering gikk stort sett på å bruke minst diesel, bruke kortest tid og ha færrest mulig stopp [...] Hele kurset bærer preg av at det tar for lang tid»

## Reporting undesirable events and conditions on route and at construction sites

The ways of reporting undesirable events related to construction sites (e.g. missing signs, road-conditions causing puncture or rupture on tires, almost-accidents and accidents with workers on site or on route to the site), and the amount of reports varied between the different firms and drivers. If something happens during a trip, some drivers talk with their administration while others would call the manager in charge of the site. Some transport companies had standard issued forms to fill out and others had transport managers that would make a call to the construction site managers if enough drivers called him about a particular problem. Some construction companies also distributed standard forms to the transport companies for the drivers to fill out and deliver as part of the construction companies internal safety system. Regarding the rare occasions that drivers are encouraged to report safety concerns, and workers on site are instructed to receive and pass on these forms to the on-site administration, truck drivers were positive and reported that actions was made based on the information provided by the truck drivers. However, the drivers also reported that these systems vary between sites operated by the same construction company, and they rarely know what to expect. Usually, truck drivers are not encouraged to report safety concerns, and if it is the truck driver's responsibility to investigate how safety concerns or reports of undesirable events are delivered to the construction company management, it is unlikely to be reported.

When delivering to a site, the worker at the site who is set to use the tool, material or masses would be the main contact for the truck driver. The drivers stated that this contact persons willingness to handle safety issues reported by the drivers would determine the amount of complaints that get passed on to the management. Especially in mass transport, with regularly returning drivers, the driver of the excavator plays an important part in the system of reporting. The experienced mass drivers knew several of the excavator drivers, and thereby knew who would be willing to receive a complaint or not. The general opinion among interviewed mass transport drivers was that they do not want to report too much because the driver of the excavator often has authority to hire other drivers.

“But where should we go if we feel that something is wrong, and the driver of the excavator refuses to do something about it? You don't get popular if you park your truck in the middle of the construction site and go to the barracks [office on-site] to report it, and then someone else is sent out to the driver of the excavator to tell him the exact thing you told him earlier, it's just that the one from the construction company has more authority and then the driver of the excavator has to do something about it, and then, at the end of the day, you are told “You can just go somewhere else”. Then they just get someone else to do the job, someone that doesn't say anything about it. I don't mean that this is always the case, but this is how it feels. So, if the driver of the excavator does not want to be a team player, it is hard to do anything about it.”<sup>20</sup>

Truck driver #2

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<sup>20</sup> «Men hvor skal vi gå hvis vi føler det er noe galt og ikke maskinføreren vil gjøre noe med det? Blir ikke populært å parkere lastebilen midt på anlegget og gå opp på brakka for å si i fra for så at det sendes en annen ut til maskinføreren og sier akkurat det samme som du sa i sted bare at han i fra entreprenøren har mer stemmerett og da må maskinføreren gjøre noe med det, og så får man beskjed på slutten av dagen om at "nei, du kan dra en annen plass du". Så får de bare en annen til å gjøre jobben som ikke sier noe om det. Sier ikke at det alltid er sånn, men det er sånn det føles. Så om ikke maskinføreren spiller på lag blir det vanskelig å gjøre noe.»

As most drivers must drive regularly all day to earn enough money, they rather help each other out in challenging situations and try to handle minor security issues themselves instead of reporting too much and risk losing the assignment. The drivers reported helping each other out in situations with poor visibility, warning each other of issues with road quality, like holes, sharp edges, challenging turns etc. The drivers further reported that there is little chance of finding new assignments on short notice if you are dismissed from a construction site.

All truck drivers, except the one with one year of experience, stated that minor safety concerns were not reported. One driver had officially reported three “undesirable events” at construction sites to the transport company management in the last eight years. Some drivers stated that signs indicating which side to pass obstacles was so often wrongly put up that they expected it and reporting this was unthinkable. Slippery roads during winter mornings were also accepted as part of the job, unless it was almost impossible to drive. One driver remembered a site he had been working at that had a steep hill. In the morning, other drivers would keep watch of adjacent roads so that he could gain enough speed to climb the hill instead of going to the construction management and complain about the road condition. In this case, the driver of the excavator had been known to be reluctant to pass on the safety concerns to the management. Other safety concerns that drivers mentioned as unlikely to report were damaged fences and constantly open gates. Furthermore, safety concerns that truck drivers were under the impression that construction company management was aware of was not reported.

“The drivers talk to each other and help each other out on walkie [radio], e.g. if you have to get up a steep hill. There is a good culture on helping each other, priority number one is to get through the workday without an accident, rather get one less delivery.”<sup>21</sup>

Truck driver #1

Several drivers seemed more willing to work with risks that would only physically harm the truck driver, as opposed to risk that concerned others. Two of the interviewed drivers had worked in mentor roles and described such situations when they took the risk, but they would not let anybody else execute the same procedures. An example being unloading challenging cargo that puts the driver at risk for a short period of time. At the same time, every driver stated that if they see a situation or condition that has the potential to seriously injure someone, they would report it and refuse to carry out the transport mission. Among the safety concerns drivers stated to be reporting were road conditions likely to cause puncture of tires and insufficient quality of access roads or on-site roads, making them inaccessible.

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<sup>21</sup> «Sjåførene snakker seg i mellom og hjelper hverandre på walkie [radio], for eksempel om man må opp en bratt bakke. Er god kultur for å hjelpe hverandre, prioritet nummer en er jo å komme gjennom arbeidsdagen uten et uhell, heller miste et lass.»

### **Frequent and most severe safety challenges during deliveries**

The challenges mentioned most frequently and emphasized as most severe were related to:

- Communication
- Road conditions
- Accessibility and facilitation

These are summarized in the following paragraphs. Some of the challenges has been mentioned in previous sections.

#### Communication

Quality of communication between drivers, managers and construction company contacts was pointed out as one of the most frequent challenges experienced by the interviewed drivers. When delivering to a new site, the drivers reported that the address might often be wrong or not specific enough. For example, the address might be related to where the project leader's office is and not the delivery site. One driver stated that even if the provided address contains a street number he just assumes the site is somewhere along the street (which in some cases might be very long) and he would just look for a crane. The same driver also reported that this would normally be a first-time-delivery problem, because the drivers would discuss new sites during their breaks and meetings. At the same time, unfamiliarity with the site location makes it impossible to plan the delivery route, which might cause problems particularly in urban areas. Several drivers discussed this challenge and stated that sometimes when they did not know exactly where to deliver, they have to make illegal manoeuvres because urban areas are often too dense for a heavy vehicle to make a turn.

As previously mentioned, some drivers were frustrated with construction companies providing phone numbers of persons that know little or nothing about the delivery. This made it challenging to get in touch with the workers that were supposed to receive the delivery, and the combination of a misleading address and an unhelpful contact person listed on the delivery was not an unfamiliar problem to the drivers. In such cases, the driver might have to return without carrying out the delivery, making it more expensive and possibly riskier than necessary, if sent to challenging or dense populated areas. The communication between leaders on the site was also discussed as a challenge, as sometimes different leaders provides different information about the same issue. If truck drivers make manoeuvres on-site or park differently from how other workers are informed that truck drivers are supposed to, this might cause confusion and dangerous situations. Furthermore, the ordered goods might be wrong due to miscommunication between leaders on site, resulting in confusion and increased deliveries.

“If two men are in charge of a site, or for example the boss has some insight to share and shall, if e.g. I have talked to him and gotten the message to drive there and do it this way and then the construction site leader come and says, “what are you doing?” and then I tell him that I was told to do it this way, and then he answers, “who told you this?” This is unfortunate, and it happens often, and I think that is pretty common.”<sup>22</sup>

Truck driver #6

The communication between drivers was also discussed as challenging. The challenge was mostly concerning mass transport or transport with frequent trips to the same site. If there was no leader distributing deliveries to the drivers, request made by construction company workers by radio might be received by several drivers, and without specifying which driver should make the delivery, this might cause confusion. One truck driver mentioned a site where the accessibility and loading point was getting worse because of the road conditions on the site. The driver of the excavator received complaints regarding that situation and asked drivers if one of them could bring some gravel on his next trip to the site. Several drivers heard the message, had discussed it on the radio, but misunderstood each other. In the end, no one went to get gravel. When the driver of the excavator found out, he talked to one specific driver, requesting him to do it and the road was fixed, 8-12 deliveries after the excavator driver's first request. While miscommunication was delaying the repair of the road, truck drivers continued tipping their load even though they had safety concerns regarding the stability. There was no accident, but the truck driver reported that the situation was critical, and in his opinion an accident was likely to happen.<sup>23</sup>

#### Road conditions

Road conditions were mentioned as another frequent challenge by all the drivers. Especially in the winter, slippery roads on site and adjacent to the site presents an almost daily challenge. Several of the drivers stated that in particular, trips early in the morning would often be challenging. The drivers normally report this issue to workers on the site who acted to improve conditions quite promptly. Sometimes, the same company delivering to a site is also hired to ensure sufficient road conditions on the site. Drivers that worked in such conditions felt that this made it easier to report bad conditions and that the road was maintained better (which is natural since it was in their own company's interest). However, it is not only in winter that road conditions are challenging. In the summer, gravel roads can be damaged very quickly (in matter of hours) if they are too dry, too wet, made of poor materials, the traffic volume is high, or the axle load is heavy. Especially drivers of dumper trucks, tank trucks or trucks with cranes are dependent on good road stability when loading or unloading because of the tall centre of mass.

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<sup>22</sup> «Hvis det er to mann som styrer et anlegg, eller for eksempel sjefen selv har et eller annet innsikt og skal, jeg har snakket med han da for eksempel og fått den beskjeden om at nå kjører du dit også gjør du sånn og sånn også kommer anleggslederen og sier «hva i alle dager er det du holder på med da?» også sier jeg at jeg har fått beskjed om å gjøre sånn også svarer han «av hvem da?» Det er en uting og det skjer ofte, og det tror jeg er ganske generelt.»

<sup>23</sup> Note, that especially when tipping the masses, stability is critical when using a dumper truck. Moist masses in particular tend to stay in the tipper until it is tilted high and the angle is sharp enough for the masses to slide off. This shifts the center of mass several meters upwards while the driver is tipping his load. If the road is not stable enough or there is a difference in altitude on the sides of the truck this might cause the truck to tilt over.

### Accessibility and facilitation

Accessibility of delivery locations and facilitation of drivers were among the greatest concerns expressed in the interviews with the drivers. Particularly in case of urban construction sites, the adjacent streets are normally typically not designed for heavy vehicles. Since most interviews were conducted in Trondheim, the same specific areas were mentioned as especially challenging. The common factors identified were steep hills, ongoing road construction and narrow roads. Steep hills make driving challenging when combined with slippery roads, but also represented a safety issue when making a turn while having a load with rapidly shifting or tall centre of mass. Information regarding an ongoing road construction is hard to retrieve when planning a delivery. In contrast, weight and/or height limitations are more easily retainable from web, phone or map services and less likely to change. The drivers reported that they were expected to retrieve this information by themselves, and that this was rarely distributed by construction companies or transport managers. This kind of information was shared in lunch breaks or staff meetings, but several drivers reported that they primarily gathered information about road construction sites by encountering them. If there is a weight or height limitation past the road construction site, an alternative road should be indicated with signs and markings. However, the drivers reported that this was often poorly executed, and it would sometimes be hard to follow the signs on the alternative route. Furthermore, this alternative route might not lead to the delivery site, making it hard to re-route when encountering such sites. Thus, information regarding ongoing road construction near the site was emphasized as important to be conveyed by a construction company ordering transport. Information regarding narrow passages or tight turns was appreciated by the drivers. However, drivers do not require information about all narrow passages and curves. They feel like they should be able to handle challenging situations as part of their work, and too much information would feel patronizing. Additionally, such an evaluation is hard to conduct without actually having a heavy vehicle trying to pass the particular route.

“Information is alfa and omega [important], but it needs to be useful information”<sup>24</sup>

Truck driver #6

Loading and unloading in the street was emphasized as undesirable and unsafe. The drivers that had experienced this felt like it was presenting an unnecessary risk, especially to the public. Some drivers stated that they felt like the construction company did not care that the loading or unloading was creating a temporary chaos in the street, with regular traffic trying to pass under poor sight conditions and limited space. The truck drivers were under the impression that construction companies would allow such conditions if the loading of trucks was executed in half an hour or less, otherwise they would facilitate by closing the street or taking other measures to ensure sufficient traffic safety.

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<sup>24</sup> «Informasjon er alfa og omega, men det må være nyttig informasjon»



One of the drivers described an urban site where he was transporting masses away. It was challenging for the construction company to execute the loading on-site, so the trucks were supposed to line up outside of the fence. The excavator was inside of the fence, loading the trucks standing in a street open to public traffic and blocking the road in one direction. The driver in the excavator had poor visibility to what was going on behind the lined-up trucks while loading rock, gravel and soil. The interviewed truck driver had concerns, but felt there was no point telling anyone at the construction company because they had decided to do it this way, and in his opinion was unlikely to change their mind about it. He expressed this as an extraordinarily uncomfortable situation but felt like the facilitation of truck transport at construction sites was poor in general.

In general, most drivers stated that they felt like they were expected to be able to transport cargo from A to B without getting any extra information or being facilitated in any way. This was also an attitude accepted and adapted by several drivers. However, all drivers had experienced getting information that made it easier and/or safer to carry out the transportation. Some drivers had also experienced deliveries facilitated in a way that made it easier and safer to deliver or pick up goods at construction sites and would like to experience this more often.

