Memo

Managing transport safety in the context of global competition: Description of transportation sectors

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The project "Managing transport safety in the context of global competition" addresses the following main problem: *How can companies and regulators work to create good framework conditions (environmental conditions) in the context of global competition?* This memo is the second part of a literature study conducted at the outset of the project. The memo describes the state of the art of research on internationalisation related to transport safety related to each transportation sector (road, railways, sea and aviation). It is concluded by comparisons across sectors of (1) roles and actors and (2) system characteristics.

The first part of the literature study is a separate memo providing conceptual and theoretical tools that will be used in the empirical studies.

The study is carried out in collaboration between SINTEF Technology and Society and NTNU Social Research.

Contents

1 Introduction

Over the last decades, all four branches of the transport sector in Norway (air, sea, road and rail) have undergone massive changes. As transport patterns, value chains and labour markets have become global, competition has become increasingly fierce. This has led to restructuring of the sector, with a strong emphasis on cost-cutting and finding new models of organization based on outsourcing and specialization.

The project "Managing transport safety in the context of global competition" addresses the following main problem: *How can companies and regulators work to create good framework conditions for safety in the context of global competition?* "Framework conditions" are the conditions that influence the opportunities different actors have to control risk. Internationalization is in itself a framework condition, but will also be a key driver influencing other framework conditions for safety. We focus on how the various stakeholders of transport safety contribute to transport safety, by adapting to framework conditions, by creating good framework conditions for safety for actors further down the chain, or by using their influence to improve the framework conditions that are produced higher up in the chain.

The purpose of this memo is to describe the state-of-the-art of research on the topic. The memo is divided in two parts, with the first part providing theoretical resources for the project, and this second part of the memo describing the status within each transportation sector. The research issues and conceptual framework for the study are presented in the first part of the memo.

The presentation of each sector comprises the following topics:

- Organisation of the sector, described with reference to the model of roles and actors in Chapter 6 of the first part of this memo.
- National and international regulation of transport safety.
- System characteristics of the sector.
- Impact of internationalisation and global competition in the sector.
- Implications of internationalisation on transport safety in the sector.

The memo is concluded by comparisons across sectors of (1) roles and actors and (2) system characteristics.

2 The maritime sector

2.1 Organization of the maritime sector

The maritime sector includes a diversity of actors; crews, shipowners, national and transnational authorities, coastal administrations, governmental ministries, flag states, insurance companies, classification companies, etc. These and other actors constitute what we may call the maritime system (Ek & Akselsson, 2005). The quality of the coordination and interaction between these actors is significant for the safety in the industry (Rasmussen, 1997). Important actors placed in the framework to be used in this project (Foss, 2015) are illustrated below.

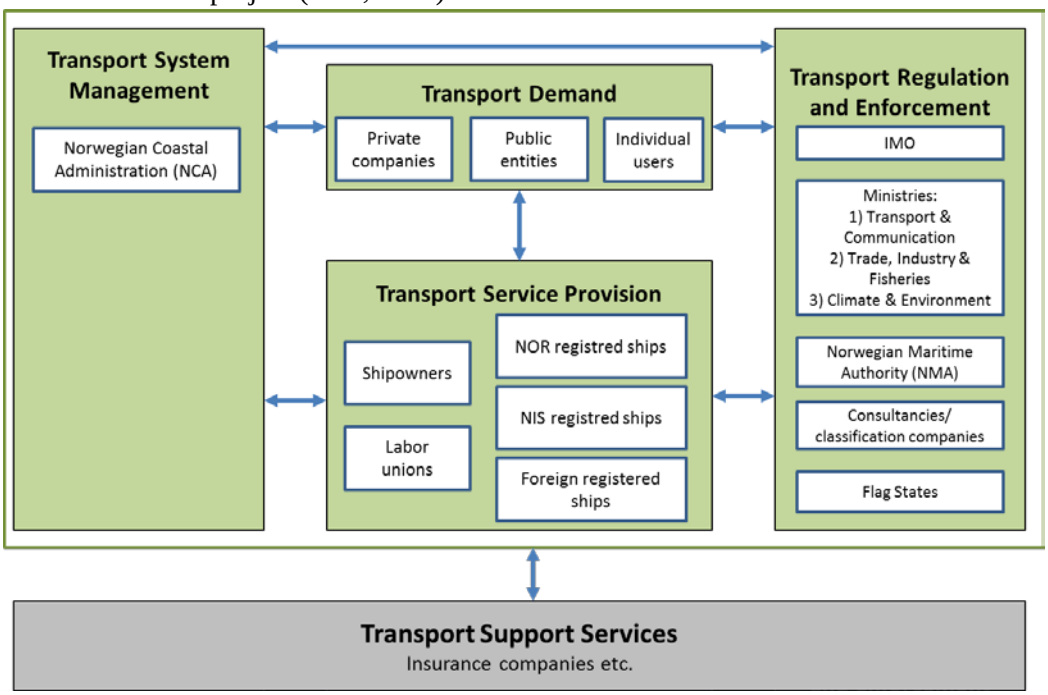

Figure 1: Central actors in the Norwegian maritime sector

The following section presents the roles of the most important actors.

Transport System Management
The Norwegian Coastal Administration (NCA) is the national agency for coastal management, maritime safety and maritime communication, organized under the Ministry of Transport and Communication. The NCA's main task is to ensure safe and effective navigation in the fairways along the coast and into ports. Their responsibility involves development and maintenance of fairways and fishing ports, navigational aids services, vessel traffic services, national preparedness against acute pollution, and port facility security. The NCA is also responsible for emergency preparedness related to acute environmental pollution situations (NCA, 2014).

Transport demand
A wide range of private companies are in demand of maritime transport services, and it is a governmental goal to shifting more freight from road to sea (Meld. St. 26, 2012-2023). Private actors include land-based industry companies, fish farming companies, petroleum companies, and others. In addition, public entities such as counties and the Directorate for Public Roads are responsible for the provision of passenger and car transportation, involving ferries and high-speed crafts. Individual users include passengers on such vessels.

Transport Service provision
For Norway, maritime transportation has been very important for economic and employment reasons. Norwegian cargo ships have operated internationally for hundreds of years, and due to our long coastal line, maritime transportation has historically had an exceptional position domestically compared to other forms of transportation. The Norwegian Shipowners' Association (NSA) had 143 members in 2015, involving 1 774 ships, including passenger ships, different tankers, cargo ships and offshore service vessels (NSA, 2015). Also, the Cargo Vessel Shipowner Association ("Fraktefartøyenes Rederiforening") includes 260 ships. Organizations for Norwegian seamen include Norwegian Seafarers' Union ("Sjømannsforbundet") and also the Common Union for Sailors ("Fellesforbundet for Sjøfolk")

Seen from a Norwegian perspective, the competition from foreign ship owners has increased in recent years, also domestically. Although shipping has always been a global industry, this development is supported by international agreements like the EEA, establishing Europe as one market, allowing the freedom of movement of goods, persons, services and capital. Domestically, this has resulted in a less portion of the cargo transported by Norwegian operated ships (NOR-registered) and more by ships sailing under "flags of convenience" (Kvinge & Ødegård, 2010). Ship owners are highly motivated for cost reductions and to retain their competitiveness. Norwegian authorities have tried to restrain the tendency for ship owners to flag out by establishing an international ship register (NIS), allowing for foreign crews on Norwegian ships.

The liberalisation of maritime transportation has led to more foreign ships and crew members operating in Norwegian waters, especially from Russia, the Baltic countries and from the Philippines. An open question is whether this development has any consequences for the maritime safety in Norwegian waters. From the Maritime directorate's accident database, we see that the proportion of groundings involving foreign vessels has increased in recent years, but it is not known whether this is due to increased foreign maritime traffic or if foreign ships involve a higher risk for groundings.

Still, a study by Bye et al. (2011) illustrates the differences in working conditions between Norwegian and foreign crews operating in Norwegian waters. Foreign crews have longer working periods (up to 6 months) and report more fatigue-related problems, work pressure and worry relating to safety. Bye et al. conclude that the working conditions for foreign crews also should be taken into consideration when differences in safety results are explained, in addition to cultural explanations.

Transport regulation and enforcement
The increasingly global nature of the maritime industry has limited the influence that single states can exert, making international agreements important to regulate maritime transportation. As a response to this, *the International Maritime Organization (IMO)* was established in 1958 as a United Nations (UN) agency, with responsibility for the safety and security of shipping and prevention of pollution by ships. It now includes 170 member states. In IMO, a number of treaties and regulations have been carved out and ratified by the member states throughout the years. These are to be implemented by the member states (IMO, 2015).

The Norwegian Maritime Authority (NMA) is an administrative agency under two ministries, (1) the Ministry of Trade, Industry and Fisheries and (2) the Ministry of Climate and Environment. Safety is a primary concern for the NMA, made evident in its main goal (NMA 2012): 'The main goal is for Norway to be an attractive flag state with high standards of safety at sea for crew, vessels and the marine environment.' The NMAs main goal builds on international conventions, in particular, SOLAS ('International Convention for the Safety of Life at Sea'). The SOLAS Convention specifies the minimum standards for construction, equipment and operation of ships (Celik, 2009) and also MARPOL ('International Convention for the Prevention of Pollution from Ships'). The strategies used by the NMA to achieve high standards of safety involve traditional inspections of vessels and the seafarers' working and living conditions, and also measures to improve safety attitudes, motivation

and behaviour. Also, the NMD is to ensure that all foreign ships entering Norwegian waters comply with international rules and regulations. Also, the NMA develop regulations in cooperation with other nations, in particular through the IMO.

In Norway, the Ministry of Trade, Industry and Fisheries has delegated some of the inspection activities to *classification companies/consultancies*, operating on the behalf of Norway as a flag state. The basis for the inspections is national regulations, ratified international regulations and their own classification requirements. The delegation is most extensive for NIS registered ships. The NMA conducts the inspections on NOR registered ships, except for inspection of the hull, machinery, and load line (NOU, 2008:8). Almklov et al. (2014) have discussed how international standards and their agents, including classification companies, may displace the sailors' local and context-specific knowledge, and how such agents disempower 'sharp end' actors.