“Sometimes we are told that: “You just have to park out in the streets”, and then a huge traffic situation arises out there, but the construction manager knows that he only needs to get 3-4 truck loads out of there, so it’s done in half an hour, but there can be a safety risk and a chaos you haven’t seen before in the streets, right, during that half hour. Maybe three trailers come simultaneously, and we line up in a city street or something like that with ongoing traffic. When workers from the construction company stands on one side and load with excavators, a lump often fly off, and if it lands on the windshield of someone passing, there will be liability demands and a baluba [mess], but often these things turn out ok, and then nobody cares [...] But this is how it is, in my opinion, it’s unbelievable that things don’t go wrong more often, but there are opinions regarding this too.”<sup>25</sup>

Truck driver #2

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<sup>25</sup> «Noen ganger får vi beskjed at: «Nei du må bare stå ute i veien» også blir det den trafikale situasjonen utpå der, men entreprenøren vet at han skal bare ha ut 3-4 lass der i fra, så det er jo gjort på en halvtime, men det kan jo være en sikkerhetsrisiko og et kaos uten like ute på veien da ikke sant, i den halvtimen det der pågår. Kommer jo kanskje tre vogntog samtidig som stiller oss opp på rad og rekke også i ei bygate eller noe sånt med trafikk på. Når entreprenøren står fra sida og laster med gravemaskin da så, det skjer jo ofte at det flyr av en klump ikke sant, havner nå den i frontruta på en som passerer da så blir det jo et erstatningsansvar der også blir jo det ett baluba, men det går jo som oftest bra så da er det ingen som bryr seg om det. [...] Men sånn er det jo bare, det er utrolig at det ikke går mer galt en det egentlig gjør syns nå jeg da, men det er jo meninger om det også»

## Improvements

The safety improvements suggested by the drivers relate to:

- Information regarding public institutions
- Information regarding access to the site
- Spotters
- Drawings of the site
- Truck drivers as an on-site ambassador

Most suggested improvements are based on safety information and facilitation that drivers remembered receiving at one or few construction sites and had experienced as helpful. The improvements are summarized in the following paragraphs.

### Information regarding public institutions

Especially information regarding public institutions such as schools or kindergartens in the vicinity of the site was pointed out as desirable information. At the same time, this kind of information was reported to be distributed quite often. The drivers stated that too much information is also problematic because there is a limitation to how much information you can remember.

### Information regarding access

No drivers reported ever receiving information regarding access roads or route to the construction site. However, when asked about what safety information that could be helpful, information regarding what route to take was mentioned by several drivers. Part of the reason why this was desired information was experiences with receiving the wrong delivery address. Some drivers had unfortunate experiences with being forced to make illegal manoeuvres in residential areas due the address being wrong, or temporary roads making construction sites less accessible. This improvement was highlighted as especially helpful with urban construction site deliveries.

### Spotters

Most of the interviewed drivers had experience with a “spotter” (i.e. a person helping the truck driver during challenging manoeuvres). This person is often equipped with a stop-sign, and temporary stops the traffic. However, several drivers stated that one spotter is not enough to cover all the blind spots when backing up. Some drivers discussed that the spotter may also make the drivers feel safer than they actually are, which is potentially dangerous. One driver had experienced working on a site close to a school where every driver had to be accompanied by 3 spotters when passing the school. He felt like this was sufficient to cover every side of the truck, and to his knowledge no accident occurred. However, this is an expensive measure and is only realistic to implement in extraordinary challenging situations.

### Drawings of the site

Another highlighted type of information was graphics of specific sites. More specifically, drawings indicating where to enter and load/unload. Some of the drivers had many thoughts concerning this, describing in detail what they want such drawings to contain. According to all drivers, those maps should particularly contain information on access roads and gates to enter and exit the site. Drivers delivering instruments, tools or materials with typical one-time deliveries would appreciate more detailed maps, showing exactly where to unload. On the contrary, mass transport drivers who are often returning to the site between 4-20 times in one day wanted more general drawings because the site could change several times during days or weeks. One driver used road construction as an example, pointing out that the site might be several km long with several entrances. In his experience, naming zones inside of the site could be helpful in the communication with other drivers, his manager, and the workers on site. If he knew where he was going, he would avoid unnecessary on-site driving. In his opinion, this would be better for him as a driver, the truck, and also for efficiency and safety on site.

### Truck driver as an on-site ambassador of the other drivers

One of the interviewed drivers was delivering at a site with a more systematic way of organizing the drivers. He had been appointed as an on-site manager of all of his co-drivers transporting masses at the site. The concept of this measure is that one truck driver is chosen to participate in operational meetings each week, together with representatives from other trades. In the operational meetings, the truck driver expresses possible safety concerns and discusses solutions to these from a truck drivers perspective, together with participants from the other trades and the construction site management. Furthermore, the truck driver is made aware of other ongoing operations and what areas on-site that might change or be challenging during the week in question. Relevant safety procedures and risk assessments related to truck drivers are repeated, and it is the truck driver's responsibility to convey this information to other truck drivers transporting masses on the construction site. In his opinion, this was a more effective way to organize the deliveries and relevant safety information. Furthermore, he felt like he was an important part of a dynamic safety process and that his experience was well appreciated.

## 4.2. Transport company management

Five transport managers were interviewed with the interview guide in Appendix ( I). These were managers of transport companies transporting concrete, fuel, oil, masses, cranes and machinery. Findings from the interviews with transport managers are summarized in topics in the following paragraphs:

- Experience in the transport business
- Distribution of the drivers
- What site or route specific safety information is provided and how
- Internal safety measures
- Reports of undesirable events and conditions
- Frequent and most severe safety challenges during deliveries
- Improvements

### Experience in the transport business

The experience as a transport company manager ranged from a few weeks to almost 20 years. One of the managers had experience as a truck driver and another as a driver of excavators which gave them valuable insight into the on-site operations. The opinions among the transport managers that did not have a truck driver's license was quite different from the opinions of the one manager with experience as a truck driver, especially regarding facilitation of the drivers. The ones with no experience as truck drivers all shared the opinion that holding a driver's license should be sufficient to conduct a safe delivery. On the other hand, the one manager with experience as a truck driver emphasized the importance of conveying safety information regarding the route and construction site in all deliveries. Furthermore, he stated that he regularly reminded his drivers not to conduct the delivery if they felt that it might not be safe to do so. The manager with experience as driver of excavators had more insight in the dynamics of the interaction between drivers and machinery drivers on site, especially regarding the time pressure and the balance of pleasing both the manager and the truck drivers.

### Distribution of the drivers

The number of truck drivers under the manager's command ranges from 4 to 70, making between 10 and 700 deliveries to construction sites each day. Most managers have regular customers among the construction companies. This made it easier to get information about new sites, and what transportation needs to be expected in the upcoming months and sometimes years. However, in addition to these routine deliveries there would be up to 10 extra deliveries each day, distributed on-the-go to vacant drivers. This is mostly the case in mass, concrete and more general goods transportation. Naturally, transportation of expensive machinery and materials is part of a more detailed and accurate plan than the transport of 15 000 m<sup>3</sup> of soil in the duration of a week.

As mentioned by the truck drivers, some sites require site-specific courses and participation in start-up meetings. Because of this, a limited number of drivers had clearance to some sites, but this was uncommon. However, when these situations occurred, the distribution of drivers was less flexible. The managers confirmed that they normally do not take into consideration if the driver was familiar with the site when distributing deliveries. All of them feel a pressure on making the distribution as efficient as possible to "survive" within the transport market, which was reported to be very competitive. Extra consideration of which drivers to distribute to different sites was not an option among any of the interviewed managers.

### What site or route specific safety information is provided and how

On every construction site, wearing protection gear like visibility clothes, protective shoes and helmet is mandatory. This information was expected to be known by every driver and worker in the construction business. It was also confirmed by all of the interviewed drivers. Because of this, such information was not distributed. Regarding the safety information flow, the managers stated that this differs, depending on the construction company which operates the site. Furthermore, one manager stated that there would be different safety information given from managers within the same company as well.

“There are several site managers in the same firms and they have different ways of doing things, some do it this way, some the other. Some share and inform a lot regarding driving here, do it this way, and others you have to ask for that information”<sup>26</sup>

Transport manager #1

The information ranged from no safety information at all, to folders or even books with safety information made specifically regarding transport safety. Every interviewed manager reported that they sometimes received site-specific information about where to enter, where to load or other security issues indicated on a map of the construction site. Some of these were made as posters and put up in lunchrooms, and both drivers and transport managers were positive to this. However, the distribution of construction site graphics were sporadic events. One manager remembered receiving such a map once during the last four years. Several managers stated that there was no clear pattern with type of construction or size of construction company regarding the distribution of such graphics. In contrast, some transport managers stated that larger construction companies usually distributed more safety procedures and information in general.

“The largest customers are strict on HMS and often distributes their own HMS books to us, also to each site with regulations [...] They are adjusted to drivers, no unnecessary information.”<sup>27</sup>

Transport manager #2

Several managers felt that the missing pattern or system in the information flow from the construction companies, is making it harder to tell what safety information is missing or not. Furthermore, there was no written procedures or system regarding what safety information the drivers should receive prior to a delivery in any of the interviewed companies. Thus, even if the information is given to the transport company, several managers admitted that this information is rarely conveyed to the drivers. One manager stated that if too much information is conveyed to the driver, it is hard to remember every detail. Thus, some of the most important information might be forgotten, which in his opinion was cargo specifics. In coherence with the drivers' statements all managers stated that normally, there would not be distributed any other information than the address and what to deliver. If there was a written description, a contact number would also normally be provided.

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<sup>26</sup> «Det er jo flere anleggsledere innenfor de forskjellige konsernene og noen gjør ting på en måte og noen gjør ting på en annen måte. Noen deler og informerer mye i forhold til kjør hit, kjør dit gjør sånn og sånn, og noen må man på en måte etterspørre den informasjonen [hos].»

<sup>27</sup> “De største kundene er stenge på HMS og sender egne HMS bøker til oss ofte, og også til hvert anlegg med krav [...] Er tilpasset sjåfører, er ikke unødvendig informasjon.”

“Unfortunately, I think that the drivers often have to find out for themselves where to enter, where to back up and where to turn.”<sup>28</sup>

Transport manager #1

During the interview, some managers reflected on how this effected the driver’s safety and actually changed their attitude regarding the importance of distributing additional safety information to drivers. Others transport managers were quite clear on the driver’s responsibility and expressed explicitly that they thought there was no need for safety information in addition to the mandatory courses. One manager stated that every driver with a license has learned how to behave safe in traffic, and by following the signs, markings and traffic law, no safety related issues should occur.

“You don’t need any folders, that is totally unnecessary with any folders and laws on security other than what you learn about: “here you shall [what you should do], your duty as a driver” then you should somehow handle that. And then you avoid all situations, there won’t arise situations that has to do with safety then, when you keep the speed limit, and like I said if you drive by a school and then there comes out 30 yellow vests with backpacks that are going to cross the road, there is no use in getting a folder then [...] Because of this, it is not high up on my list to include it [safety procedures, safety information] because it is another unnecessary thing.”<sup>29</sup>

Transport manager #3

The way of distributing information varied between different companies. The common factor was that most of on-the-go deliveries are managed by phone. Several companies use tablets or similar mobile devices that contains a description of each delivery. These are digital versions of the order, showing goods specification and delivery address.

### Internal safety measures

One of the companies had monthly campaigns, focusing on safety. However, this was not reported by any of the two managers, but by one of the interviewed drivers in the company. None of the interviewed managers were positive to arranging any safety campaigns, courses or similar measures.

Some transport leaders stated that folders or books regarding risks associated with the type of goods typically transported by the company is placed in the trucks together with internal safety procedures. However, none of the drivers remembered to mention these folders or handbooks in the interviews, even though all interviewed drivers were asked specifically regarding their company’s safety procedures and rules.

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<sup>28</sup> «Jeg tror dessverre at sjåførene ofte må finne ut litt sånn selv hvor kjører vi inn hen, hvor rygger vi og hvor snur vi»

<sup>29</sup> «Du trenger ikke noen permer, det er helt unødvendig med noen permer og noen forskrifter på sikkerhet, på det annet en det du får lært at: her skal du, din plikt som sjåfør.. så skal du på en måte passe på det der. Og da unngår du alle situasjoner, det dukker ikke opp noen situasjoner som har med HMS da, når du overholder fartsgrensa, og som jeg snakker om hvis du kjører forbi en skole og så kommer det ut 30 sårne gulvester med sekker på ryggen som skal krysse en vei, det nytter ikke å hente fram en perm da [...] Derfor så har ikke jeg det veldig høyt opp da, sånn for å ta det med for det er på en måte en sånn ekstra unødvendig ting.»

## Reports of undesirable events and conditions

The managers rarely receive reports on unwanted events from their drivers. In average there was roughly one complaint per driver every second month. The managers were under the impression that their drivers would report it at the site if something was wrong. Also, two managers stated explicitly that they were under the impression that their driver would refuse to deliver and return to the loading site if the conditions were not safe enough to deliver.

“Does not happen often, but the drivers are good at putting down their foot if they feel it is not safe.”<sup>30</sup>

Transport manager #4

The managers gave the impression that minor safety challenges are to be expected, and that drivers should be able to handle these based on their training and experience. With minor safety challenges, slippery but accessible roads, missing or wrong signs and markings and excavator drivers loading too much masses on the trucks were mentioned. Some managers gave the indicated that such safety challenges would not be dealt with unless several drivers reported the same issue.

One manager also had experience with construction companies calling and informing on insufficient conditions at the site to conduct the delivery. However, this was regarding delivery of fuel which has more strict regulations regarding transport and storing (ADR). This was not mentioned by any of the interviewed managers transporting other kinds of goods.

## Frequent and most severe safety challenges during deliveries

Challenges mentioned by most transport managers, and challenges emphasized as most severe were:

- Road conditions
- Communication

These are summarized in the following paragraphs.

### Road conditions

The most frequently reported events were regarding quality of roads, both regarding drivability and danger for punctured tires. Especially in the transition between winter and summer, the conditions would sometimes become too challenging to operate with trucks on the site. One manager pointed out that this is often the case for the access roads and experienced the authorities as more demanding than helpful in such situations.

“Sometimes it is challenging accessibility on the sites. Sometimes in the transition of seasons we have to close [the site] [...] It is always us [transport company] that has to fix it, the municipality and public road administration are just putting sticks in the wheels.”<sup>31</sup>

Transport manager #3

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<sup>30</sup> «Skjer ikke ofte, men sjåførene er også flinke til å sette ned foten når de føler det er utrygt.»

<sup>31</sup> «Hender at det blir vanskelig framkommelighet på anlegget. Når det er overgang mellom årstider hender det at vi må stenge [anlegget]. Er jo vi [transport firma] som må ordne opp alltid, kommunen og statens vegvesen de setter jo bare kjepper i hjulene.»



## Communication

The quality of communication between construction company, transport company and drivers was mentioned as challenging by several transport managers. The wide range in quality and content of the safety information distributed from the construction companies made it challenging for the transport managers to know what safety information to expect.

Furthermore, truck drivers receive safety information through several channels; on the site, through online courses and through the transport management. These different and sometimes overlapping links in the safety information flow makes it challenging for the transport managers to know what safety information each driver has received regarding different construction sites. Furthermore, the non-existent routines on what safety information to provide to truck drivers was part of the reason why safety information provided by construction companies would rarely reach the driver.

“For example, often he [the driver] should have driven on that side or now we are working here and not there, and this information is not always conveyed well enough [from the transport managers]. So, I have no problem understanding that a driver could want more information and it should be clearer how it is [at the site], there is things that could be done differently, and we could possibly become better at. At the same time, this demands feedback on what to improve [...] So often we follow the same tracks and as long as it looks like it is working you don't do anything about it.”<sup>32</sup>

Transport manager #1

## **Improvements**

One interviewed manager had experienced sites where his drivers participated in daily briefings regarding on-site operations that were planned to be completed each day. His impression was that this made it safer for everybody when the drivers were aware what was going on around them and thereby had a better picture on what risks they were exposed to, and others were more aware of the risks the trucks posed as well. At the same time, he was under the impression that the participation of truck drivers in daily meetings could be too costly in small-scale projects.

Another manager would appreciate more safety information from construction companies. More specifically he required information about where to enter, exit, wait, load and where not to drive. In his experience, a drawing of the site presents an efficient and understandable way to convey such information. Such an idea was quite similar to the drawings that the drivers had described as desired information, and probably based on experience with some of the same drawings, provided from specific sites. One manager was under the impression that this way of distributing information made it easier to remember the important things. Furthermore, if the driver did not remember details on the map, he could just look it up himself if it was distributed on pads/phones/paper in the truck. The driver would not have to call up the manager or use his radio to get information if the drawing was sufficient to understand where to drive and load. Even more importantly, the driver would not just drive around looking for an entrance or take a chance because he did not want to ask for the same information twice.

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<sup>32</sup> «Nå er det jo ofte det at for eksempel at han skulle ha kjørt på den sida, eller at nå holder vi på der og ikke der lenger og at den informasjonen der ikke bestandig kommer godt nok frem. Så jeg kan godt forstå at en sjåfør vil kunne ønske mer informasjon og at det skulle stått klarere hvis det er sånn og sånn men ja, det er jo ting man kan gjøre annerledes og eventuelt blitt bedre på. Det igjen krever jo at de tilbakemeldinga blir gitt der forbedringa kan gjøres [...] Så det er jo ofte det at en går i samme sporet og så lenge det tilsynelatende fungerer så gjør man jo ikke noe med det.»



### 4.3. Construction company management

Based on the insight and suggested solutions to the challenges experienced by truck drivers and their managers, a construction site manager was interviewed. The purpose of this interview was to get insight into the safety information flow and identify possible improvements from a construction company manager's perspective. Findings from interviews with the project manager are summarized under the following topics:

- Experience as construction company manager and position
- Risk assessments in the start-up of construction sites
- Safety during the construction phase
- Improvements
- Economic and organizational barriers

#### Experience as construction company manager and position

The interviewed construction company manager had 10 years of experience within construction company management. The manager's position is project leader, typically managing construction sites together with a construction site leader. In this position, it is the manager's responsibility to follow up on contracts and agreements with the project owner with regards to economy, progress, quality and safety, in addition to the requirements given by Norwegian law. The requirements and procedures in the contracts between the construction company and project owner are updated and supplied in meetings with the project owner representative. The project owner representative participates in operational meetings each week in addition to other meetings with the construction company management, aiming to provide a dynamic safety process with ongoing risk assessments and evaluation of safety measures in cooperation with the construction company management.

#### Risk assessments in the start-up of construction sites

Prior to start-up of on-site operations, start-up-meetings are held by the construction company with every sub-contractor in on-site operations or deliveries. However, this is only to the extent of sub-contractors hired by the construction company with the general contract. Thus, the transport companies hired by the sub-contractors are not participating in the start-up meetings. In these start-up meetings, administrative routines are described. Furthermore, site-specific risk assessments on-site (SHA) and in close proximity of the site (YM), are described. The sub-contractors are responsible to convey this information to their employees and contractors, but the interviewed construction company manager stated that there is no required documentation on the distribution of this information. The manager pointed out that there are many links in the flow of safety information and this makes it challenging to make sure that all safety information regarding trucks are conveyed to all truck drivers associated with the site.

“We have a chain under us which are sub-entrepreneurs and suppliers, but they might have transporters beneath them [in the chain]. So, I don't have direct contact with the transporters, just a few [...] most goes through others, I have little direct contact with the transporters.”<sup>33</sup>

Construction company manager

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<sup>33</sup> «Vi har jo en kjede under oss som er underentreprenører og leverandører, men så kan jo de igjen ha en transportør under seg. Så jeg har ikke direkte kontakt med transportørene, det er mere noen enkelte [...] mest går via andre, jeg har lite direkte kontakt med transportører»

The construction manager stated that the assessments of the traffic situation associated with the site are made, and possible measures to reduce the increased traffic risks in the vicinity of the site are described when applying for approvals to start on-site operations. However, neither of these plans usually include special facilitation or consideration of trucks.

### **Safety during the construction phase**

During the phase of on-going construction, the construction company manager participates in every weekly operation-meeting. The same chain of information flow is present in this phase, with no direct contract between construction company management and the transport companies hired by sub-contractors. However, the parties represented in these operational meetings are reminded about safety procedures, HMS and YM. In these meetings, sub-contractors are encouraged to present their safety concerns regarding risks that are not sufficiently handled and described in the existing contracts and agreements. The construction company manager stated that these operational meetings should be the forum to make additional safety measures when new risks arise, and that the decision regarding what measures to implement should be made with participants from the lowest possible level in the organizational hierarchy, ideally the ones carrying out the risk-related work.

*“And every week we have operation meetings, and then such things [safety procedures] are repeated. So, there is a part with outer environment and HMS (health, environment, safety) in the start of every operation meeting, which is walked through with the participants on the site. And then one representative from each firm is present in the meeting [...] it’s not always the project leader participating in the meeting, sometimes a chairman or another which is actually out there working on the site [...] that’s the purpose of those meetings, that decisions are made on the lowest possible level, this way you don’t have to make detours via, when those participating in the meetings have authority to make decisions on behalf of the firm. So, it’s a little up to them which, if they send their project leader or they send the chairman, if the chairman has authority to make those decisions that are supposed to be made on behalf of his company, then it is ok by us that they send them. If he sits there and says no, I have to take it up with my boss, then rather he sends his boss, that’s where everything is repeated, and all agreements on the way [during construction] are made then.”<sup>34</sup>*

Construction company manager

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<sup>34</sup> «Også er det jo sånn at hver uke så har jo vi driftsmøter, og da blir jo sånne ting repetert. Så det er en egen bolk med ytre miljø og HMS i starten av hvert eneste driftsmøte, som blir gått igjennom med deltakerne som er på plassen. Og da stiller en representant fra hvert firma i det møtet [...] det er ikke alltid at det er prosjektleder som kommer i driftsmøtet, hender at det er formann eller at det er den som faktisk er ute og styrer på plassen [...] det er det som er formålet med de møtene, at beslutningene skal tas på lavest mulig nivå, at man slipper å gå de omveiene om, altså at de som sitter i møtene skal ha myndighet til å ta beslutninger på vegne av sitt firma. Så da er det litt opp til dem som, om de da sender prosjektlederen eller de sender formannen sin da, hvis formannen har myndighet til å ta de beslutningene som skal tas på vegne av det firmaet så er det greit for oss at de sender dem. Hvis han sitter der og sier nei, det må jeg ta med sjefen min, så får han heller sende sjefen sin. Så det er på en må det viktigste møtet på en byggeplass da det det driftsmøtet, det er der alle sånne ting blir repetert, og alle sånne avtaler underveis blir gjort da»

Regarding transport, the construction company manager stated that no drivers participated in these meetings. However, in the managers opinion, the importance of conveying site-specific safety information to the drivers is clearly stated to the sub-contractors.

“We tell our contractors that if they are hiring a transporter here: “it is important to us that you go through this agreement [contract with safety procedures] with your transporter.””<sup>35</sup>

Construction company manager

### Improvements

Based on the interviews with truck drivers and transport managers, the following suggested improvements on the safety information flow were discussed with the construction company manager:

- Information regarding public institutions
- Drawings of the site
- Truck driver as an on-site ambassador

The managers insights on these suggested improvements are summarized in the following paragraphs.

#### Information regarding public institutions

Regarding public institutions, the construction company confirmed that such information is always provided by the project owner and part of the risk assessment if there are schools, kindergartens, sports arenas etc. close to the site. The construction company manager stated that the greatest risks were in connection with children and that site-specific information regarding this, with information about schools and kindergartens locations together with measures associated with them were expected to be conveyed to the truck drivers. The manager was quite confident that this information was conveyed to the truck drivers.

*“It is a greater risk with children than with other things.”*<sup>36</sup>

Construction company manager

*“Such as schools and the like, is that something you also expect the driver to be told about?”*<sup>37</sup>

Interviewer

*“Yes, I expect that. We know that is done as well.”*<sup>38</sup>

Construction company manager

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<sup>35</sup> «Vi sier i fra til våre kontrakts-medhjelpere at: «hvis dere skal ha inn en transportør her så er det viktig for oss at dere går igjennom denne avtalen med deres transportør».»

<sup>36</sup> «Det er større risiko med unger en med andre ting.»

<sup>37</sup> «Sånn som med skoler og sånn, er det noe du forventer at også blir sakt til sjåføren?»

<sup>38</sup> «Ja, det forventer jeg. Det vet vi at blir gjort også.»

### Drawings of the site

Regarding drawings of the site, the construction company manager stated that the rig plan, with information on where to enter and exit is always presented in the start-up meeting and conveyed to every sub-contractor. Furthermore, the manager stated that the idea was that the driver should be provided with this information. However, there might be several links between the construction company and the transporter delivering goods to the site, and this was pointed out as part of the problem in the case that the driver does not end up with this information.

“Is it resource demanding for you to send out a rig plan which contains: here you shall enter, here you shall exit, here you shall turn, here you shall not turn?”<sup>39</sup>

Interviewer

“No, we do that with everybody we are in contract with, that is part of the start-up meeting. We go through the rig plan, show that: here you enter, here you exit. And it is a construction site in motion, so you can’t always unload there [...] we go through that with all of the different trades [companies] we are in contract with.”<sup>40</sup>

Construction company manager

“With the idea that the driver is supposed to end up with that information?”<sup>41</sup>

Interviewer

“Yes.”<sup>42</sup>

Construction company manager

“But, what goes wrong in the process?”<sup>43</sup>

Interviewer

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<sup>39</sup> «Er det ressurskrevende for deg å sende ut en sånn plan, en riggplan som inneholder; her skal du inn, her skal du ut, her kan du snu, her skal du ikke snu?»

<sup>40</sup> «Nei, vi gjør det jo med alle de vi har kontrakt med, det er en del av oppstartsmøtet det der. Vi går igjennom riggplan viser at: her kjører du inn, her kjører du ut. Også er det en byggeplass i bevegelse, så det er ikke alltid at du kan losse varene akkurat der [...] Alle fagene som vi har avtale med så går vi igjennom det der.»

<sup>41</sup> «Med en tanke om at sjåføren til slutt skal ende opp med den informasjonen der?»

<sup>42</sup> «Ja»

<sup>43</sup> «Hva er det som går galt på veien da, de gangene de ikke får det?»

“It might stop there, between our sub-contractor and the one driving. And the situation is that we start and have a start-up meeting with our sub-contractor in November, and then he starts operations on the site during November or December, and then he has a start-up meeting he is supposed to be familiar with, and that is also stated in the contract by the way. But, there are lots of papers and we see that such things fall between two chairs [...] And the transport leader might also have gotten the message, but it is not certain he got the message either, because, in this case, the sub-contractor on foundation is named [...] and they have a company named [...] doing transport to and from the site for them, so that’s two different persons [companies] really. I have contact with the project manager with the foundation-entrepreneur, but then he is supposed to, they have their own trucks, but if there is a need to hire trucks, they hire trucks, there are many links, where the information might disappear.”<sup>44</sup>

Construction company manager

Some drivers stated that graphics showing some of the route to the site is also helpful. The rig plan only describes what is going on on-site and in close proximity to the site. The choice of route, dependent on road-quality, road-side activities, road construction and other challenges was discussed with the construction company manager. The manager emphasized the importance of knowing exactly what route to take and knowing beforehand that it is possible to carry out the transportation, especially with challenging cargo. In some cases, the construction company has direct contact with transport companies, and the manager had experience with making and conveying maps indicating the preferred route to the delivery site. In this case, it was the managers own initiative, due to safety concerns regarding the delivery. The transport company had responded positively to this initiative.