A ship's flag state is the national state where the ship is registered. The port state is the national state to which ships arrive at its harbours while the coastal state is the state that ships pass on their voyage (Ptil, 2006). Flag states vary regarding taxes, and also laws and regulations for safety and environmental standards and the enforcement of such standards. Ship-owners can register ships in flag states that involve lower costs. Paris MOU on Port state control is an organisation consisting of 27 national maritime administrations that aim at preventing sub-standard ship operations. Information regarding inspections is shared among the members, and each year flag states are classified regarding how they meet international standards. The "White List" represents quality flags with a consistently low detention record, "Grey list" flags have an average performance while the "Black List" involves flags with a high detention rate (www.parismou.org).

2.2 System characteristics of the maritime sector

When discussing similarities and differences between transport sectors and how these are affected by internationalization, one needs to consider some technical and organizational characteristics that are specific to the individual sector. Without reverting to technological determinism, considerations such as the fact that trains need tracks and ships don't, have consequences both for policy, regulation, market developments and safety management.
In most waters there are few restrictions as to where ships are allowed to sail. Moreover, they are usually not guided in pre-determined paths and monitored like airplanes. In some near-coast areas, areas with high traffic density or near harbors there may be some restrictions and governance of traffic, but as a general rule the captain has considerable autonomy regarding how and where to operate the ship. In contrast to road and rail and partly air traffic, ships aren't that much affected by other ships or by specific infrastructures.

Varied transportation
Transport of goods and people by sea is an ancient form of transport. It has also been international for centuries. It is still a dominating transport form for long hauls large quantities of goods, bulk products and fluids. Faster and cheaper air travel and land transportation (cars and trains) of people in particular and of smaller quantities of goods, have made sea transport less important for some transport services, and exposed to an multi-modal market. The competition against other transport forms is therefore important for some types of transport. This is relevant for the project, since internationalization in one industry can also influence other industries (e.g. how cheaper transport of goods by road can change framework conditions for sea transport)
Some of the most important maritime transport niches (in Norway) are:

- Passenger transport: short distances, cruises, and ferries and high speed crafts.
- International hauls of large cargo, containers, oil/gas, bulk.
- Coast transport competing with trailers and in some cases rail.

More infrastructure independency

In contrast to cars- that are restricted to roads, trains – restricted to railways, ships operate freely. They depend on maps and external navigation aids as well as suitable ports. Ships are fully capable to operate without external assistance in most cases. In areas with high density high traffic density or near ports, services like Vessel Traffic Systems (VTS) are more important. Improvements in ICTs have also made the ship less autonomous, having a closer involvement with onshore offices with regards to choice of route, fuel use etc.
Compared to other transport forms, ships can choose routes with larger degrees of freedom. This means, for example that they have the possibility to cross national boundaries and move to new areas of operation with relative ease. Moreover it means that shipping only to a limited extent is restricted by other ships (in ports or in very trafficked waters).

The 24 Hour society
While some vessels, like ferries and high-speed crafts, are typically manned by staff that live nearby, work short shifts and go on and off the boat between shifts, the maritime transport typically consists of ships on which crews live, work and sleep for more extended periods of time. When the crew live onboard a ship, it makes it less dependent on location, national regulation etc. This difference may contribute to explaining how some parts of the maritime industry are less exposed to internationalization than others.

Lesser standardization
While the safety management systems must adhere to the ISM code, and there are standards in terms of communication and some technical systems, shipping is, compared to the other sectors discussed in this project to a lesser degree standardized. There is a wide technical diversity (different ship types, but also variation within types[1]) and also variation in operational procedures and competence. Individual ships, even within the same type, have their own capabilities and quirks that necessitate a crew with a certain level of experience with this specific ship. Also for parts that could be standardized, like the main controls, there is wide diversity. For example bridge design is notoriously diversified, something that is quite problematic for ship simulators in contrast to flight simulators. This has relevance for internationalization, as it makes it somewhat harder to commoditize work, and make the crews interchangeable. There is an added value of having the same crew over time.

Couplings and complexity
Perrow (1984) used the notions of loose and tight coupling and linear and complex interaction to in his discussion of normal accidents. He places Marine transport as a system with rather tight couplings and slightly below middle in the diagram below. This, however, is based on a specific level of analysis. Onboard a ship, a tightly knit society with several technical systems on a confined space, the couplings are tight. One event may spread to larger parts of the system. If we regard shipping as a transport system, we will argue that the couplings are looser than other transport systems. Ships don't influence other ships as trains do trains, cars do cars, and (to some extent) planes may influence plane traffic.

1

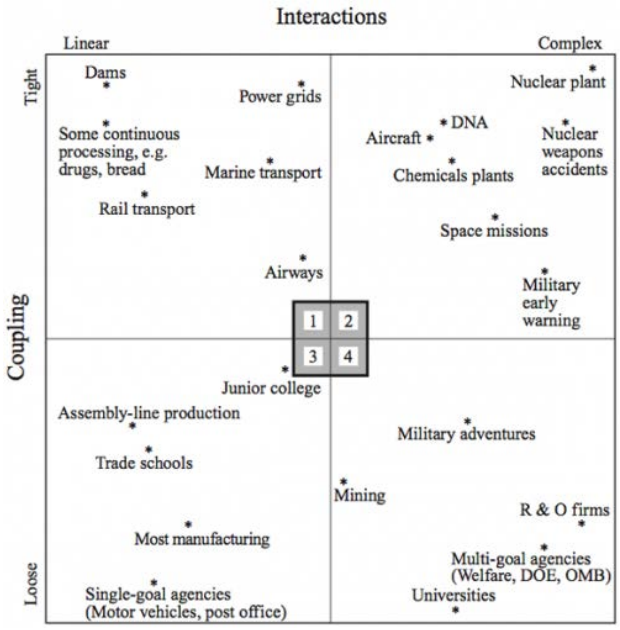

Figure 2 Couplings and complexity. From Perrow (1984)

2.3 Impact of internationalization and global competition in the maritime industry

Flag, crew and class hopping

The maritime industry has been international for centuries, and many shipowners now compete in the global market. We have also seen that periods of economic recessions have increased the global competition in the industry. This section discusses the maritime industry and the more recent developments.

In the mid-20th century, two major transitions occurred in the shipping industry: the improvement of technology and the shift from traditional maritime countries to foreign flags (Couper 2000). As ships became larger, specialized, technologically improved, and the need for a large number of crew members was reduced. Furthermore, the recession and increased oil price in the 1970s forced ship owners to look into different ways to reduce their costs (Sampson 2013). One such advantage was registering their vessels under a different flag. Different flag states require varying amounts of corporate tax; the smaller the tax the flag state requires, the bigger the ship owner's competitive advantage becomes. These Flags of Convenience (FOCs) are mostly small countries, offering their flags to ship owners as a way to increase their earnings through ship registration fees at almost no cost (Goss 1994). The FOCs allowed ship owners to place each vessel under a different company "creating a corporate veil over the owners" and "protecting the vessels from cross-liabilities" (Couper, 2000:3). Due to the lure of economic benefits provided by these open registries, shipping companies increasingly "flagged out" to FOCs. In addition to lower taxes, the FOCs were lenient in terms of nationality requirements of the crewmembers on board. As a result, "flagging out" encouraged "crewing out" (Couper 2000, Sampson 2013). This development made it possible for ships to be registered under one flag state and employ the cheapest labour supply elsewhere. Seafarers from countries in Asia and Eastern Europe with limited opportunities for work in their own country, were hired through agencies on the basis of temporary contracts (Progoulaki and Roe 2011, Sampson 2013).

Many flag States established second registers to protect their maritime industry from further capital flight and job losses (Sampson 2013). These countries are more flexible regarding required minimum

seafarers on board a particular ship and salaries are often negotiated with the countries the seafarers come from (see Selkou and Roe 2004; Winchester et al. 2006). Fearing that local shipping companies would flag out, national registers followed suit and became more relaxed regarding the requirement on nationality (Sampson 2013). As the shipping industry is a naturally mobile sector, the pick-and-choose process can occur several times. The result is fierce international competition and a global labour market with vulnerable labour institutions (Sampson 2013, Oxford Economics 2014).

In a study of 507 vessels in Cadiz port, it was found that crews are not only selected for economic reasons, but also due to working hours and conditions on board (Silos, Piniella et al. 2012). According to Silos et al. (2012), crew costs depend on two factors: The first one depends on the flag of the vessel and the requirements of the flag state such as minimum number of crew members, crew salaries, and required conditions on board. For example, crew costs may be doubled if the vessel is registered under the European flag instead of being registered under the FOCs (Stopford, 2009 in Berg, Storgård and Lappalainen, 2013). The second factor is the crew itself where nationality plays a major role in influencing crew costs. Crew members coming from a country where poor working conditions and wages are commonplace are more likely to accept lower standards than those coming from more economically prosperous countries (Silos, Piniella et al. 2012). As the number of potential seafarers overweighs the amount of demand, employment agencies may take advantage of the seafarers by applying a high percentage of salary deduction, costs obligatory examination or exclusion of persons exceeding a set maximum age (ibid). Another challenge related to the use of crewing agencies is that some of the seafarers may come from so-called "paper mill educators" that provide seafarers with certificates without providing them proper training (Berg, Storgård et al. 2013). Yet another issue is the risk of using crew members with purchased falsified certificates(Berg, Storgård et al. 2013).

The rules that apply to a specific crew depend on the regulation of the flag state they are registered under. Thus, there is a diversity of labor norms where some may deviate from the international standard (Jiménez 2014). Contract workers may be offered a working period of 5-8 months and then terminated afterwards or they may be transferred to another vessel that could be registered under a different flag (ibid.). In some cases, seafarers are even denied medical care or do not receive compensation from accidents incurred at work. Couper also points out that taking action against ship owners may render seafarers jobless in the future as they may become blacklisted and their names distributed to several international employment agencies (Couper, 2000:5). He also revealed that some ship owners go to the extent of stipulating the prohibition of contacting trade unions as well as providing two contracts where one is for "show" and the other stating the actual (lower) salary (*ibid.*). When business goes bad, the ship owner may decide to abandon their ships and crews. Abandoned seafarers may be left without any wage for the voyage. If they seek help from the country of abandonment, the judicial authority may renounce responsibility and declare that the flag State, country of the recruiting agency, the mortgagee of the vessel, or the beneficial owner is responsible (Couper 2000).

Aside from the risk of being abandoned by the vessel and not being provided with a means of coming back to their country of origin, several other challenges in the maritime global labor market have been identified[2]. Seafarers may be forced to perform the task of cargo handling, a risky activity and should, therefore, be performed by an individual with a specific type of training and experience. Also, due to heavy workloads, low crew numbers, long working hours or less time spent to recuperate due to faster turnarounds, seafarers are often at risk of fatigue. The evidence is growing that so-called "riding gangs" are increasingly being used. These are non-seafarers that are usually employed outside "collective agreements". They do not have certificates stating that they are medically fit to work onboard, and they usually do not have any training in emergency procedures. They are often hired to perform maintenance and repair, cleaning and painting, or cargo handling. They are sometimes even hired to perform seafarer duties and are considered a part of the minimum safe crewing levels. Not only are they in danger of being exploited, but also endangering seafarers due to lack of training.

[2] From itfseafarers.org

There is also concern among seafarers that there are some trade unions that are set up by the company to deter seafarers to join legitimate ones. Some countries also establish their trade unions called "yellow unions" that are either state sponsored or company sponsored and thus not genuinely protecting workers. Some countries, according to the site, have made trade unions illegal, such as in the United Arab Emirates. Finally, itfseafarers.org also mentioned that FOC vessels are themselves a risk to seafarers, having very high casualty numbers. Port State Controls (PSCs) have detained several aging and badly maintained FOC vessels which should never have been allowed to sail. These ships are often referred to as "floating coffins".

The globalized maritime labour market left competent but "more expensive" seafarers with no job. To counter the effects of the globalized labour market, the UK for instance provided aid to stimulate training of new local cadets. This initiative, however, did not result in the increase of employed UK officers as the ship owners still preferred to recruit cheaper cadets from other countries (Sampson 2013).

Maritime labour policies vary in different countries and reflect the country´s interest or focus (Sampson 2013). For example, the Philippines is a major supplier of seafarers and aims to promote the maritime labor force which is a major contributor to the country's remittance revenue. Low crewing costs aim to attract international employers (Lobrigo and Pawlik 2015:130). Due to this labor "production" strategy, the need for investing in necessary upgrades in the maritime education and training may be overlooked, which in turn leads to deficiencies in the quality of maritime education and training (Lobrigo and Pawlik 2015:130). Poland is another country that supplies the maritime labour market. The country´s approach to labour supply, however, is focused on a holistic approach regarding education and training. Despite this strategy, the country is facing challenges in promoting the maritime profession since there is a tendency for competent seafarers to shift to land-based employment that provides better labour conditions (Lobrigo and Pawlik 2015). To this day, there is no global policy regulating the maritime labour market (Lobrigo and Pawlik 2015). The variations in the maritime labour policies pose a risk for shipping companies who are inclined to cutting crewing costs at the expense of competence and safety (ibid.).

Brazil laid down strict maritime labor requirements to protect Brazilian seafarers. They require Brazilian seafarers on Brazilian-registered ships and ships with activities in their territorial waters (ibid.). The enactment of the Normative Resolution No. 72 of the National Immigration Council of the Ministry of Labor in Brazil requires a certain ratio of crew composition on foreign vessels operating in Brazilian waters (see table below) (Westshore 2014, Lobrigo and Pawlik 2015).

Table 1 Brazilian crew member requirements under Resolution #72

Number of days in operation in Brazilian waters	Number of crew members of Brazilian citizenship
90 – 180	1/3
180 - 360	1/2
More than 360	2/3

In addition to the crew composition requirement, foreign seafarers are required to obtain a work permit when they are employed on vessels under the Brazilian flag or on foreign vessels that are in Brazilian waters for a certain period (Lobrigo and Pawlik 2015). The restrictive policy does not prove to be beneficial for the commercial shipping operators in Brazil. However, the policy serves as a way for Brazilian seafarers to have a relatively high salary compared to foreign seafarers and encourages young individuals to pursue a maritime career. On the other hand, Brazil has only two maritime schools and cannot accommodate all the applicants, serving as a bottleneck for the increased supply of Brazilian seafarers. Lobrigo and Pawlik also point out that Brazilian labor protectionism, in this case, may prevent the growth of its maritime industry and hinder the country from reaping greater economic benefits (Lobrigo and Pawlik 2015).

Closer investigation as to whether or not there is paucity in the number of Brazilian officers in the labor market, the opposing camps laid out contending conclusions. On the one hand, the union of Navy officers (Sindmar) pointed out that a low number of officers is only temporary (it will soon develop into a surplus of officers). On the other hand, the union of offshore shipowners (Syndarma) and the universities concluded that there will be a deficit in the number of officers (Westshore 2014).

Governments have introduced maritime policies that include tonnage tax, reduction in seafarers´ income tax and social security contributions for European seafarers employed by an EU-registered ship to promote international competitiveness of the shipping industry in EU (Oxford Economics 2014, Lobrigo and Pawlik 2015). Among the EU shipping nations, Greece was the first to introduce the tonnage tax in 1957 (and adapted in 1975), followed by Cyprus and Malta. Although not a member state, Norway also introduced national tonnage tax in 1996 (ibid.). Other actions include launching of programs that aim to shift land transport to water transport and applying strategies to expand EU controlled fleet (Mitroussi 2008 in Lobrigo and Pawlik 2015).

Tonnage tax is a way of calculating taxable income by calculating it through the net tonnage or the carrying capacity of the ships in the shipowner´s fleet, without considering the actual earnings of the vessel and its operations[3,4]. The income that is taxable using this system is at a fixed rate and is substantially lower than the actual profit thus providing a competitive and "positive fiscal environment" for the shipping companies and inward investors (Maritime.UK). The choice in taxation through tonnage tax is usually binding for a 10-year period[5]. According to Maritime UK, other countries have also realized the benefits of implementing tax incentives to encourage shipping companies to register under their flag. Singapore, named as the most important shipping centre of the world, is expected to increase in its influence (Maritime UK).

[3] https://www.ukchamberofshipping.com/information/tonnage-tax/
[4] http://www.deutsche-flagge.de/en/financial-matters/tonnage-tax
[5] http://www.dma.dk/themes/jointheDanishmerchantfleet/Sider/Tonnagetaxandseafarerstaxation.aspx http://www.maritimeuk.org/wp-content/uploads/2012/08/Maritime-UK-tonnage-tax.pdf

2.4 Implications of internationalization on maritime safety

What is safety at sea?
In this study, the definition of safety adopts the description of safety at sea by Kopacz, Morgas et al. (2001:201). Safety may then be expressed as safety in terms of 1) the ships technological and operational safety, 2) safety of navigation, 3) safety of people, and 4) prevention of marine pollution from ships (see Kopacz, Morgas et al. 2001 for the specific elements each system contains). The figure below demonstrates the main components of the maritime safety system:

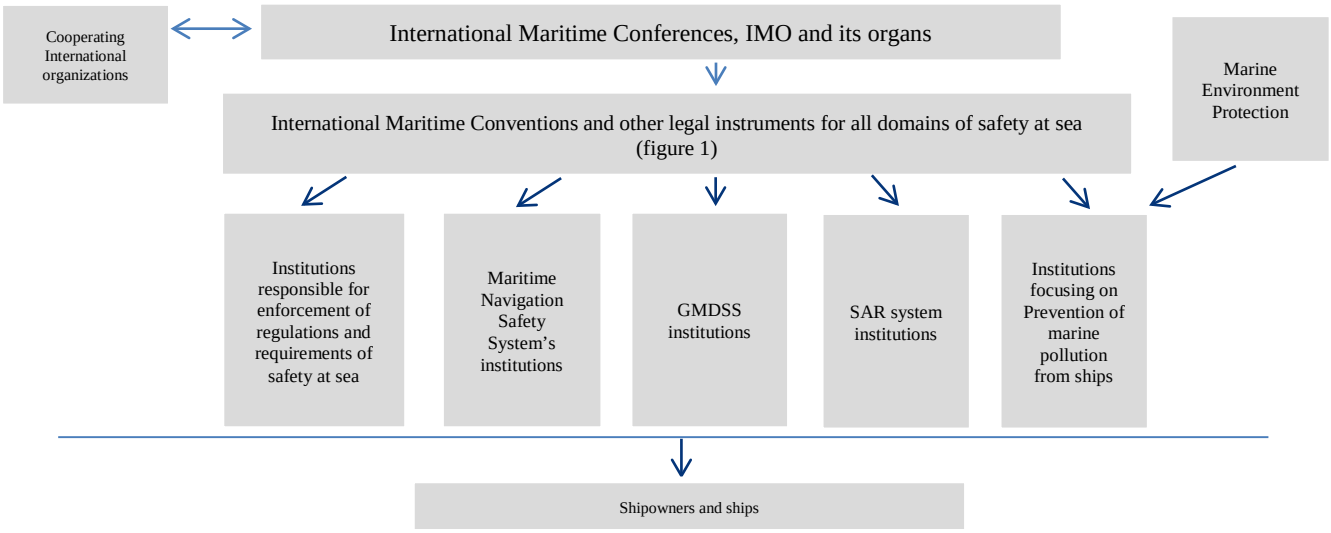

Figure 3 Main components of the maritime safety system (adapted from (Kopacz, Morgas et al. 2001:202))

The maritime safety system described by Kopacz, Morgas et al. (2001) shows that there are many actors involved in upholding safety at sea. The multitude of actors, as we shall see, may sometimes act as barriers to improving or implementing safety regulations and performance.