“I made a map showing the entire area from the E6, where they should drive, and where it was critical in regard to sharp turns and where there could be many children and people in the way, and then I wrote to the one in charge of the transport company: “You need to go through this with everybody that is going to drive here, and then you have to confirm that you have done so.” And I got that confirmation [...] I got positive feedback from the transport company on that one and it took us just 15-30 minutes to make that sketch, and also, we wrote some points about what was important.”<sup>45</sup>

Construction company manager

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<sup>44</sup> «Det kan jo stoppe der da, mellom vår underentreprenør og den som kjører. Også er det jo sånn at vi starter og har oppstartsmøte med en underentreprenør i November, også starter han på byggeplassen i løpet av november eller desember da, og da har jo han ett oppstartsmøte [gjennomført i november] som han skal ha satt seg inn i og det der står jo for så vidt i kontrakten også. Men, det er jo mye papir og sånne ting som detter mellom to stoler da, det ser vi jo [...] Også kan det godt hende at transportlederen også har fått den beskjeden, men det er ikke sikkert han har fått beskjeden heller, for sånn som underentreprenøren vår på grunn [grunnarbeid] her da, heter [...] også har de et selskap som heter [...] som driver med inn og ut kjøring for dem, så der er det to forskjellige personer [selskap] egentlig, jeg har kontakt med han som er prosjektleder for grunn-entreprenøren da, men så skal jo han ha, har jo de egne biler, men så hvis de har behov for å leie inn biler så leier de inn biler, så det er mange ledd da, der informasjonen kan forsvinne.»

<sup>45</sup> «Lagde kart over hele området i fra E6en med hvor de skulle kjøre hen, og hvor det var kritisk hen i forhold til krappe svinger og at det kunne være mange unger og folk i veien da, også skreiv jeg til han som var ansvarlig for transportfirmaet at: «den der må du gå igjennom med alle som skal kjøre hit også må du bekrefte at du har gjort det.» Og det fikk jeg bekreftelse på [...] Fikk positiv feedback i fra transportfirmaet på akkurat den der og det tok jo oss bare kvarter, halvtime å lage den der skissa, og vi skrev jo noen punkter også om det som var viktig.»

After reflecting on the driver's statements that such rig plans rarely reached the driver, the construction company manager stated that he did not see this as a problem prior to being presented with it. The manager pointed out that in such cases the construction company might not do more than what they are asked to do, and that the transport company should require this information. During each project, most digital documents are shared online, with users having access to specific files, dependent on their position and responsibility. This access is primarily provided based on the start-up meetings, with sub-contractors providing information regarding distribution of responsibility within their own personnel, effectively leaving out the hired transport companies. However, this way of organizing access makes it possible to provide access to the rig plan and risk assessments in SHA and YM. In the managers opinion, it might be a better idea to initiate routines on collecting better information regarding what transport companies the sub-contractors plan to hire, together with contact information, to make sure the rig plan with truck-related risk assessments, safety procedures and measures are sent to the transporters. However, the manager pointed out that there would always be additional transport companies involved in hectic periods. Thus, there would always be some truck drivers that did not receive the safety information prior to delivery.

“We could have initiated a routine, that we should know who they [sub-contractors] use as transporters, and have contact info, then we could make sure that this[truck-related safety information] is sent to the transporters [...] There would be some exceptions, sometimes they use transport companies they did not intend to use [...] it is not much work to do that, you just have to know who to send it to.”<sup>46</sup>

Construction company manager

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<sup>46</sup> «Vi kunne jo innført en rutine om at vi skal vite hvem de [underentreprenører] skal bruke som transportør, og hatt kontaktinfo, så kunne jo vi sørget for at det der ble sent til transportørene [...] Noen avvik hadde det blitt fordi, enkelte ganger bruker de transportfirma som de i utgangspunktet ikke hadde tenkt å bruke [...] det er ikke en veldig stor jobb å få gjort det, man må bare vite hvem man skal sende det til.»

### Truck driver as an on-site ambassador

The construction company manager had no experience with a truck driver working as an on-site ambassador. However, the manager had experience with transport companies demanding a walk-through on-site prior to the delivery. In particular, the delivery and montage of tower cranes and mobile cranes always included such a walk-through with a transport company representative and construction company representatives. The manager indicated that this might have to do with the size of the materials and mobile cranes used to montage the tower crane. This inspection prior to delivery is part of the safety procedures set by the company delivering the crane, and not a part of the construction companies' own procedures regarding safety.

“E.g. when we are montaging a crane, we always have that, I don’t know why, but when we are going to montage such a tower crane or a mobile crane, we have this routine with someone from the firm coming and participating in walking through the route on how to get things into the site and where to unload, I think it has a little to do with the size of it.”<sup>47</sup>

Construction company manager

The manager stated that when the structural work of buildings is going to be conducted, the transporter is on an inspection with the construction company. The structural work is often carried out quite rapidly, with large elements arriving by trucks in the right order to be consecutively lifted into place by a tower crane on site. After reflecting on the topic, the manager indicated that the reason to the increased procedures associated with these deliveries is a matter of costs, with large economic consequences if the construction has to stop. Thus, measures to minimize the possibility of the transport causing the construction to stop are small investments in this context.

“Actually, I have experienced transport companies to do the same thing. That was also delivery of large concrete elements, like beams and such with special transport. In this case I participated in an inspection of the road due to the trucks being low, and it was not possible with steep hills or anything like that, it had to be a straight road. Here I participated, it was very, the reason I think, is that the consequence is so huge if it fails, that costs money. Such a crane costs 2000 NOK per hour, right, so if it is standing still for a few days it costs a lot of money. I believe that is the reason why there is such a routine concerning that. Always when you start with the structural work, like steel and concrete you are actually on an inspection with the transporter, when I think about it.”<sup>48</sup>

Construction company manager

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<sup>47</sup> «Vi har det alltid når vi skal montere en kran for eksempel, jeg vet ikke hvorfor, men det har vi som en rutine at vi, når vi skal montere en sånn type bygge-kran, eller en sånn mobilkran, så kommer det en fra det firmaet og er med og går ruta på hvordan vi skal få inn ting og hvor vi skal stå og losse, det har litt med at det er størrelser på det tror jeg.»

<sup>48</sup> «Jeg har faktisk vært borti at et transportfirma har gjort det samme. Det var også leveranse av store betongelementer da, altså type bjelker og sånn der det var spesialtransport. Da var jeg med å befare veien for der var det litt lave biler og det var ikke mulig å ha sånn bratte bakker eller noe sånt, det måtte være en strak vei. Der var jeg med, det var veldig, grunnen til det tror jeg, er fordi at konsekvensen er så stor hvis det ikke går, da koster det penger. Altså en sånn kran koster 2000 kr timen sant, så blir det stående da i noen dager så koster det mye penger. Det tror jeg egentlig er bakgrunnen for at det har blitt en sånn rutine rundt det der. Alltid når man begynner med et råbygg, sånn stål og betong så er man faktisk på befaring med transportøren når jeg tenker meg om.»

## Economic and organizational barriers

All the improvements discussed with the construction company manager exceeds what is required by law. Measures to make sure that information regarding public institutions, the rig plan and truck-related risk assessments and procedures reaches the driver prior to delivery all require the construction company manager to demand confirmation by the transport companies that the information is conveyed to the drivers. However, the manager stated that none of these two measures were costly or time-demanding.

Having a truck driver as an on-site ambassador of other truck drivers would probably be a costlier measure. However, after receiving a description by the interviewer of how this ambassadors position is arranged on another ongoing site, the manager indicated that having such an arrangement might make the transport more efficient. Furthermore, the manager stated that construction companies might have reduced cost with this measure. The manager pointed out that if the driver chosen as ambassador participates in the operational meetings he primarily receives information regarding what is going on inside of the fence. To optimize the benefit on truck-safety, some information regarding what access routes to use and risk assessments on these should be part of the operational meetings.

“Of course, there is a cost if he is participating in that half hour each Monday”<sup>49</sup>

Interviewer

“But with that, they probably had reduced costs regarding the transport companies [...] But again, the focus is with what is going on the site, it might not be so much about outer environment, if there is a road to that address, you don’t think that much about it, if the road is ok or not.”<sup>50</sup>

Construction company manager

The manager reflected on why on-site inspections were carried out with some transporters and not with others. Part of the reason is the organizational barriers with information and responsibility transferred in contracts with sub-contractors. Sub-contractors might also order goods delivered by suppliers, without receiving any information regarding what transport companies that are used to deliver the goods. This is common within transport of building materials, office supplies etc., where the suppliers order transportation as part of the service. Another reason why there are more safety measures associated with some deliveries, might be that some deliveries are more critical in the process, making it costlier if they are not carried out on time.

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<sup>49</sup> «Det er klart at det koster jo litt at han [sjåføren] er med på den halvtimen hver mandag»

<sup>50</sup> «Men de sparte sikkert på det i forhold til transportørene [...] Men der igjen er det jo fokus med det inne på tomte da, det er kanskje ikke så mye ytre miljø da, så er det nå en vei fram til adressen så tenker man jo ikke så mye på om den veien er ok eller ikke.»



The manager stated that if there is going to be a general change in how safety information is provided, and how truck drivers are involved it needs to come from above the construction companies. The project owner needs to address these issues in the project description, with specifics regarding what information to convey, how to convey it and how to involve truck drivers in the process. This way, every construction company is operating on the same premises when making offers on the projects. If not, a construction company including extra safety measures in their offers risk losing the completion on the project.

“We do this when we are montaging large elements, like crane, concrete and such, so maybe we should, why don’t we do this with other disciplines for example? [...] So, the reason why we started focusing on this [truck-safety with large deliveries] is probably money, I guess [...] There is a competition with getting the job, so if one has included it in the costs, while three others do not, that could have had an effect on, that you do not get the job, so it is a little important that the customer defines what he wants included in the job.”<sup>51</sup>

Construction company manager

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<sup>51</sup> «Vi gjør jo det når vi driver og monterer store ting, altså kran, betong og sånn, så kanskje man skulle, hvorfor gjør vi ikke det på andre fag for eksempel? [...] Så bakgrunnen for at vi begynte å fokusere på det der er sikkert penger da, vil jeg tro [...] Det er jo en konkurranse for å få jobben, så hvis en har priset inn det da, mens tre andre ikke har gjort det, så kunne jo det ha slått ut på, at han ikke hadde fått jobben da, så det er faktisk litt viktig at det er kunden som definerer hva han skal ha med i jobben.»

#### 4.4. Project owner

Based on the insight and suggested solutions to the challenges experienced by truck drivers and their managers, a manager representing the municipality as project owner on-site was interviewed. The purpose of this interview was insight on the safety information flow and possible solutions from a project owners point of view. Findings from interviews with the project manager are summarized under the following topics:

- Experience as manager on the project owner side and position
- Risk assessments and plans prior to start-up
- Safety during the construction phase
- Improvements
- Economic and organizational barriers

##### **Experience as manager on the project owner side and position**

The interviewed project manager and developer had almost 20 years of experience in his position on the project owner side. As project developer, he is involved in the process of planning, preparing and sending out the specification of new projects on which construction companies make their offers to get the job. As project manager, he is involved in on-going projects, as a controlling and facilitating unit on-site. Thus, he had first-hand knowledge regarding what safety measures and risk assessments that are made regarding trucks associated with the site from the first stage of planning, throughout the phase of construction and even in the operational phase if operation and maintenance is not taken care of by another company.

##### **Risk assessments and plans prior to start-up**

Prior to the start-up of on-site operations, the project owners make SHA plans concerning safety on the site. According to the project owner, the SHA plan handles operations inside of the fence and in the borderline out towards the public area. A general SHA plan made by Trondheim municipality exists, but the SHA plan is adjusted to the risk assessments on each site. Regarding trucks, a rig plan is made, specifying where the trucks are supposed to enter and exit the site. The gates locations are specified in detail on this map and are not to be changed by the construction company without consulting with the project owner. These locations are not changed without very important reasons, and the gates are to be changed back to their original location if the challenges are temporary. Because of this, the gate's locations and procedures on which gates to enter and exit are often the same throughout the project. In some cases, specific locations for loading are indicated on the rig plan. Delivery of large goods (e.g. concrete elements delivered on semi-trailers) is considered within the rig plan to make sure there is enough space for on-site movements and delivery. The project owner stated that normally, no truck drivers or transport managers participates in these evaluations.

In addition to the SHA plan, a YM-plan is made, considering the outer environment. However, according to the project owner these rarely include specific procedures or measures regarding traffic. Normally it contains a general point about maintaining traffic safety in the adjacent streets. In coherence with the transport managers statements, the project owner pointed out that the Norwegian laws regulates the traffic in public streets. Thus, it is not the project owner's responsibility to make specific safety procedures or plans regarding what is going on in the public streets, in his opinion. However, the project owner stated that information regarding schools, kindergartens, elderly homes, sports arenas etc. in the vicinity of the site is specified in the contract and documents that are made available for the construction company.