Several actors continuously shape international maritime safety regulations (Kuronen and Tapaninen 2010). As previously described, IMO is the international authority for maritime safety, security, and prevention of pollution from ships. The organization develops the regulatory framework together with other actors, to devise regulations and standards that the international maritime industry actors agree upon, adopt and implement (IMO 2015). Aside from IMO, safety regulation is also performed in the "supra-national, national, and regional levels" (Kuronen and Tapaninen 2010:49). According to Kuronen and Tapaninen (2010), safety regulation occurs as a "nested hierarchy" with the international level being the outermost circle while the inner circles are made up of the other levels. For regulation to be effective, the different circles should be consistent with each other (ibid.). Some safety issues may be regulated at a national or supra-national level before IMO regulates the same issue. Furthermore, they pointed out that other issues, such as piloting, concern national safety regulation. Classification societies and marine insurance companies may also be able to influence maritime safety despite not having legislative powers (ibid.) Kuronen and Tapaninen presented several regulators and their regulatory instruments (see Table 2).

Several accidents and major disasters such as the sinking of the RMS Titanic in 1912 resulted in efforts to improve the safety of maritime transport (Boisson 1999, Kuronen and Tapaninen 2010, Allianz Global Corporate & Specialty 2012). The most significant development after the Titanic was the first international conference on the safety of life at sea (SOLAS) in 1914, where an international agreement was drafted in London and signed by five states (Boisson 1999). The next SOLAS

convention was attended by 18 nations and resulted in the introduction of international regulations on ship construction, lifesaving and firefighting equipment, radio communications, aids to navigation and rules for preventing collisions(Boisson 1999, IMO 2015). Additional regulations from succeeding conventions encompassed a wider range of vessels, modernizing regulations, amendment procedures, and also recognition of the UN´s establishment of the IMO[6] (Boisson 1999, IMO 2015). Several international bodies and programs have since entered the maritime industry(Boisson 1999)(see IMO.org for a list of affiliated bodies and programs). The table below lists some of the most significant milestones since the establishment of IMO in 1948.

Table 2 Milestones in the Maritime Industry (AGCS 2012)

1965	RADAR was made mandatory (SOLAS 1960 convention)
1972	Established "rules of the road" for the shipping industry (COLREG)
1978	Training and certification requirements from the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STWC)
1993	IMP adopted the International Safety Management code (ISM code)
1999	GMDSS protocols for ships in distress and rescue scenarios. Mandatory distress communication equipment onboard.
2000	VDR or "black boxes" mandatory on new vessels
2004	Automatic Identification System (AIS) for vessel ID and tracking, reducing risk of collision.
2004	International Ship and Port Facility Security Code (ISPS Code)
2012	Electronic Chart Display and Information System (ECDIS) to become mandatory

International regulations relate to three areas of governance: ship building, ship maintenance, and ship operations in commercial shipping (Knudsen and Hassler 2011). These three areas have corresponding control and verification systems (ibid.). The flag states are responsible for the maintenance and construction of the vessels aside from the task of ensuring that the measures implemented abide by the IMO mandate. The Flag States normally delegate this task to classification societies. This arrangement becomes problematic when the performance of the classification society is poor. Some flag states don't man up to their responsibilities.

The port state control (PSC) acts as a ''safety net'' for instances that flag state implementation is not good enough (Knudsen and Hassler 2011:203). However, the port states have limits regarding capacity and thus only inspect a certain number of vessels (ibid). Knudsen and Hassler (2011) underline that although the IMO conventions have increased safety in shipping, may flag States and PSCs fail in their implementation. As a result, many vessels with critical inadequacies are allowed to set sail. They attribute implementation failure to IMO's feeble link to the national maritime authorities that continue to practice a wide range of facultative practices. The additional regulations may not solve this problem and may even have negative consequences on already existing regulations. Furthermore, additional rules due to external pressures may only add insult to injury.

The International Labour Organization

The International Labour Organization (ILO) is an agency under the United Nations focusing setting on international labor standards and promoting rights, work opportunities, and decent work conditions (ILO). ILO has 185 member states where each member state is represented by two government delegates, an employer delegate, a worker delegate and their advisers (ILO 2015). The ILO's Maritime Labour Convention (MLC, 2006), also known as "seafarer's bill of rights" is an international standard for the maritime industry (ILO 2013). The Convention promotes decent work conditions and fair competition among ship owners. According to the MLC, 2006, seafarers have the right to (ILO 2013):

[6] IMO was then known as IMCO or Inter-Governmental Maritime Consultative Organization

- a safe and secure workplace that complies with safety standards
- fair terms of employment
- decent working and living conditions onboard the ship
- health protection, medical care, welfare measures and other forms of social protection

The MLC came into force on August 20, 2013, for the first 30 countries registered and for other countries, 12 months after the ratification date (ILO 2013). The Convention instructs that commercial ships 500 gross tonnage or more need to follow certain requirements during international voyages. This includes carrying with them the Maritime Labour Certificate (MLC) and a Declaration of Maritime Labour Compliance (DMLC), that are subject to inspection upon entering ports of other countries that have ratified the Convention (ILO 2013). Although a ship may be under a flag of a country that has not ratified the MLC, they are still subject to inspection when it comes to working and living conditions upon port entry (ibid.). Working and living conditions include minimum age, seafarers' employment agreements, hours of work/rest, paid annual leave, repatriation at the end of contract, onboard medical care, use of licensed private recruitment and placement services, accommodation, food and catering, health and safety protection and accident prevention, and seafarers' complaint handling (ILO 2013). The Convention does not apply to ships that are entirely operating in inland waters, close to sheltered waters or where port regulations apply. Fishing ships, traditional build ships and warships/naval auxiliaries are also not within the scope of the MLC, 2006 (ILO 2013).

Both IMO and ILO are important international organizations in the maritime industry. Regulation of the maritime industry occurs in two ways: (1) the Port State Control (by officials from the Port the vessel arrives, and (2) the Flag State Control (the national ship register) (Sampson, Walters et al. 2014). International shipping may also be regulated at the regional level, such as the European Commission.

Policies are made in the different levels of jurisdiction (Roe 2008):

- International – IMO, OECD
- Supranational – European Union (EU), the North American Free Trade Agreement (NAFTA) and the Association of South East Asian Nations (ASEAN).
- National – Norway, Greece
- Regional – Attica and Devon
- Local – Piraeus and Plymouth

Port inspections

Port State Control (PSC) organizations are regionally organized inspections of ships flying under a foreign flag entering a national port. These inspections aim to verify that the ship conditions, equipment, and operations meet the requirements of international regulations (IMO). PSC inspections were established as a "safety net" due to concerns regarding effective flag State implementation of the IMO regulations (IMO).

The Paris Memorandum of Understanding (Paris MoU) is an organization consisting of 27 Maritime Authorities[7] carry out Port State Control (PSC) (parismou.org). Through their cooperation, they aim to remove sub-standards ships and ensure that ships are safe and meet security, environmental and living/working standards. The Paris MoU member ports perform onboard inspections of foreign ships yearly. The responsibility for compliance with international maritime conventions is placed upon the shipowner whereas the responsibility of ensuring compliance is accorded to the flag states. In 2014, of the number 18, 430 inspections, 10,214 inspections resulted in deficiencies (parismou.org). Of these inspections, Spain, the United Kingdom, and the Netherlands, had the highest number of inspections.

[7] The Paris MoU member states are: Belgium, Bulgaria, Canada, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Latvia, Lithuania, Malta, the Netherlands, Norway, Poland, Portugal, Romania, the Russian Federation, Slovenia, Spain, Sweden and the United Kingdom

The inspections in 2014 resulted in a total of 614 vessel detentions and 20 cases with refused access (banned). Norway port state inspections totaled 585 inspections in 2014. The Paris MoU's worldwide index for flag performance, "White, Grey and Black (WGB) List", list and classify countries. In the classification, the flags belonging to the "White List" have high-quality flags whereas the "Black List" entries are flags with poor performance. The "Grey List" contains the name of flag 'states with average performance (MoU 2014). Ships that are refused access from the Paris MoU region may be due to multiple detentions, inability to call repair shipyard indicated by the PSC or not following detention orders (MoU 2014). The flag states and their classification according to Paris MoU's WGB List (2014) are as follows (the countries mentioned according to rank number):

1) White List – France, Hong Kong China, Bahamas, Norway, Sweden, Isle of Man UK, Denmark United Kingdom, USA, Italy, Singapore, Marshall Islands, China, Greece, Germany, Finland, Liberia, Belgium, Netherlands, Bermuda UK, Malta, Cayman Islands UK, Gibraltar UK, Croatia, Cyprus, Faroe Islands DK, India, Iran, Saudi Arabia, Kazakhstan, Barbados, Turkey, Estonia, Japan, Antigua and Barbuda, Latvia, Russian Federation, Ireland, Panama, Switzerland, Luxembourg, and Republic of Korea.
2) Grey List – Portugal, Ukraine, Malaysia, Spain, Lithuania, Lebanon, Bulgaria, Poland, Libya, Thailand, Egypt, Tunisia, Curacao, Morocco, Vanuatu, Albania, Saint Kitts and Nevis, Algeria, and Tuvalu.
3) Black List – Sierra Leone, Cambodia, Saint Vincent and the Grenadines, Belize, Comoros, Dominica, Cook Islands, Togo, Republic of Moldova, and Tanzania.

Classification societies may act as Recognized Organizations (ROs) or flags. Among the top-ranked ROs were: DNV GL AS (DNVGL), Lloyd's Register (LR), American Bureau of Shipping (ABS), and China Classification Society (CCS). On the contrary, INCLAMAR, International Register of Shipping (IS), and the Bulgarian Register of Shipping (BRS) were among the lowest performing ROs (MoU 2014).

There are other organizations that have a memorandum of agreement between its members other than the Paris MoU. These include Tokyo MoU, US Coast Guard Port State Control, Indian Ocean MoU, Viña del Mar MoU and the Mediterranean MoU, Indian Ocean MoU, Riyadh MoU, Caribbean Port State Control MoU,

Although port states have the potential of uncovering crew conditions, they may lack the manpower to carry out inspections or perform controls at the expense of taxpayer money. Couper (2000) underlines that the only way for changing this situation is to grant a state flag the right to register ships under them only when they have the resources or the ability to enforce the internationally agreed upon technical and social requirements.

According to Roe (2008), policy-making is still unsuccessful in many aspects. Ships are still sinking, marine waters are still getting polluted, and national governments are generating policies instead of international authorities, and remain diffused (such as PSC not being able to detect risky vessels and operators) (Roe 2008:265). There have been problems regarding what Roe (2008) describes as a static policy-making hierarchy that fails to reflect real-life situations. An example of this is the sinking of the oil tanker Prestige in 2002 off the Northwestern coast of Spain (García-Mira, Real et al. 2006). The single-hulled tanker was asking to seek refuge during the storm but was not granted harbor by both Spain and Portugal (Galiano 2003), resulting in the tanker breaking in two and polluting the marine environment with the oil it was carrying. What happened next was that several member states introduced legislation to enforce using double-hulled tankers prior to any legislation from the IMO and any agreements within the EU (Roe 2008). The Exxon Valdez disaster also triggered the USA´s legislation on double-hulled tankers way before IMO or EU contemplated on the issue (Roe 2008). Roe points out that the shipping industry has the ability to exploit its power and back the nation states, so that the shipowners may continue to take advantage of the differences between the various open

registries. The increase in tonnage tax regimes to prevent shipowners from flagging out serves as evidence to this (Roe 2008).

Classification societies

According to the International Association of Classification Societies, the purpose of a classification society is to "provide classification and statutory services and assistance to the maritime industry and regulatory bodies as regards maritime safety and pollution prevention, based on the accumulation of maritime knowledge and technology." (IACS 2011).

Silos et al. (2013) noted that both the IMO regulations (IMO 1974) and EU directives (EC 1994) refer to classification societies as Recognized Organizations (ROs). The SOLAS Convention highlights the role of the ROs. Some Flag States (especially Open Registry countries) may not have sufficient resources to carry out inspections and certification services and, therefore, turn to private entities for assistance (Silos, Piniella et al. 2013). The Governments of States usually perform activities of recognition and inspection to check if the vessels comply with maritime safety and pollution standards. Private organizations only perform these tasks when the ships are outside the national territory. On the other hand, classification may be awarded to a vessel by a classification society provided the vessel complies with the rules set by the society. Certification is issued to vessels when their construction meets the Societies\ standards in drawings, stability, operating procedures, etc. Periodic inspections to ensure that they continue to comply. The vessel may lose its classification if repairs are not done despite the demands of the society (Silos, Piniella et al. 2013).

The ship construction market has grown in Asian countries along with classification societies with questionable competence. Due to this development, the European Commission and the Member States published Classification Societies they recognize (Silos, Piniella et al. 2013). These Classification Societies are American Bureau of Shipping, Bureau Veritas, China Classification Society, Det Norske Veritas, Germanischer Lloyd, Korean Register of Shipping, Lloyds Register of Shipping, Nippon KaijiKyokai, Registro Italiano Navale, and Russian Maritime Register of Shipping.

The Classification Society's revenue comes from fees they charge ship owners through their inspections. This dependence on revenue gained by maintaining a high number of customers may result in the lowering of their standards in fear of losing customers (shipowners) who may look elsewhere for a classification society that may be less rigorous in their standards (Silos, Piniella et al. 2013). Classification Societies that have very low requirement levels have themselves been subject to inspections by the PSC (ibid.). Ships belonging to MoU regions that have good PSC control of vessels that are not according to the standards opt to use classification states that are part of the IACS due to their fear of being detained by the PSC authorities.

Due to the international mobility of the maritime industry, ship owners have the opportunity to flag out, crew out and "class hop", making the maritime industry complicated and extremely difficult to govern (Couper, 2000:6).

Table 3 Maritime Safety – regulatory instruments (Kuronen and Tapaninen 2010:50 based on Boisson 1994, Eide et al. 2007, Finland Minister of Transportation and Communications 2009, Roberts 2007, Stopford 2009 and IMO)

Sector	Regulatory instruments	Legislator/Actor
Ship construction and equipment	• Construction and Subdivision • Stability • Equipment • Stowage • Navigation • Handling of the cargo	• IMO

Surveillance of ship conditions	• Flag state control • Port state control • Host state control • Classification societies • Vetting inspections	• IMO • IMO, PARIS MOU • EU • Private companies • Private companies
Mariners and safety management	• Working conditions • Employment conditions • Manning of Ships • Safety and quality management	• IMO, ILO
Navigation	• VTS • Ship reporting systems • Traffic separation schemes and routings • Traffic recommendations and restrictions • Piloting • Waterway Safety • Nautical charts • Information supply on weather, water level, ice situation, etc. • Towage services	• IMO • IMO, regional cooperation • IMO, regional cooperation • IMO, regional cooperation, nations • Nations • IMO, IALA • IMO, IHO • IMO • Nations, private companies

Challenges in safety regulation

The process of devising international regulations by the IMO is often slow and may be preceded by supra-national or national legislation (Kuronen and Tapaninen 2010:51)(see Roe 2008 for the case of double-hull tankers).

Command and control regimes do not provide optimal solutions for regulating activities of modern enterprises (Sampson, Walters et al. 2014). The ISM Code, a regulatory framework adopted by IMO, introduced the element of self-regulation (Kristiansen 2005:467 in Lindøe 2011). This regulatory framework requires all vessels over a specific size must have a valid safety management system. Through the ISM Code, the ship owners are given the responsibility for their ship's safe operations. However, Lindøe, Engen et al. (2011:96) point out that delegating safety management and risk regulation to the shipping companies may not be effectual unless the industry actors recognized this as legitimate and implemented by competent and motivated actors.(Lindøe, Engen et al. 2011).

Due to the intensive competition between flag states, government authorities have become less eager in enforcing standards (Bennett 2000). This is where the role of third parties in uplifting safety in the industry comes in. Third parties have the power to influence ship owner behavior (Bennett 2000 in Kuronen and Tapaninen 2010). Examples of third party actors are classification societies, banks, auditors and insurers (ibid.). Governments, for instance, can introduce a legal requirement for ship owners to use third party auditors or insurers (see Bennett 2000).

Notwithstanding the significant improvement of safety in the shipping industry, AGCS (2012) underline many hurdles the industry is facing. For instance, the general increase in vessel size poses insurance challenges while large cruise ships pose evacuation and rescue difficulties during emergencies. As ground-breaking vessel designs are made to cope with harsh conditions, raising concerns regarding structural integrity. AGCS also point out what was earlier discussed: shipowners' constant search for lowering costs runs the risk of crewing their vessels with varying competence and training. Moreover, the minimum crewing levels may be far too low such that physical and cognitive conditions of the crew, in addition to increased administrative responsibilities, may increase the risk of

accidents. Despite efforts to improve maritime safety at international and national levels, AGCS is concerned that the safety management system may still be inadequate and that enforcement of the different regulations is deficient. Piracy is still a problem in some shipping routes, leading to high economic losses. They have also underlined that language barriers may hamper communication as the trend in setting up multi-national crews continues. According to them, fire on Ro-Ro ferries still poses a major risk on board. Finally, the development of routes raises safety and environmental concerns (Allianz Global Corporate & Specialty 2012).

In the year 2005, the World Customs Organization (WCO) adopted the Framework of Standards to Secure and Facilitate Global Trade (SAFE Framework) to deter international terrorism, secure revenue and promote the facilitation of trade (World Customs Organization 2015). A new version of the framework was introduced to WCO members in June 2015, containing a new Pillar[8] that emphasizes cooperation among governmental agencies, customs, and inter-governmental agencies (*ibid*.). Fruits from the efforts to increase security are becoming visible in the form of a decline in the attack of vessels in the Gulf of Guinea, the coast of Somalia, and Western Indian Ocean (UNCTAD 2015).

Despite the introduction of several IMO legislations, there is still serious deficiencies in the implementation as inspections reveal that many ships at sea still have safety-crucial inadequacies(Knudsen and Hassler 2011). Knudsen and Hassler (2011:202) identify five features that undermine the implementation of regulations and policies from both IMO and ILO. First of all, they point out that IMO implementation is national member state responsibility. However, the national implementation is usually inadequate, and port state control cannot compensate for the deficiencies in implementation at the flag state due to insufficient capacity. Insurance companies, like classification societies, support the national maritime administrations and shipping companies in their implementation of international regulations (Knudsen and Hassler 2011). Classification societies play the role of technical experts and assist the flag states, insurance companies and shipping companies in their implementation of IMO regulations (ibid.).

The IMO regulations are not directly translated into national regulations. Knudsen and Hassler (2011) identify the different steps involved from IMO legislation to implementation. According to them, the IMO legislation is an activity comprising of interaction between governments and influence of various stakeholders. After adoption of a Convention by IMO or ILO, the classification societies delegated the task of ensuring the quality of implementation of flag state responsibilities. The Societies act as informal authorities and provide technical expertise in translating regulations into standards and certifications. The member states need to ratify the convention and study the consequences of the Convention at the national level. After analysis, the action is then incorporated into their national legislation. The concerned ministries then establish specific rules and are usually in dialogue with other relevant authorities. Finally, proclamation occurs, and the act of implementing begins (Knudsen and Hassler 2011).

Knudsen and Hassler (2011) identified five characteristics of maritime regulation that undermine the implementation of both IMO and ILO legislations. First of all, IMO does not implement the procedures rather; the national authorities are responsible for this activity. The main weakness in this characteristic is that national administrations are nationally appointed and under a different jurisdiction with its own priorities and resources. Due to the varying priorities, the implementation becomes varied from flag state to flag state. The implementation at this level is usually deficient unless they are delegated to competent classification societies. PSCs perform their task of compensating for deficiencies of the flag state through sampling, usually directing their focus to the most faulty ships from their previous records. Although port state control may act as a safety net for inadequacies of the national level authorities, they also do not have the capacity or the efficiency to compensate for the shortcomings of the flag states. Another characteristic is the IMO decision-making itself, usually proactive and responsive to concerns of the general public. As different stakeholders have varying

[8] Cooperation between Customs and other Government and Inter-Government agencies

concerns, the IMO needs to satisfy various demands. Decisions are often made so quickly that the flag states and PSCs are not capable (various obligations, limited resources, time and manpower) of implementing them. In this situation, local inspectors may choose to focus on some parts of the rules such as those that can be easily verified. Aside from a long "checklist", language and interpretation of the text add complications. A third flaw in the maritime governance is that complex rules may lead to unforeseeable or inadvertent results unless legal instruments are introduced with great caution. Knudsen and Hassler (2011:204) state that "interaction effects relevant here are basically of three kinds: crowding i.e., too many rules vying for attention, missing rule application, and inconsistent (faulty) rule application, triggered partly by insufficient capacity to implement, partly by inconsistent implementation routines between countries and regions." A fourth characteristic is the concentration of accidents in the coastal or narrow waters, where flag states are observant and may introduce political pressure for IMO to come up with more stringent rules. Finally, since it is impossible to prevent every single accident, newsworthy accidents that do occur brings about political pressure on IMO. Thus, the cycle of rule creation and implementation continues, encumbering the limited capacity of local authorities (Knudsen and Hassler 2011).