*“And when they are out there [in the street], then it is not out property you know, then it is under the jurisdiction of the traffic law. We cannot enjoin the one or the other, we just tell them to be careful, if there is a school in use, a kindergarten in use, an elderly home in use, a sports arena in use, if there are people going in and out. Such things are specified, if there are schools or the others in use and this is handed to the construction company. It is in the job description when the project documents are sent out for the construction companies to apply with their offers on the job, but no responsibility in the street, there is no responsibility for us there.”<sup>52</sup>*

Project owner

### **Safety during the construction phase**

In the project owners experience within the public sector, this SHA coordinator is mostly an external party and is not supposed to have other interests in the project than serving in his position as a safety controlling unit. The control of and assurance that everything is in coherence with specifications and regulations in the contracts and Norwegian laws is the SHA coordinators job description, but the project owner’s responsibility. At all times, the project owner is responsible to make sure that traffic signs, markings, fences, gates, loading areas, construction site roads etc. are in coherence with the approved WZTCP, SHA and YM plan.

In the project owners experience, safety procedures and measures are specified in contracts and followed up by meetings with the project managers on site, participating in the weekly operational meetings etc. and having on-site inspections. The representation of the project owner on site is obliged to work partly on-site. The interviewed manager had 2-3 days each week on average. He stated that the project owner normally deals with safety information in meetings with the construction company management and in operational meetings. Prior to startup of new phases on the site he has the responsibility and opportunity to specify and walk through specific safety procedures. Participants in these meetings are managers on site and representatives of each work group like electricians, carpenters, excavation workers etc. However, the project owner had no experience with truck drivers or transport company representatives participating in these meetings. Thus, if truck-related safety issues arise, truck drivers are dependent on on-site employees to convey the concerns to representatives participating in these meetings, as safety concerns are handled and discussed in these meetings with the project owner representative. If the purposed measures to such safety challenges are incompatible with the excising safety procedures and plans specified in the contract, preliminary exceptions can be made. However, this is rarely carried out unless there is a clear safety benefit. Because of this, the safety plans and procedures specified in the project documents are likely to stay unchanged throughout the on-site operation. Thus, it is easier to distribute correct safety information that is rarely outdated.

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<sup>52</sup> «Og når de kommer uti [gata] der så er det jo faktisk ikke vår eiendom heller vet du, da er det trafikkreglene som gjelder [...] Vi kan ikke pålegge dem noe sånn at hverken det ene eller det andre sånn sett, vi sier bare at det skal vises aktsomhet, om det er en skole i drift, en barnehage i drift, et sykehjem i drift, det er et idrettsanlegg i drift, som det går inn og ut folk i. Sånne ting presiserer vi da, at det er skoleanlegg og de forskjellige i drift som blir overlevert til entreprenøren. Det ligger i anbudsdokumentene når de får anbudet, men ikke noe ansvar ute i den gata, det har vi ikke.»

## Improvements

Based on the interviews with truck drivers and transport managers, the following suggested improvements on the safety information flow were discussed with the project owner representative:

- Information regarding public institutions
- Spotters
- Drawings of the site
- Truck driver as an on-site ambassador

The manager's insights on these suggested improvements are summarized in the following paragraphs.

### Information regarding public institutions

The interviewed truck drivers emphasized the importance of information regarding schools, kindergartens, sports arenas etc. As described in the paragraph above, the project owner stated that this information is always collected and handled to the construction company in the project contracts and documents. Thus, the project owner's part of the responsibility on the matter was handled and covered in his opinion.

### Spotters

Regarding spotters, which is one or few persons helping the truck driver in challenging maneuvers, the project manager's view was that such usage should not be decided prior to start-up of the construction. In his opinion, this is a costly measure and should be part of a dynamic and always on-going evaluation. In hectic phases of the construction or if the construction company inquires for such measures, this should be evaluated. This conservative use of spotters as a safety measure was in coherence with the truck drivers' experience of this measure being utilized in extraordinary challenging situations.

*"We say that you should be considerate and careful and all that, and such things as a spotter can come later in the process. It is hard to be specific, we could of course, like now we have experience with the kids getting picked up this way, so we did not demand spotters. We could do it, but it makes the project more expensive, right. If we should have traffic guards with each truck arriving it becomes very expensive. However, in hectic periods like excavation or when trucks with big elements are arriving, building materials are arriving, those are the two periods, right. Between those, with electricians and carpenters and all that, with small trucks and equipment, it gets expensive if you should have spotters on all of that."*<sup>53</sup>

Project manager

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<sup>53</sup> «Vi sier at hensyn og forsiktighet og alt det der, også kan sånn som ryggevaktt komme senere i prosessen. Det blir vanskelig å si spesifikt, vi kan jo selvfølgelig, sånn som nå har vi jo egentlig erfaring med at ungene ble henta sånn og sånn, så vi gikk ikke inn og sa i fra at det må være vakter. Vi får det til, men da stiger prisen ikke sant. Hvis vi skal ha trafikkvakter for hver lastebil som kommer inn blir det veldig dyrt. Men i hektiske perioder, som utgravning, eller når det er store elementer som skal inn, byggematerialer som skal inn, det er de to periodene ikke sant. Mellom der, med elektriker og rørlegger og alt det der ikke sant, med småbiler og utstyr utom, det blir veldig dyrt om du skal stå og passe på det.»

### Drawings of the site

Another kind of safety information that was expressed as desirable information by almost every interviewed driver was a map indicating where to enter, load, turn and exit if such procedures exist on the site. The interviewed project manager stated that these graphics are made prior to the start-up of every construction site. As described in the section on Risk assessments and plans prior to start-up, they are called a rig plan and normally include a sketch of the site, indicating the areas and shape of what is going to be constructed and already existing infrastructure. Furthermore, gates are indicated with accurate positions and decisions are made regarding what gates the truck driver should use to enter and exit the site during the different phases of construction. Based on the rig plan, safety during truck deliveries is evaluated and areas to turn and load are indicated on the rig plan in this process. Thus, all of the specifics wanted by the drivers are already included on this rig plan, except access roads.

*“That is always a part of our plans. Early on we decide, me, the signee with others: such is your rig plan, here you can exit, and here you can also exit [...] We describe in detail and draw: here you shall drive in and here you drive out. We have to decide this because if not, the constructors are free to do what they want, and then they might decide to exit here [pointing on the map], or now we should exit here [pointing on a different location] [...] The rig plan is finished when we send out the project documents for the construction companies to come with their offers on the job [...] All of the trucks are supposed to unload on pre-specified locations [...] We have to make sure there is enough space, here they are supposed to deliver large elements, and they have to have sufficient space to get them into place, so we have taken into consideration how they are going to load.”<sup>54</sup>*

Project manager

### Truck driver as an on-site ambassador of the other drivers

Some of the interviewed drivers had experience with a more systematic way of organizing the drivers. A truck driver had been pointed out as an on-site manager of the truck drivers, handling delivery scheduling and distribution of safety information. The project manager had no experience with organizing the drivers like this and pointed out that plans regarding the distribution of safety information to the drivers was not the project owner's responsibility.

*“We don't make plans on how to distribute safety information to the drivers, that is the constructor's responsibility. We would like to have insight into how they do it, would like to have a copy [documentation], but it is not our responsibility. We make the rig plan.”<sup>55</sup>*

Project manager

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<sup>54</sup> «Det er fast da, på våre planer. Tidlig i fasen så bestemmer vi, meg, undertegnede med flere: sånn er riggplanen din, her kan du kjøre ut, også kan du kjøre ut også der [...] Vi skriver helt spesifikt og tegner inn: her skal du inn og her skal du ut. Vi må bestemme det for hvis ikke så gjør entreprenøren akkurat som han vil, og da finner han ut at nå skal vi kjøre ut her [peker], nei nå må vi kjøre ut her [peker et annet sted] [...] Riggplanen ligger ferdig når vi sender ut på anbud [...] Alle lastebilene skal losse av på bestemte områder [...] Vi må jo passe på å få det stort nok til når de skal, her skal de jo levere store elementer, så da må vi passe på at det er nok plass. Her [peker på kartet] vet vi at det skal mange elementer, og da må de ha muligheten til å plassere dem, så vi har tenkt på hvordan de skal laste.»

<sup>55</sup> «Vi legger ikke planer for hvordan sikkerhetsinformasjonen skal formidles til sjåførene, det er entreprenøren som har ansvaret. Vi vil gjerne se hvordan de gjør det, gjerne ha en kopi, men det er ikke vårt ansvar. Vi har ordnet riggplanen.»

## Economic and organizational barriers

Both the distribution of the rig plan to drivers and having an on-site manager of the driver's present safety measures that exceed the minimum requirements on safety regarding truck drivers at construction sites. Including such measures in the contracts would make them more expensive, and the project manager stated that such implementations need to be required by someone superior to the project owners because the basis of their plans and contracts are the Norwegian laws and requirements. At the same time, the project owner was very positive to these measures, and in his opinion the distribution of the rig plan should not have any actual economic consequence. The appointment of an on-site truck manager on the other hand might have a considerate economic consequence, but on this point the project manager was inconclusive.

"We have to be ordered to do so, some one superior needs to say: "This have to be done, get it in the contract, write this." And then they do this, then they have to account for this. But we can't order them to do so as long as this is not given by law, without them charging us heavily for it. And then there is costs and such things, so we have to act by what is given by laws and by-laws concerning what we do."<sup>56</sup>

Project owner

"But such as that map, that might not be so costly, if you write a sentence about it [in the contract], that it should be distributed?"<sup>57</sup>

Interviewer

"Yes, no it does not increase with that [the costs], that's just that the project manager, the construction company is made aware that it should be distributed. That's a good measure."<sup>58</sup>

Project owner

"How much do you think such a measure as described might cost, with a truck driver working as an ambassador for the others [drivers] and participate on operational meetings each week?"<sup>59</sup>

Interviewer

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<sup>56</sup> "Vi må få et pålegg vi, her må noen si overordnet: «dette skal gjøres, få det inn i kontrakten, skriv det der.» Og da gjør dem det, da må de vekte etter det. Men så fremt det ikke er noe lovpålagte ting, så kan ikke vi liksom påtvinge dem uten at de tar klekkelig betalt for det. Og da har vi sånn med kostnader og sånn, så vi må bare forholde oss til lover og vedtekter som finnes for akkurat det vi holder på med."

<sup>57</sup> Intervjuer: «Men sånn som det kartet da, det er kanskje ikke noe som koster så mye, om du skriver en setning om det [i kontrakten] om at det skal distribueres.»

<sup>58</sup> «Ja nei det stiger ikke noe på det, det er kun at prosjektlederen, entreprenøren er oppmerksom på det at det skal distribueres. Det er jo et godt tiltak det»

<sup>59</sup> «Hvor mye tenker du det vil koste med et slikt tiltak som beskrevet, med en lastebilsjåfør som virker som ambassadør for de andre og som deltar på driftsmøter hver uke?»

“It’s hard to say how much costlier it makes the project, it’s one man, if he does other things in between, or what he is doing, he is probably a driver, he is plucked out. So, if you look at it that way it should not matter at all economically. It’s just that he is doing another kind of work for half an hour in the morning when he goes out [starts], so what that has to say, no, I dear not say.”<sup>60</sup>

Project owner

“Based on your experience, do you feel like this is an unrealistic measure?”<sup>61</sup>

Interviewer

“No, not even close, again, it’s based on how you acquire those trucks that are driving in [...] I think that is very positive, that they have their routines and system on this, nothing is better. It makes the situation better, I mean the information flow.”<sup>62</sup>

Project owner

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<sup>60</sup> «Hva det fordyrer prosjektet med er litt vanskelig å si, det er en mann, om han gjør andre ting i mellom der, eller hva han holder på med, han er jo sjåfør sikkert, han er jo plukka ut. Så sånn sett skal det ikke bety noe i det hele tatt kostnadsmessig da. Det er bare at han har en annen arbeidsoppgave i en halvtime fra morgenen når han går ut da, så hva det betyr, nei det tør jeg ikke si.»

<sup>61</sup> Basert på din erfaring, føler du det er et urealistisk tiltak?

<sup>62</sup> «Nei, på langt nær, igjen så baserer det seg på hvordan de får tak i de bilene som kjører inn. [...] Jeg ser veldig positivt på det der, at de har rutiner og system på det der, det er jo ingen ting som er bedre. Det bedrer jo situasjonen, altså informasjonsflyten.»

## 5. Discussion

As previously stated, the objective of this research has been:

*“To understand how information is communicated with regards to safety in urban construction site deliveries, and identify potential ways to improve the information flow to increase safety”*

Six research questions have been formulated to address the objective:

1. What general safety information do truck drivers receive?
2. What site-specific safety information do truck drivers receive, and how?
3. What safety concerns do truck drivers report at urban construction sites, and how?
4. What general safety information could increase safety in urban construction site deliveries?
5. What site- and route-specific safety information could help truck drivers conduct safe deliveries?
6. What measures could improve the safety information flow at urban construction sites?

The findings relevant to the main objective and these research questions (formulated in chapter 1.1) are discussed in the following paragraphs. Research questions 1-4 are already addressed in the results, and a short summary is presented in the discussion, while research questions 5-6 present possible measures based on the findings and are discussed in more detail within this chapter.

### 5.1. Bias in interviews

Considering the methodology used in this study, interviews are also self-reported data and might be affected by social desirability. Especially if the actions in question are undesirable, the frequency or severity of encountered situations might be underreported (Sullman & Taylor, 2010). However, when truck drivers and transport managers were reporting their own routines on safety, no one seemed to have problems with stating that such routines were close to non-existent, someone even stating that they thought they were unnecessary. On one occasion, a manager hesitated and stated that he was not sure if his statements were in accordance with the official guidelines in the company. However, after reflecting briefly on what the situation in question looked like in official papers, he continued describing the situation based on his experience and knowledge. In general, all truck drivers and transport managers seemed quite comfortable in the situation and based on the quick answers and spontaneous reflections, they seemed to be speaking quite freely. The construction company manager and project owner did not seem to be largely affected either, reflecting quite spontaneous and openly on present and past safety short-comings on their sites.