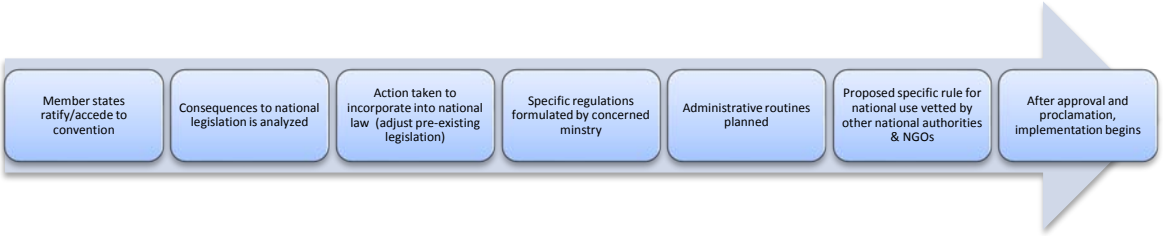

Figure 4 Process from IMO legislation to local implementation (Knudsen and Hassler 2011:202)

Ship owners themselves have the power to render scrupulous firms out of business and support fair competition by requiring transporters with a high level of safety (Kuronen and Tapaninen 2010). Moreover, Kongsvik, Antonsen et al. (2014:473) identify ship owners as "a key element in the industry´s safety management chain", as they interact directly with employees and address safety issues. (Kongsvik, Antonsen et al. 2014)

The shipping industry today

The world fleet consists of 89,464 vessels (UNCTAD 2015). Twelve months before January 2015, the world fleet grew only by 3.5%, the lowest annual growth rate in the span of ten years (ibid.). The largest ship-owning countries are Greece, Japan, China, Germany, and Singapore (ibid.). These countries own more than 50% of the world tonnage (UNCTAD 2015).

Growing concern for the environment has led to new regulations regarding technologies that involve waste, emissions, treatment of ballast water, and fuel-efficiency (UNCTAD 2015). Regulatory[9] and economic incentives[10] encourage shipping companies to invest in the modernization of their fleets. However, if the older fleets continue to operate, this would lead to global overcapacity and pressure on freight and charter rates. With regards to environmental regulations, Norway has an advantage, as modern Norwegian ships are one of the most eco-friendly and fuel-efficient vessels (Shipowners´Association 2015).

Freight costs are pressured to go downward due to the existence of older, undemolished tonnage which saturates the market (UNCTAD 2015). This is where economic and regulatory incentives, plus strict environmental regulations, play a vital role in stimulating investment in modern ships (ibid). Container and tanker markets have experienced erratic changes in freight rates throughout 2014 (UNCTAD 2015). Albeit increased demand worldwide for container shipping, the pressure to lower freight rates

[9] Such as regulation requiring companies to invest in environmental technologies to reduce emissions, w aste, and ballast water treatment.

[10] Investment in environmental technologies will increse cost savings due to increased fuel efficiency

were due to an oversupply of vessels and the influx of very large container ships (UNCTAD 2015). Several Bulk carrier companies filed for bankruptcy due to a drop in earnings in 2013 and 2014 (ibid.).

Competitiveness in a global environment also relies on the performance of ports and terminals (UNCTAD 2015). Some of the challenges this sector faces include growing traffic, an increase in ship size, port infrastructure adaptation costs, changing market conditions due to alliances between shipping lines, and environmental pressures (ibid.).

Growth in developing countries is estimated to decelerate due to low oil price levels, political uncertainties, developments in the European Union and Greece, the largest ship-owning country. Import demands from China have increased activities in dry bulk shipping and crude oil tankers while China´s export activities contributed to container shipping movement in Asia, North America and Europe (UNCTAD 2015). The stagnation in China´s growth, according to UNCTAD (2015) will have ramifications for the maritime industry.

The decrease in oil prices will strengthen purchasing power, resulting in savings for importing countries whereas exporting countries will have the opposite effect due to cuts in subsidies, a decrease in profit, and disadvantageous trading terms (UNCTAD 2015). UNCTAD (2015) also projects postponements and cancellations of oil-related investments, effects that Norway as a major oil exporter is already experiencing.

McKinsey&Company, point out that the major container shipping lines have created alliances which are divided into four groups[11] G6, CKYHE, Ocean Three and 2M (Joerss, Murnane et al. 2015). Maersk Line and Mediterranean Shipping Company (MSC) signed the world´s largest sharing agreement (VSA) in January of 2015 (WMN 2014, Leach 2015). The ten-year agreement poses a threat to the market and leads to decreased competition in the maritime industry, according to European Shippers´ Council chairman Denis Choumert (WMN 2014). Moreover, the Chairman also fears that alliances might cause a narrowing of the market, where smaller carriers performing tailor-made services will be squeezed out. The alliances will also result in bigger ships and higher container numbers that have to be moved in a short span of time, necessitating the need for more cranes and employees manning the ports. A positive side to this is that larger ships mean fewer emissions per container. The 0.1% Sulphur Directive will affect deep-sea shipping and will need to pay surcharges whereas short-sea shipping (within EU) has a few options, according to Choumert. The increase in prices will press the clients of shipping companies to look more closely into their logistics chain and perhaps resort to all road transport or shorter maritime transport, something that may have a larger consequence to the environment than predicted (WMN 2014).

Peter T. Leach (2015), Editor of Journal of Commerce, emphasized that these carrier alliances (2M, Ocean 3, G6, and CKYHE) will dominate 95% of the east-west cargo trade in volume. Leach points out that it is easier for coalitions to connive on freight rates. Carrier size was pointed out as a factor for decreasing freight rates. This may engender cutting of rates despite lower profitability to gain market shares. This unstable environment, however, will not impair China Shipping or the United Arab Shipping as their governments will financially aid them so as not to become insolvent (Leach 2015).

Shipping alliances come to an end once the shipment is unloaded from the carriers at sea (Joerss, Murnane et al. 2015). McKinsey&Company predicted that alliances will change and expand to landside alliances. Reasons for this development include financial benefits from the reduction of the overall cost base and operational benefits from the reduction of operational complexity(Joerss, Murnane et al. 2015).

[11] **G6:** APL, Hapag-Lloyd, Huyndai Merchant Marine Company, Misui O.S.K. Lines, Orient Overseas Container Line, and NYK Line. **CKYHE:** China Ocean Shipping (Group) Company, Evergreen Marine Corporation, Hanjin Shipping Company, "K" Line Ship Management Company, and Yang Ming Group. **Ocean Three:** China Shipping Container Lines Company, CMA CGM, and United Arab Shipping Company. **2M:** Maersk Group and MSC

Norway

Deregulation trends from the 1960s resulted in forced safety management regulation forward (see Bhattacharya (2012) for a thorough overview). Deregulation made the ship-owners seek cheaper and easier regulatory regimes, leading to global competition and weaker rights for the seafarers. In parallel, a growing number of maritime accidents called for stronger safety management regulations. The catastrophic capsizing of the *Herald of Free Enterprise* in 1987 and the *Estonia* in 1994, of which managerial errors were identified as important causal factors, accelerated the IMO's work with a code to regulate workplace safety and pollution.

Eventually, this resulted in the *International Management Code for the Safe Operation of Ships and for Pollution Prevention* (the ISM Code), which was established by the IMO in 1993 and made mandatory from 1998. It is designed to 'ensure safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment (…)' (ISM Code, section 1.2.1). According to the ISM code, a safety management system should include, for instance, (1) a safety and environmental protection policy, (2) procedures to ensure the safe operation of ships, and (3) defined lines of communication between shore and shipboard personnel (IMO 2014). The Norwegian ratification of the ISM code on passenger vessels was effectuated in 1995 (Lovdata 2014). Now the code is included in the *Norwegian Ship Safety Act* (Lovdata 2007), which consists of functional requirements and states that companies are responsible for safety on their ships.

In 1987, the Norwegian International Ship Register, NIS, was effective in increasing the number of vessels registered under the flag and altering the downward trend in Norwegian seafarer numbers (Shipowers`Association 2015). The implementation of the shipping tax regime, regulatory changes, net wage scheme were other measures that proved positive for the Norwegian maritime industry (ibid.).

The Norwegian maritime cluster creates an annual value worth 175 billion NOK. There are about 110,000 seafarers employed in the cluster(Norwegian Shipowner´s Association 2015). International businesses that the Norwegian offshore service shipping companies are engaged in bringing about 60% of the revenue for the ship owners(Norwegian Shipowner´s Association 2015).

The geopolitical tensions, global economic slowdown and oil price decline in 2015 has negatively impacted the Norwegian maritime industry(Norwegian Shipowner´s Association 2015). The slowdown in the investment on the Norwegian shelf has resulted in three of four offshore service shipping companies expecting a lower profit in 2015(Norwegian Shipowner´s Association 2015). Unlike the strong growth in 2013 and 2014, a 2% decline in 2015 is expected (Norwegian Seafarers' Union 2015). Norwegian ship owners also projected a decrease in the number of recruitment of seafarers, and recruitment will primarily consist of foreign personnel (Shipowners´Association 2015).

The Norwegian Shipowners´Association identified several issues that are critical to remaining a competitive and attractive as a flag state in their 2015 report. The maritime cluster should remain complete to encourage enterprises in locating their business in Norway (Shipowers`Association 2015). Competitive maritime policies are also vital in maintaining competitiveness in the global maritime industry. According to the Norwegian ship owner's association (2015), the implementation of tonnage tax and its subsequent adjustments have contributed to the growth in the number of vessels. Having a competitive net wage scheme for Norwegian seafarers is seen as a competitive edge when it comes to innovation and competence. The Norwegian Shipowners Association views the current net wage scheme as not competitive (Shipowers`Association 2015). A competitive NIS, according to the association, must be based on international rules and regulations, without additional national rules and interpretations in Norway. In their report, the association also underlined that Norway should not allow the NIS register to "deteriorate" as ships would flag out and result in a decrease of influence on international shipping policies and laws. They also identify three important conditions that will determine potential reflagging of shipowners to NIS. These include a competitive net wage scheme

for Norwegian seafarers, relaxation in cabotage rules, and a higher level of service and quality in the Maritime Authority and Norwegian registries (Shipowners´Association, 2015:92).

Short sea shipping[12], according to the Norwegian Shipowners´Association, plays a role in bridging Norwegian export to Europe (Shipowners´Association 2015). The shipowners in this segment of the Norwegian cluster not only competes with road and rail transport but also provides a greener and safer way of transporting goods and services (ibid.). The white paper *National Transportation Plan 2014-2023* will strengthen freight transport by sea and rail (Meld. St. 26 (2012 – 2013)):

The Government will pursue a proactive maritime transport policy. Within the framework of a short sea shipping strategy, NOK 3 billion (EUR 0.4 billion) will be set aside during the plan period for measures aimed at ports and the design of policy instruments to strengthen short sea shipping. Among other things, the Government will:

- *Design measures that stimulate increased use of short sea shipping.*
- *Design a grant scheme for governmental support of investments in designated ports.*
- *Design a grant scheme for port cooperation and concentration of cargo.*
- *Strengthen research and studies of freight transport by sea and intermodal transport solutions.*

The investment program aims to improve and mark fairways to accommodate larger and deeper vessels (Meld. St. 26 (2012-2033):30-31). Fairway measures will improve safety, better navigation in narrow waters and shorter sailing distances in some fairways (*ibid*.).

The Norwegian Shipowners' Association believes that three key factors will drive the growth of the Norwegian maritime industry. These include 1) growth in global economy, 2) increased energy demand, and 3) increased energy production in the High North. Barriers to growth include increased protectionism, stricter sanctions on Russia, and geopolitical and security issues (Shipowers`Association 2015).

The Arctic and Polar Regions

Interest in the Artic region is growing as it holds significant amounts of fish, oil, gas, and minerals (Shipowners´Association 2015). Norwegian offshore shipping companies possess modern ships that are well equipped for the demanding conditions in the Arctic (*ibid*.).

Despite this advantage, the market conditions in the Arctic region changed for the Norwegian offshore shipping companies due to the crisis in Ukraine and the EU-imposed economic sanctions on Russia[13](Shipowners´Association 2015).

The IMO has adopted the Polar Code, which is expected to be enforced at the beginning of 2017[14]. The Polar Code contains safety and environment-related provisions such as requirements for ship construction, equipment, navigation, training, operations, search and rescue, as well as environmental protection (IMO.org 2015). The enforcement of the Polar Code may be an advantage for the Norwegian shipowners that have modern ships. Moreover, Norwegian shipowners have bases close to the Arctic region and experience in maneuvering across demanding waters.

2.5 Conclusions

The maritime industry has regularly been exposed to major accidents, and for parts of the industry the risk is constantly high for the sailors (e.g. fisheries).

[12] transportation of goods and passengers between European ports

[13] http://www.consilium.europa.eu/en/policies/sanctions/ukraine-crisis/

[14] http://www.imo.org/en/MediaCentre/HotTopics/polar/Pages/default.aspx

We have illustrated that maritime transport is highly international, and more globalized that road, railway and also aviation, at least at present. Many ship-owners compete on the same global transport marked, and as a consequence they also seek access to the same *labor* markets to retain their competitive ability, e.g. by flagging out to 'flags of convenience'. This has been met by national authorities, also in Norway, by establishing secondary ship registers to reduce the negative national economic and employment consequences.

This highly international industry has proven to be hard to regulate. Although the transnational UN entity IMO is well established, the devising of regulations has proven to be slow, and the enforcement of the regulations (e.g. the ISM code) is in the hands of the member states. On a national level, the authorities are under pressure from ship-owner associations to ensure viable conditions for the industry, and must balance industry interests against stronger safety regulations.

Some segments of maritime transport are of a more local nature, and less exposed to internationalization. Local ferries and passenger transports typically have crews living onshore between shifts and are also subject to national tendering processes that, at least to some extent, shield them from exposure to global competition.

For the INSIKT project, there are at three interesting issues to pursue further. First, there is a need to provide updated information on the extent of foreign ships operating in Norwegian waters, including cabotage. In relation to foreign operations, the influence on maritime safety should be addressed. Providing updated information implies a combination of various data sources. Second, the NIS arrangement is seen as a necessary adaption to the increasing internationalization of the sector. What safety implications have the establishment of this register seen from the perspective of regulators, ship-owners and crews? Third, the IMO as an international actor is important regarding the development of regulations. How do national authorities handle the slow decision processes in IMO, and what leeway do national authorities have in pursuing new and critical safety issues that need quick responses?

3 Railways

As a part of the project "Managing transport safety in the context of global competition", literature studies on the four different sectors that are studied were undertaken. This memo presents the railway sector in Norway with a focus on how changes in transport patterns, value chains and labor markets affect safety. The focus is on safety in the context of internationalization and globalization.

Searches for literature have been done in online databases such as ScienceDirect and Google Scholar with search strings containing one or more of the following words: rail(way), safety, global(ization), deregulation, international(ization), liberalization, privatization, competition, labor, work, regulations and Norway. Articles have further been used to find new articles through references. Also searches on the web and on actors' web-pages have been done.

First, the railway sector in Norway will be described in two parts; organization of the sector and system characteristics. Thereafter the aspects of internationalization and possible effects on safety will be presented.

3.1 The Railway sector

Railway operation can mainly be divided into two types; passenger transport and freight transport. The two parts have different customers, operators and conditions for operation, but the technical system of operation, such as the tracks they use are the same.

The first railway in Norway opened in 1854 and was 68 kilometers long. Since then it has expanded to be in total 4219 kilometers in 2015 with 337 stations (Norwegian National Rail Administration, 2015). In 2014 the Norwegian railways had 70 million passenger journeys and in total 3420 million passenger kilometers (Norwegian National Rail Administration, 2015). During the years, there have been ups and downs for the sector, such as competition with cars, busses, low cost airlines and also accidents have affected the reputation of the railway. However, during the recent years the number of passenger kilometers have been growing, and the railway has between 50 to 80 percent of the domestic freight transport on longer distances, despite low funding over several decades (Ministry of Transport and Communications, 2015). The number of cross-border transport has however decreased on the passenger side from 2013 to 2014, but grown for freight traffic (Norwegian National Rail Administration, 2015). The current situation is that central parts of the railway network are overloaded, and a further growth is expected. Therefore, there are plans to increase capacity along with a new reform allowing more private operators. The rail infrastructure is founded by the state, and the operators own the rolling stocks.

3.2 Organization of the sector

The railway sector in Norway is organized under the Ministry of Transport and Communication. The reform with separation of infrastructure from operations began in the late 1980's in Sweden (Nash, 2008). The Norwegian Railway system is also split according to this Swedish model. In 1996, the Norwegian Railway sector went through major organizational changes, when the state-owned railway company (NSB) that was operating most of the railways in Norway was split up into an infrastructure operator, the Norwegian National Rail Administration (Jernbaneverket), and a train operator, NSB BA. The NSB group both has ownership and operations of passenger transport and freight transport. At the same time a control and supervisory authority, The Norwegian Railway Authority (Statens jernbanetilsyn), was established. The Accident Investigation Board of Norway also has a role in the rail sector as they investigate incidents and accidents, and play an important role for prevention of transport accidents. For 20 years the structure has been the same, only with a few additional companies on passenger and freight transport.

The organization of the sector is more closely described using the framework model of Foss (2015) based on ARKTRANS reference model (Natvig et al., 2009). The model is divided in five parts, in where the different roles of the sector are allocated. This is shown in Figure 1.

On the ***Transport demand*** side are the users of the passenger transport and freight transport. For the passenger transport the demand comes from the individual users. On the freight transport there are private companies that want to transport merchandise, and also state-owned corporations, such as Norway Post (Posten Norge AS; mail and logistics group) that uses trains for transportation.

The ***Transport Service Provision*** includes all rolling stocks that provide transport services, organizes and delivers the transport services and manages the transport means. The train drivers have a very important role for service provision, and are therefore as a separate role in the framework. They also play an important role for safety.Train

On the passenger side in Norwegian railway, all the transport is operated by state-owned companies. Most of the transport is operated by the NSB group with subsidiary companies, which is owned by the Ministry of Transport and Communications. A smaller part is operated by Flytoget AS, which is under the Ministry of Trade, Industry and Fisheries. The majority of the transport on the rail is domestic. A small part is operated over the border to Sweden by either NSB or a subsidiarity of NSB AS, Svenska Tågkompaniet AB. The trains used for this are owned either by the Swedish state-owned rail company, SJ AB, or NSB AS.