The phrasing of questions might also be leading, and this might be especially relevant in the interviews with the construction company managers and project owner, where possible solutions (based on the first round of interviews) were presented to gain their insight. However, both managers expressed organizational and economical concerns, and did not embrace the ideas presented without critique.

The questions might also be phrased so that some specific kinds of information seemed more relevant to report than others, providing an overrepresentation of some kinds of data. However, the interesting findings are based on the general trends. Some specifics, like maps of the construction site are addressed, but the findings are interesting because several drivers reported it.



## 5.2. Q1 - What general safety information do truck drivers receive?

### **Mandatory courses**

Every interviewed driver reported to participate in the mandatory continuing educational course every fifth year. The content is described in the regulations of professional drivers, and companies and teachers in the courses have to apply to the regional road administration to get the courses approved (Samferdselsdepartementet, 2008). The transport managers all felt responsible to make sure that all of their drivers participated. However, all drivers expressed negative attitudes toward the courses, especially regarding the theoretical parts, and some drivers reported that they never learned anything useful in these courses. Drivers stated that the understanding of risk and learning to recognize dangerous situations is primarily provided through experience.

The truck drivers were more positive regarding the practical part of the mandatory courses, when they drive trucks, while the teacher is observing them. However, this module was reported to focus on efficiency and environment, not safety. The drivers described it as a competition. Such competitive style of the course could add even more pressure on making deliveries as fast as possible, which is an unfortunate effect in an already time-pressured business where time pressure is reported to represent a serious safety challenge (TØI, 2013).

### **Internal safety information**

According to interviewed drivers and managers, there was rarely any general safety information provided by the transport companies. Several drivers stated that there was no need for additional general safety information, and some managers stated that arranging campaigns or safety awareness courses was unnecessary and a waste of time.

## 5.3. Q2 - What site-specific safety information do truck drivers receive, and how?

In general, all drivers were positive to site-specific safety information. Every driver reported that normally, no safety information was provided prior to delivery, neither by the transport company or the construction company. However, most sites are equipped with signs at the gates indicating what safety equipment that is required. Furthermore, information regarding public institutions (e.g. school, kindergarten, sports arena) was sometimes provided. Other safety information (e.g. rig plan, accessibility issues on-site and maximum number of trucks on-site) rarely provided. Especially within mass transport, most deliveries are managed by verbal communication on phone or radio. Within transportation of goods with one or few deliveries to the same construction site, there is often a written description of the delivery.

Experience with a truck driver as on-site ambassador was only reported by transport managers and truck drivers. The interviewed project manager and construction company manager had no knowledge of this way to organize drivers. However, both managers had interesting insights regarding implementation of such a measure e.g. addressing truck-safety on route to the site in operational meetings. Furthermore, organizational and economic barriers were pointed out, together with the need to standardize safety measures through laws and regulations. The drivers familiar with this way of organizing distribution of deliveries and information were positive toward this measure. The interviewed truck driver with experience as an on-site ambassador stated that participating in the operational meetings makes it easy to share insight prior to new operations, and the teamwork between different trades makes operations safer and more effective. In the ambassador's opinion, continuous communication made it easier for other truck drivers to report safety concerns to the construction company through the ambassador.

#### 5.4. Q 3 - What safety concerns do truck drivers report at urban construction sites, and how?

Most drivers stated that there are only few construction companies making the drivers aware of how to report safety concerns. Thus, most safety concerns were delivered to the transport company management. The drivers were under the impression that transport company managers contacted the construction company in question if the risk was severe, or if several drivers reported the same issues. This corresponds with the statements by some transport leaders, indicating that temporary issues like slippery roads might not be handled if not reported by several drivers.

There was an interesting difference regarding the age and experience of the drivers and their attitude towards reporting undesirable events and safety concerns. The young driver stated that every safety concern was reported because it might harm the next one to pass. However, the more experienced drivers were more willing to accept the risks, trusting their own abilities to make up for the lack of safety measures or adverse conditions. Part of the explanation to why experienced drivers rarely report safety issues might also be that drivers feel like nothing is done to improve conditions anyway. Another aspect is the massive pressure on efficiency, with several drivers stating that waiting or refusing to carry out deliveries due to minor safety issues was out of question. Furthermore, several drivers stated that they were under the impression that reporting too many minor safety issues would potentially cause the driver to be dismissed from the site. This seemed to primarily be a problem within mass transport, within hectic phases with continuous truck traffic and high pressure on efficiency. However, no truck drivers should feel pressure to carry out deliveries they are not comfortable with or be exposed to serious risks because efficiency and not truck-safety is prioritized by the construction company.

Drivers with 40 years of experience were educated with less regulations regarding safety, and an almost non-existent system for reporting undesirable events. This might also be part of the reason why a higher risk seems to be accepted, and the lack of reporting undesirable events. This change in safety awareness and measures might be a good reason why the walk-through of safety measures and demands together with the responsibility to report safety concerns should be included in the mandatory courses, even for experienced drivers.

#### 5.5. Q4 - What general safety information could increase safety in urban construction site deliveries?

According to the truck drivers and transport managers opinions, the continuing education of drivers through general safety courses and ADR-courses every fifth year are already covering too much general safety. Therefore, these courses should probably be reviewed with regards to their content, quality and attractiveness. Something should be done to gain the truck drivers attention and motivation. First of all, the duration of the course (5 days for trucks and bus, or 4 days with only goods transport) seems to be too long for busy drivers. The frustration with “loosing” a whole work week and having long days with a theoretical approach is tearing on the truck driver’s motivation. Thus, making the general course shorter and more practical (e.g. testing strength of old or damaged ratchet straps, demonstrating impact of goods falling off trucks in motion) seemed to be what most drivers wanted, if dropping the whole course was not an option. Regarding the course on dangerous goods (ADR), choosing the relevant modules with adjusted exams, dependent on each driver and manager’s work description seemed to be what most drivers and managers desired.

## 5.6. Q5 - What site- and route-specific safety information could help truck drivers conduct safe deliveries?

### **Information regarding public institutions**

Information regarding public institutions was reported to be conveyed to drivers to a large extent. However, there is no law or regulations demanding the distribution of this information. Drivers desire this information, and the construction company manager stated that children were associated with the grates safety concerns, and under the impression that such information was always conveyed to the drivers. Thus, there would probably be little resistance in the construction industry if this distribution was demanded in the format of leaflets, posters, written descriptions etc.

### **Information regarding access roads and correct address**

The drivers reported misleading addresses as one of the most common safety challenges. Road construction and construction sites with narrow or steep access roads was also mentioned as a frequent safety challenge. If the construction companies were obliged to make a quick risk assessment regarding what routes the truck drivers should use, problems with misleading addresses and unfortunate choices of route might be reduced. Unnecessary truck-traffic along public institutions could also be avoided if truck drivers were told to choose another route. Alternatively, drivers could be told to arrive within specified hours e.g. avoiding conflicts with children arriving or leaving the school. This is especially relevant in urban construction site deliveries.

### **Graphics of the site**

Several drivers mentioned maps of the construction site as especially helpful information. Different types of deliveries require different information, with mass transport drivers primarily desiring knowledge regarding where to enter and where to exit the site. Drivers delivering machinery or materials on the other hand, desire specific loading locations indicated on the map, in addition to information regarding where to turn, park, enter and exit. The project owner is already carrying out assessments and making procedures regarding this to a large extent with the rig plan. However, it might not be as simple as just handing over the rig plan with descriptions to all of the drivers hired to make deliveries at the site. The easiest solution might be to require the distribution of a simple version of the rig plan, only indicating the areas of existing infrastructure, perimeter of the site and location of gates with indication of what gates to enter and exit on the map. Then every construction company with sub-contractors decide how specific the maps are made regarding different deliveries.

### 5.7. The safety information flow

With the exception of information regarding access roads, all other measures discussed in the previous chapters were based on the truck drivers or transport managers experiences with receiving such information. These results indicate that the information desired by the truck drivers already existed in the information chain but did not usually reach the driver. The distribution of graphics of the site and information regarding public institutions was discussed in interviews with a construction company manager and a project owner. These interviews confirmed that this information is present in the evaluation of safety in every project. Thus, it is a matter of improved information flow if this safety information should reach the driver.

In the following paragraphs, two characteristics of the information flow are used as parameters; *consistency* (how often the information is provided) and *quality* (if the provided information is correct). In the following paragraphs, these parameters are used in the discussion of these respective links in the safety information flow:

- Project owner and construction company management in general contract
- Construction company management and sub-contractors
- Transport companies as sub-contractors
  - Sub-contractors that are not transport companies
  - Sub-contractors and transport companies
- Transport company managers and truck drivers

The links are based on the organizational map described in the chapter on background and presented in Figure 2.

#### **Project owner and construction company management in general contract**

The safety information flow between project owner and construction company management can be divided into two phases; prior to and during the project.

Prior to the project, the project owner sends out project documents on which the construction companies make their offers. The rig plan together with safety procedures are already decided in these documents. Active public institutions in the vicinity of the site are always included in the risk assessments, that are available to the construction company management.

During on-site operations, the risk assessments, procedures and measures are carried out in a dynamic process with both the construction company management and project owner present. Thus, both parties in the link have mutual access to the updated safety information. Both the construction company manager and project owner stated that few specific truck-assessments are made. Particularly regulation of traffic in general and measures to reduce conflicts between trips generated by public institutions and construction site traffic are very relevant to truck drivers operating on the site. Based on the interviews this information seems to be transferred with high consistency and quality between the project owner and construction company management.

### **Construction company management and sub-contractors**

The safety information flow between construction company management and sub-contractors can also be divided into two phases; (1) start-up of the sub-contractor's operations on the site and (2) updates during the sub-contractor's operations on site.

Sub-contractors are hired through contracts with included documentation of risk assessment, safety procedures and measures. However, this process is usually less extensive than the one between project owner and construction company with the general contract. There is a large range in kinds of trades, risks, time span and cost within these contracts. Thus, there is a variation in documentation of risk assessments, safety procedures and measures. However, all sub-contractors are supposed to be briefed on safety risks associated with their on-site operations in start-up meetings with the construction company management.

During on-site operations, all sub-contractors are participating in the weekly operational meetings where risks and safety procedures relevant to the on-site operations during the week in question are repeated and discussed. Usually, there are few transport companies among the sub-contractors, and the difference between transport companies hired by sub-contractors and transport companies sub-contracted by the construction company in general contract seems to be significant. The different links are described separately below.

#### Transport companies as sub-contractors

Based on the statements of the construction company manager, transportation of tower cranes, mobile cranes and large structural elements is often contracted by the construction company in a general contract. These deliveries were reported to have a high consistency and quality regarding the transfer of risk assessments, safety procedures and measures. Some of these risk-assessments and safety measures were often initiated by the transport companies, demanding a change in the safety information flow upwards in the chain. Some of these safety measures demanded by the transport companies also exceeded the existing risk assessments and safety procedures. The construction company manager was positive to these initiatives to increase the consistency and quality in the safety information flow. However, the economic perspective seems to be of importance when deciding the extent of risk assessments and safety procedures. Deliveries of goods that are not expensive or critical in the progress of construction, compared to cranes or custom made structural elements, are not facilitated in the same way. Usually, no safety information is provided.

#### Sub-contractors that are not transport companies

Most deliveries to a construction site are organized by sub-contractors. In such cases, truck-related safety information is transferred through the sub-contractors to their hired transport companies. Thus, no drivers are present in the start-up or operational meetings, and it is the sub-contractor's responsibility to require the truck-relevant safety information associated with their need of transportation. Based on the construction company managers statements, the consistency in the truck-safety information flow to these sub-contractors might not be as high as with sub-contractors that are transport companies.

### **Sub-contractors and transport companies**

No sub-contractors were interviewed in this research, and for further research on the subjects, these should be included. Transport managers reported a large variation in the distributed safety information. In general, transport managers stated that the large customers normally distribute more safety information and have more safety requirements. Furthermore, more complex deliveries were also reported to be associated with more safety information. If one assumes that the “large costumers” are construction companies with general contracts ordering transportation, and that “small contractors” are sub-contractors like carpenters, plumbers, electricians etc., ordering materials and machinery, less safety information seems to be conveyed in these deliveries. Part of the explanation to this trend might be that the materials are ordered by suppliers that have their own transportation agreements as part of the service. In this case, the carpenters ordering materials have no knowledge of what transport company that is delivering the goods, and if safety information was to be conveyed, it would have to go through the supplier. Based on the transport managers and the construction company managers statements, both the consistency and quality of truck-related safety information seems to have room for improvement in this link.

### **Transport company managers and truck drivers**

Transport managers reported that site-specific safety information was rarely distributed to the drivers. If construction companies distributed books or folders, these were placed in the vehicles. However, no drivers remembered these when they were asked about what site-specific information they receive. The transport managers blamed the inconsistency in the safety information they received. They argued that it is easier to just make sure information like the address and goods description have a higher quality. In contrast, the truck drivers reported that the safety information they receive has high quality. However, if contact numbers and address are not defined as safety information, the safety information flow was reported to be very inconsistent. In contrast, the address was always part of the delivery description, which is natural since a delivery without a destination is unlikely. However, the drivers were frustrated with the quality of this information, reporting that wrong delivery address was not unusual. Furthermore, a contact number was often provided on written delivery descriptions, but good consistency is useless if the contact number is to a person without knowledge of the delivery.

### **Trends in the information flow**

To describe the most obvious trends in the information flow, the transfer of four different types of information through the chain are defined. Rig plan and information regarding public institutions can be considered as safety information. In addition, the transfer of address and contact number is described. These are not categorized as safety information in this research. However, this information is related to safety, and represent the only information truck drivers normally receive. In Figure 4 and Figure 5, the four different kinds of information are listed with colours to indicate the consistency and quality of the respective information in different levels in the information chain. Green represents both a high quality and consistency, ranging through yellow and orange, with red colour representing only sporadic events within consistency, and a high certainty of the information being wrong or misleading within quality.

## Consistency of information

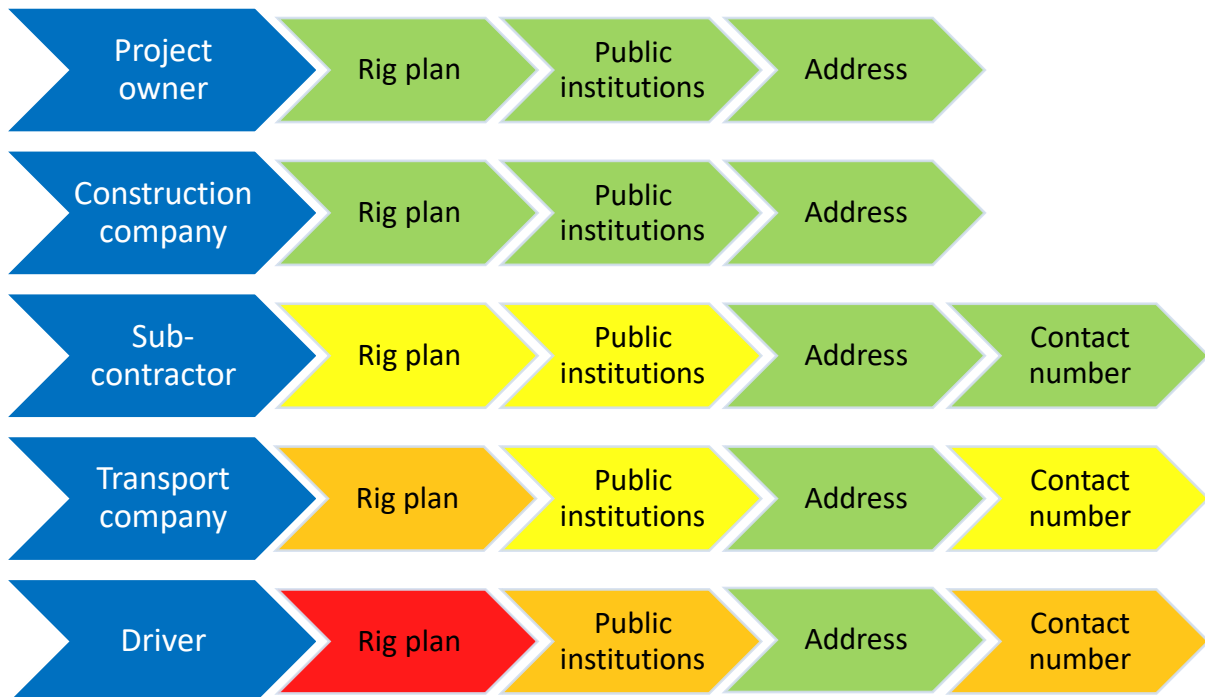


Figure 4: Consistency of different information in the information flow

## Quality of information

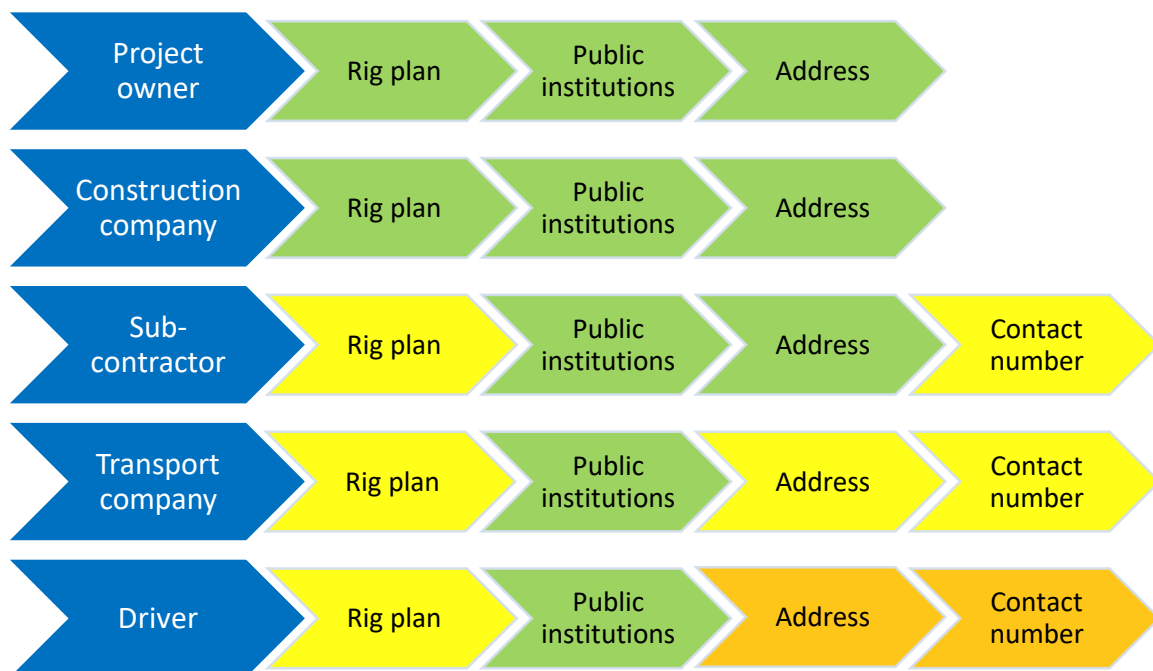


Figure 5: Quality of different information in the information flow



### Norwegian laws and regulations

One of the most obvious patterns in the safety information flow is that where the laws and regulations do not require distribution of information, the information stops. This is best described with the rig plan. The law requires the project owner to make the relevant risk assessments and procedures regarding trucks operating on or delivering to the site. The project owner is obliged to make sure the construction company follows these safety procedures, and that on-site operations are in accordance with the law. The construction company in general contract are obliged to inform every employee of risks associated with their work and make sure that they receive necessary training, practice and instructions, as are the sub-contractors. However, truck drivers are usually not employees of the construction companies operating on-site. Transport companies are hired to deliver a service. Thus, the responsibility to inform the truck drivers of risk associated with their work and provide instructions is with the transport company. However, the law is too general to claim that transport managers are obliged to inform their employees of specific risks and instructions at each construction site. Thus, there is a gap in laws and regulations, and the transfer of site-specific safety information like the rig plan is not required by law. This link between construction companies operating on-site and transport managers also seems to be a critical link in the safety information flow, where such safety information is lost.

However, there is one interesting anomaly to this trend within the safety information that was discussed in the interviews. Information regarding public institutions seems to travel through the information chain all the way from the project owner to the truck driver to a large extent, relatively to other kinds of safety information. However, one might argue that information regarding schools, kindergartens, sports arenas etc. is easily retainable, and the locations are not likely to change often. Thus, it might be sub-contractors remembering that there is a school on route when ordering a delivery, transport managers being familiar with these locations or even the truck drivers reminding each other of these locations when hearing about new sites. However, it is not likely that this is always the case, and some truck drivers reported situations where this safety information was provided by the construction company. Thus, the results indicate that this information is transferred in the link between construction companies and transport companies to some extent. The construction company manager stated that the greatest safety challenges are often associated with children close to the site. If this opinion is shared by the other parties in the information chain, this might be part of the reason why this is the safety information most commonly distributed to the drivers.

### The format of the information

Another aspect of the information flow is the format in which the information is distributed. Most drivers reported receiving site-specific safety information verbally, by phone, radio or in person. No drivers reported receiving information exceeding the address, goods specifications and contact number in writing via tablets or similar digital equipment. The rare occasions when the rig plan was distributed, it was reported to be in the format of posters in lunch rooms or printed copies brought in the truck. Information regarding public institutions is easily conveyed by phone or other verbal communication, which is reported to be the most dominant communication between transport managers and truck drivers. In contrast, a rig plan is transferred in a written format, demanding a graphic, digital distribution or distribution of paper copies, which are reported as unusual ways to transfer information in this link. Thus, information regarding public institutions is more easily transferred.



Another indication of the barriers related to the format is represented with the pattern regarding distribution of contact phone numbers. This was only reported as part of the delivery description if distributed on tablets or other digital devices fit to receive written descriptions. Thus, the consistency of contact phone numbers is low, due to the limitations related to verbal distribution of information. Addresses on the other hand have high consistency, but the lack of written delivery descriptions might be part of the reason why the quality of this information is low. If the address is conveyed verbally by the construction company to the transport manager and from the transport manager to the truck driver, there are many possibilities of human error.

#### 5.8.Q6 - What measures could improve the safety information flow at urban construction sites?

Based on findings presented in the result and discussion, some possible measures to improve the safety information flow are presented in the following subsections.

##### **regulations demanding description of truck-related risk assessments and procedures distributed to truck drivers**

Construction companies are required to make risk assessments and safety procedures of on-site operations, and by law, all employees are to be made familiar with risks in connection with their work and relevant safety procedures. If these requirements were extended to include hired truck drivers, delivering at construction sites, the gap of responsibility between the construction companies and transport companies could be closed. It is unthinkable to have a meeting between the construction company and every driver delivering at the site. However, conveying the risk assessments relevant to truck drivers, and truck-relevant procedures e.g. where to enter and exit, speed limits on-site, required protection gear, height limitations, and demanding the truck drivers to sign that this information is “read and understood” might not be a very extensive measure. Furthermore, a study of work-related accidents in Norwegian road, sea and air transport concluded that the most frequently mentioned risk factor is lack of complete, written risk assessments (TØI, 2015). Most truck-related risks are already assessed, and procedures regarding on-site traffic are made. Thus, the information only need be conveyed to the drivers.

However, there are many challenges with extending the regulations to include all drivers. If the law is extended to include deliveries ordered by companies operating on site, the truck drivers hired by suppliers as part of the service is excluded because the delivery is ordered by the supplier, which is not operating on-site. Furthermore, transport companies hired to deliver at a site is not necessarily defined to be operating on the site. Thus, if the hired transport company hires another company to make deliveries at the site, this might also be excluded in the extension. However, it should be possible to redefine regulations to cover more truck deliveries than the present regulations.

This measure to improve the information flow could be specified to include information regarding public institutions, access roads and graphics of the site described in the discussion of research question 5.

##### **Truck driver as on-site ambassador**

The experiences with this way of organizing truck drivers is limited and stated experiences with one site is too limited knowledge to make general conclusions. However, the drivers interviewed regarding this arrangement were positive, and reported that the safety information flow was sufficient, both with regards to receiving relevant safety information and reporting

safety concerns. Furthermore, participating in the making of truck related adjustments and implementations was reported as very positive by the driver in this position.

The arrangement might only be feasible with mass transport, due to the characteristics of these operations. With excavators loading the trucks, the process is most efficient if one truck arrive right after another has left the loading area, providing a continuous flow of transportation. Thus, mass transport is often characterized by several truck drivers operating on the site simultaneously, and drivers of the excavators organizing the truck drivers, goods specifications and depot destinations. With the drivers of excavators always calling the appointed ambassador, the risk of confusion regarding what drivers who make which deliveries might be minimized.

The direct contact between all truck drivers and the construction company management puts the ambassador in a unique position, with the possibility to distribute relevant safety information to other truck drivers and reporting safety concerns with a collective of drivers to support his claim. Furthermore, production on-site might be more efficient by the ambassador's possibility to order the closest driver to make pick-ups of goods that are to be transported to the site, compared to the driver of the excavator ordering deliveries by truck drivers leaving the site, which might make the measure more attractive to construction companies.

This way to organize drivers might also be feasible in other kinds of transportation, dependent on the site. The important factors are the large generation of trips with continuous truck-traffic and the dynamic change in safety challenges and procedures, generating a need for updated safety information. However, the participation of a truck driver in the operational meetings, providing insight from a truck drivers point of view might be utilized independent of the truck-trips generated at the site. The truck driver's perception of truck safety regarding maneuvers, visibility, road quality etc. exceeds the insight of others without experience as a truck driver, independent of which goods the truck driver usually transports.

However, this might be a costly measure, and as stated by both the construction company manager and project owner, no construction company would include this in the costs when making offers on a new project, and risk losing the competition. The construction company manager stated that this need be included in the requirements given by the project owner, and the project owner further stated that it need be included in the requirements set for the project owner, when describing and planning new projects. Based on these statements, the economic perspective seems to be paramount in any project.

Every project owner and construction company want to avoid accidents. However, it is impossible to plan construction site-related operation in a way that no accidents occur. Thus, someone needs to define what level of safety, or what safety requirements that are sufficient. The laws and regulations are the basis of the existing definitions regarding the minimum of what safety requirements every project owner needs to include. Thus, if net present value is the basis when considering additional safety measures, the project owner need be convinced that the additional safety measure is likely to reduce accidents and/or increase efficiency, providing saved costs exceeding the costs of the safety measure in question. However, if there are no empirics indicating such an economic benefit, it is unlikely that such a measure is utilized by project owners. Thus, there probably needs to be made a change in laws and regulations if such a way of organizing drivers is going to be utilized more generally.

## 6. Conclusion

The objective of this research was:

*“To understand how information is communicated with regards to safety in urban construction site deliveries, and identify potential ways to improve the information flow to increase safety”*

Based on the data collected in this research, the most critical links in the safety information flow were identified. These are links between sub-contractors and transport managers, and transport managers and truck drivers. Furthermore, a discrepancy was found between the safety information that the project owner expects the drivers to be provided with, and the safety information truck drivers normally receive prior to delivery at urban construction sites.

To improve the safety information flow, a general safety management system of construction site truck-traffic, supported by law or regulations, is suggested. The requirements for such a management system should include:

1. Specific risk assessments of truck-operations on-site and evaluation of access roads conducted by the project owner at every construction site. The construction company and project owner should have a shared responsibility to make sure that these assessments are updated when new operations induce unexpected truck-related risks.
2. Based on the risk assessments, truck-related safety procedures should be prepared by the project owner in a written format and complemented by indications on a map of the construction site.
3. All orders of goods to construction sites should be followed by these written procedures and the map of the construction site which the transport managers are responsible to convey to the driver carrying out the delivery.
4. Drivers delivering to construction sites should be required to make themselves familiar with the procedures prior to carrying out the delivery.

With support in law or regulations, everyone included in the safety management system should have a legal claim to stop on-site operations if risk assessments or procedures are not conveyed in accordance with the requirements. If transport managers feel that safety procedures on-site are not sufficient based on the truck-related risks, they should have a legal claim to demand an update on the risk assessment. Furthermore, if the provided safety information is insufficient, based on the safety management system, the transport manager should have a legal claim to demand sufficient safety information prior to delivery. The truck drivers should have the same legal claims towards their managers. Construction company management should also have a legal claim to refuse truck drivers access if they are not familiar with the site-specific truck-related safety procedures. Thus, both the consistency and quality of truck-related safety information should be improved in the critical links.

Regarding the general safety information, both the mandatory continuing educational course for professional drivers and the mandatory course on dangerous goods (ADR) should be reviewed regarding content, quality and attractiveness.

The findings indicate that even though stakeholders express content with the status quo, there are frequent and severe safety challenges that could be improved by increased quality and consistency in the safety information flow.

## 7. Further research

With current economic development, more construction sites are to be expected together with increased truck deliveries in urban areas. At the same time, the share of vulnerable users is likely to increase in the cities, with bikes, elderly and children, so it is vital to ensure the safest traffic as possible.

In further research, the suggested safety management system's effects on the safety information flow at urban construction sites could be tested. The stakeholders' opinions and experiences are important aspects of the continued improvement of the system, balancing the relation between the theoretical approach and the practical execution of construction site deliveries.

There is a discrepancy between the safety information that the project owner expects the drivers to be provided with, and the safety information truck drivers normally receive prior to delivery at urban construction sites. With further research, insight into the dynamics of safety information flow between construction company with general contract, sub-contractors and transport companies should be gained through more data collection. Especially limitations and possibilities with the safety management system in deliveries through suppliers that order transportation to construction sites should be identified.

The feasibility of the concept of truck drivers as on-site ambassadors should be looked into, both regarding the size of construction sites and transportation of different goods. The participation of a truck driver in operational meetings with the risk assessments and evaluation of safety measures might prove to be a more feasible part of the concept than the on-site organization of drivers and safety information. However, variants of the concept that could provide more consistency in the safety information flow between construction companies and truck drivers should be evaluated.

Further research regarding the content, quality and attractiveness of the mandatory continuing educational course for professional drivers and the mandatory course on dangerous goods (ADR) could identify possible improvements. There is possibly a large variation in both content and approach between different course holders. Truck drivers could also be interviewed more specifically regarding what content and approaches that gains their interest and motivation. The possibility to order specific modules relevant to the respective drivers work situation could also be investigated.

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## Appendix

- *Appendix ( I ) Interview guides*
  - Professional drivers (English)
  - Professional drivers (Norwegian)
  - Transport company management (English)
  - Transport company management (Norwegian)
  - Construction company manager (English)
  - Construction company manager (Norwegian)
  - Project owner (English)
  - Project owner (Norwegian)

## Appendix ( I ) Interview guides

### Professional drivers (English)

1. How long have you been working as a truck driver?  
(1-5, 6-10,10-20,20-)
2. Approximately how many drivers are employed in your company?
3. Approximately how many times a week do you deliver goods to construction sites?
4. Do you often deliver to the same construction sites?
5. When you deliver to a site, what kind of information do you get regarding safety inside and outside of the site?
6. Who delivers this information to you, and how?
7. Could you tell me a little bit about your company's internal rules regarding safety?
8. Does your company arrange campaigns, seminars etc. regarding safety?
9. If you experience a dangerous situation, caused by the layout of the site, how do you report it?
10. What kind of situations would you likely report?
11. At the end, is there something that you would like to add?

### Professional drivers (Norwegian)

1. Hvor lenge har du arbeidet som lastebilsjåfør?  
(1-5, 6-10,10-20,20-)
2. Omtrent hvor mange ansatte sjåførere er det i ditt firma?
3. Omtrent hvor mange ganger i uka leverer du gods til anleggsområder?
4. Er det mange av de samme anleggene?
5. Når du leverer til et anleggsområde, hvilken sikkerhetsinformasjon mottar du om anleggsområdet og områdene rundt?
6. Hvem leverer denne informasjonen, og hvordan?
7. Kan du fortelle meg litt om deres interne regler for sikkerhet?
8. Arrangeres det kampanjer, seminarer eller lignende for sikkerhet i bedriften?
9. Hvis ikke, er det noe du kunne tenke deg å delta på om du fikk muligheten?
10. Hvis du opplever en farlig situasjon, forårsaket av anleggets utforming, hvordan er systemet for å rapportere det?
11. Har du opplevd noen slike situasjoner?
12. Hvilke situasjoner vil du si det er sannsynlig for deg å rapportere, og hvem ville du rapportert til?
13. Vi er på slutten nå, er det noe annet du tenker på som du vil legge til?



### **Transport company management (English)**

1. What is your position and responsibility in this firm?
2. How long have you been employed in this company?  
(1-5, 6-10, 10-20, 20-)
3. How many drivers are employed in this firm?
4. Does your company have internal rules regarding safety?
5. How are these rules enforced?
6. Does your company arrange campaigns, seminars etc. regarding safety?
7. How many goods deliveries do you have to construction sites?
8. Does your company often deliver to the same sites?
9. When you have deliveries to a construction site, does the entrepreneur provide safety information regarding protocols at the site or challenging areas/traffic situations?
10. Is the information regarding the safety inside or outside of the site?
11. What are the routines regarding distributing this information to the drivers?
12. Have you experienced drivers reporting dangerous situations regarding the layout of construction sites?
13. Are there safety situations that seems to be more challenging or more frequent than others?
14. In your opinion, is there anything that that should be done differently regarding safety?
15. At the end now, is there anything you would like to add?

### **Transport company management (Norwegian)**

1. Kan du begynne med å beskrive din stilling og ansvarsområder?
2. Omtrent hvor lenge har du vært ansatt i dette firmaet?  
(1-5, 6-10, 10-20, 20-)
3. Omtrent mange sjåfører er ansatt i dette firmaet (i uka)?
4. Leverer dere mye gods til anleggsområder?
5. Er det mange av de samme anleggene, og kjører de samme sjåførene dit?
6. Når dere skal levere gods til et anlegg, får dere informasjon fra entreprenøren vedrørende sikkerhetsrutiner eller -utfordringer?
7. Er det oftest sikkerhetsinformasjon vedrørende det som skjer innenfor eller utenfor anleggsområdet? (SHA/YM)
8. Hvordan formidles typisk denne informasjonen til sjåførene?
9. Har dere erfart at sjåførene rapporterer farlige situasjoner vedrørende utformingen på et anlegg?
10. Er det noen situasjoner/type anlegg/løsninger som skiller seg ut med tanke på å være ekstra utfordrende eller virker å oppstå hyppig?
11. Har dere interne regler for sikkerhet som gjelder sjåførene?
12. Har dere arrangert seminarer, kampanjer eller lignende vedrørende sikkerhet?
13. Arranger dere det ofte?
14. Er det noe du syns burde gjøres på en annen/bedre måte med tanke på sikkerhet?
15. Vi er på slutten nå, er det noe du har lyst til å legge til?

### **Construction company manager (English)**

1. What is your position and responsibility in this firm?
2. How long have you been employed in this company?  
(1-5, 6-10,10-20,20-)
3. Approximately, how many drivers are delivering at this construction site an average day?
4. What kind of safety plans/procedures do you make regarding transportation to/from construction sites?
5. When ordering transportation of goods/masses, what kind of safety information is distributed to truck drivers and their managers?
6. Is the information regarding the safety inside or outside of the site?
7. What are the routines regarding distributing this information to the drivers and their managers?
8. Have you experienced drivers reporting dangerous situations regarding the layout of construction sites?
9. Are there safety situations that seems to be more challenging or more frequent than others?
10. After interviewing several truck drivers, an overview map of the site seems to be what most of them want. With this I mean a construction site drawing showing accessibility and where to load/unload. What do you think about this?
11. Another experienced and wanted solution was the participation of drivers in planning the site and one driver working as a contact towards the rest of the drivers in the executive phase. One of the interviewed drivers had experienced being this contact, participating in weekly meetings and having a daily contact with the man in charge of the site, bringing this information to the other drivers.
12. At the end now, is there anything you would like to add?

### **Construction company manager (Norwegian)**

1. Kan du begynne med å beskrive din stilling og ansvarsområder?
2. Omtrent hvor lenge har du vært ansatt i dette firmaet?  
(1-5, 6-10, 10-20, 20-)
3. Omtrent hvor mange sjåførere er innom dette anlegget i løpet av en dag?
4. Hvilke sikkerhetsplaner/prosedyrer lager dere vanligvis for transport til og fra anlegg?
5. Når dere bestiller transport av gods eller masser, hvilken sikkerhetsinformasjon gir dere til sjåførene og deres ledere?
6. Er det oftest sikkerhetsinformasjon vedrørende det som skjer innenfor eller utenfor anleggsområdet? (SHA/YM)
7. Hvordan formidles denne informasjonen?
8. Har dere erfart at sjåførene eller deres ledelse rapporterte farlige situasjoner vedrørende utformingen på anlegget?
9. Er det noen situasjoner/type anlegg/løsninger som skiller seg ut med tanke på å virke ekstra utfordrende for sjåfører av tunge kjøretøy?
10. Etter å ha intervjuet flere anleggssjåførere virker det som et oversiktskart er informasjon de fleste sjåførere finner hjelpsomt når de skal levere. Med dette menes en anleggstegning hvor det er markert tilkomst til anlegget og hvor lasten skal losses/lastes. Hva tenker du om det?
11. Et annet erfaringsbaser ønske fra sjåførene er inkludering i planleggings og driftsfase hvor én sjåfør er kontaktperson for alle sjåførene. En av de intervjuede sjåførene hadde selv erfart å være en del av den ukentlige gjennomgangen og å ha daglig kontakt med bas hvor han får oppdatering og videreformidler informasjon til de andre sjåførene på anlegget. For større anlegg – er dette noe dere føler er aktuelt?
12. Vi er på slutten nå, er det noe du har lyst til å legge til?

### **Project owner (English)**

1. What is your position and responsibility on this site?
2. How long have you been employed in this company?  
(1-5, 6-10,10-20,20-)
3. Approximately, how many drivers are delivering at this construction site an average day?
4. What kind of safety plans/procedures do you make regarding transportation to/from construction sites?
5. Is the information regarding the safety inside or outside of the site?
6. How is this information distributed to the construction company?
7. Do you usually make plans for how this information is distributed to the drivers?
8. Are there safety situations that seems to be more challenging or more frequent than others?
9. After interviewing several truck drivers, an overview map of the site seems to be what most of them want. With this I mean a construction site drawing showing accessibility and where to load/unload. What do you think about this?
10. Another experienced and wanted solution was the participation of drivers in planning the site and one driver working as a contact towards the rest of the drivers in the executive phase. One of the interviewed drivers had experienced being this contact, participating in weekly meetings and having a daily contact with the man in charge of the site, bringing this information to the other drivers.
11. At the end now, is there anything you would like to add?

### **Project owner (Norwegian)**

1. Kan du begynne med å beskrive din stilling og ansvarsområder på dette anlegget?
2. Omtrent hvor lenge har du vært ansatt i dette firmaet?  
(1-5, 6-10,10-20,20-)
3. Omtrent hvor mange sjåførere er innom dette anlegget i løpet av en dag?
4. Hvilke sikkerhetsplaner/prosedyrer lager dere vanligvis for transport til og fra anlegg?
5. Er det oftest sikkerhetsinformasjon vedrørende det som skjer innenfor eller utenfor anleggsområdet? (SHA/YM)
6. Hvordan formidles denne informasjonen til entreprenører?
7. Legger dere planer for hvordan informasjonen skal videreformidles til sjåførene?
8. Er det noen situasjoner/type anlegg/løsninger som etter din erfaring skiller seg ut med tanke på å virke ekstra utfordrende for sjåførere av tunge kjøretøy?
9. Etter å ha intervjuet flere anleggssjåførere virker det som et oversiktskart er informasjon de fleste sjåførere finner hjelpsomt når de skal levere. Med dette menes en anleggstegning hvor det er markert tilkomst til anlegget og hvor lasten skal losses/lastes. Hva tenker du om det?
10. Et annet erfaringsbaser ønske fra sjåførene er inkludering i planleggings og driftsfase hvor én sjåfør er kontaktperson for alle sjåførene. En av de intervjuede sjåførene hadde selv erfart å være en del av den ukentlige gjennomgangen og å ha daglig kontakt med bas hvor han får oppdatering og videreformidler informasjon til de andre sjåførene på anlegget. For større anlegg – er dette noe dere føler er aktuelt?
11. Vi er på slutten nå, er det noe du har lyst til å legge til?