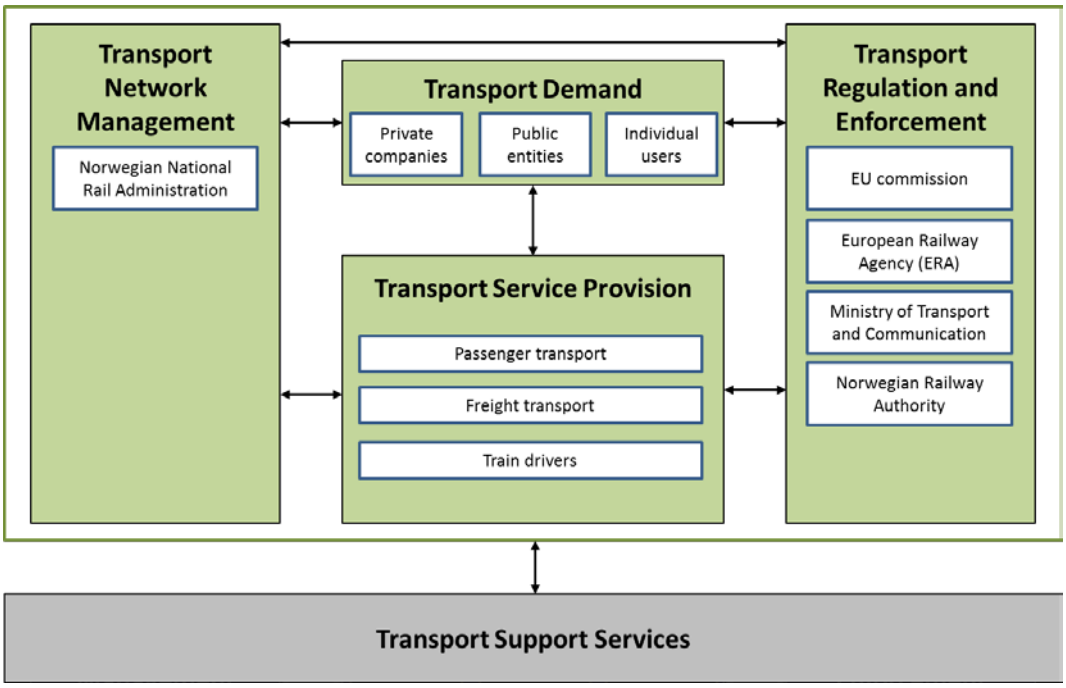

Figure 5 Organization of the railway sector in Norway (after Foss (2015))

On the freight side, there are more companies operating, and several of them are private. Per January 2016, seven operators have valid certificates to operate. CargoNet AS is a company under the Norwegian public owned NSB-group. There are aslo two Swedish public owned operators; Green Cargo AB and LKAB Malmtrafik AB. Additionally four private companies are operating. Two are Norwegian companies; Cargolink AS, Grenland Rail AS, and two are Swedish; Hector Rail AB and Tågåkeriet i Bergslagen AB.

The ***Transport System Management*** includes all the owners, all roles related to management, operation, maintenance and utilization of the infrastructure. The Norwegian National Rail

Administration that is the infrastructure owner and manager and is under the Norwegian Ministry of Transport and Communication.

Transport Regulation and Enforcement covers all roles related to the regulating and monitoring the railway. Both international and national actors are controlling and affecting the rail sector through regulations and enforcements. On the international level is the European Union (EU) commission, which sets rules that the EU and European Economic Area (EEA) member states need to relate to and implement. The European Railway Agency (ERA), which is an agency of the EU, has the task to help to create a safe, modern and integrated railway area. It is also the system authority for the European Rail Traffic Management System (ERTMS).

In Norway, the Ministry of Transport and Communication is the highest authority in the sector and has the authority over the laws and regulation, as well as the main responsibilities with the strategic planning and establishment of framework conditions. The Norwegian Railway Authority, which is under the Ministry of Transport and Communication, has the task to perform practical controls and supervise the rail traffic. The authority ensures that operators meet requirements from the legislation. They also have the responsibility for drawing up regulations, giving out licenses for rail activities and approving rolling stocks and infrastructure.

The ***Transport support services*** include all roles that provide any type of service that is used to operate a transport system. These are roles such as maintanence, electricity providers and communication services providers like a telecom operator. The main maintenance service for rolling stock on rail in Norway, Mantena, is also in the NSB group and has maintenance units both in Norway and in Sweden. Mantena carries out maintenance on both passenger trains and freight trains as well as on construction machinery. The largest customers are NSB passenger transport, Flytoget and CargoNet, which are all state-owned. Also some of the private operators use Mantena as a maintenance service provider.

Other parties that influence the railway systems are trade unions, which are the employees' voice and are strong in Norway. Norsk Jernbaneforbund, the Norwegian Transport Workers' Federation (NJF), is both for employees of the NSB group, the Norwegian National Rail Administration and other state-owned or private corporations and companies. Most of the occupational groups in the railway sector are organized in NJF. The train drivers have their own trade union, Norsk Lokomotivmannsforbund, which is affiliated to the Norwegian Confederation of Trade Unions (LO). NJF cooperates with the Nordic Transport Workers' Federation (NTF), the European Transport Workers' Federation (ETF) and the International Transport Workers' Federation (ITF). Other international parties that play a role in the railway sector are for example organizations such as the International Union of Railway (UIC), which promotes rail transport on a worldwide level as well as interoperability and international cooperation, the Community of European Railways (CER) and European Infrastructure Managers (EIM).

When an accident or near accidents happens the Accident Investigation Board Norway (AIBN) has the role to investigate the accidents according to national and European regulations and issue safety recommendations if needed. The aim of AIBN is to improve transportation safety.

Legislation

The national legislation of the railway sector in Norway consists of two acts in short called Railways Act (Jernbaneloven) and Railway Investigation Act (Jernbaneundersøkelsesloven). Additionally, there are several regulations from the Ministry of Transport and Communications and from the Norwegian Railway Authority, and more technical specifications for interoperability of the railway. As a part of the EEA and through the EEA Agreement, Norway is obliged to enact large parts of legislation from the European Union (EU) into the national legislation. In the railway sector the regulations are based on the EU-regulations with some national additions. According to Jernbanegruppa (2011) Norwegian regulations only exists where there are deficits in the EU-regulation.

The European legislation consists of several directives. Until now three Railway Packages have been introduced in Europe, and a fourth is proposed. The First Railway Package from 2001required separation of the management infrastructure, establishment of a rail regulator, a non-discriminatory setting of access charges and allocation of paths, establishment of independent rail regulators, a performance regime to incentivize the infrastructure manager, and ensuring a financial equilibrium of the infrastructure manager (Nash, 2010). Clarifications and corrections of the legislations from the First Railway Package were done in 2012 (Alexandersson & Rigas, 2013). The Second Railway Package from 2004 promoted common standards for interoperability and safety, and opened up the market on the European network. The Third Railway Package from 2007 opened up for internationalization in the passengers services and introduced further safety measures for safety such as conditions and procedures for the certification of train crews operating locomotives and trains (Alexandersson & Rigas, 2013). The Fourth Railway Package aims to cut administrative costs for rail operators, and ease the entry of new operators into the market through further regulations. The goal is a single European Transport area.

Transportation Reform

The whole Norwegian transport sector is standing in front of challenges coming from population growth and growth in freight transport, which is desired to be dealt with in an efficient and environmental friendly way. One solution to this challenge is higher focus on railway, and in Norway, the sector has in the latter years gotten more attention and higher budget allocations from the Government. This is a part of the Norwegian Transportation Reform where the aim is to make the whole transportation sector more efficient and socio-economical profitable.[15] For the railway this means a reform with a better management structure, a more commercial organizational form, a better customer orientation and clearer goals for the sector. According to the Report to the Storting (White Paper), Meld. St. 27 (2014-2015), the goal is to organize the railway more efficiently and open up for more competition and more private operators (Ministry of Transport and Communications, 2014). The public sector will still have the responsibility for the infrastructure. It is suggested to establish a new Railway directorate under the Ministry of Transport and Communications that will be responsible for coordination, operational management and ongoing development of the sector. An infrastructure state-enterprise is suggested to manage current and new infrastructure and properties, and be responsible for traffic control. Private companies such as train companies, maintenance companies, contractors and service providers are supposed to compete for tenders. On the maintenance side it is suggested to also have a state-owned, but commercially ran company.

This reform will obviously have implications for safety management, which needs to be adapted to adequate strategies and structures to keep a desired safety level in railway transportation. The government requires the sector to have a safety and emergency preparedness standard at least as high as today with the new reform (Ministry of Transport and Communications, 2015).

Working conditions

There is not found much literature about employment relations in the rail sector in Norway, however articles from trade unions indicate that a shift is coming, especially for the freight traffic where there is competition between companies.

When the rail sector was reorganized in 1996 it lead to a too high workforce which in the later years was reduced both in NSB BA and the Norwegian National Rail Administration (Rodal, 2002). In the late 1990's there was a lack of train drivers in Norway, but because of different education systems across Europe, it was challenging to recruit from abroad (Rodal, 2002). Another challenge was different signal systems and rules for train operations in various countries.

[15] http://www.statsbudsjettet.no/Statsbudsjettet-2015/Statsbudsjettet-fra-A-til-A/Transportreformen/

According to statistics from Norwegian National Rail Administration (2015), the number of permanent employees in the Norwegian National Rail Administration has increased from 2005 until 2014. This can be related to the recent and future investments that the Norwegian National Rail Administration is doing. When it comes to NSB, they have regulations on hiring and hiring out labor; hiring and hiring out can only take place between companies that have proper wages and working conditions (Norsk Jernbaneforbund, 2014).

In the freight transport on rail we are about to see some changes in terms of employment. Cargolink, a freight transport company, wants to employ train drivers in a separate company, Trainlink, and hire them in for Cargolink's operation. According to Norsk Lokomotivmannsforbund; the trade union for train drivers, this can lead to unclear terms of employment where collective agreements will not have roots with the employer and might degrade the health, safety and environment (HSE) work as a consequence (Mortensen, 2015). This new trend has come from the low-cost airline companies, such as Norwegian.

3.3 System characteristics

According to Perrow's Normal Accident Theory, a system can be classified according to couplings and interactions. Railway transport systems are very linear and also have a quite high degree of couplings, which makes it a tight coupling (Perrow, 1984). A system being linear means that the functioning is expected and predictable. Being tight coupled means that there is little slack, and disturbances can fast spread throughout the system. There is little redundancy to restrain the disturbances. These characteristics have implications for the safety aspects in the system and the way to handle and control the system. According to the Normal Accident Theory, the organization must be matched to the type of system it is, to make the system resilient to major accidents. A centralized management is suggested to handle these tight couplings in a good way. However, if circumstances in the system changes, the management strategy should be adapted accordingly. Further, activities need to be thoroughly coordinated, which is possible through detailed regulations (Rosness, 2008).

Railway operates over large geographical areas, where it can transport many people or large quantities of goods in an efficient way. As a means of transport of people, an advantage of rail is that it can move many people using only small areas. As for freight transport over longer distances it gives low marginal costs. The railway is also seen as a more energy friendly means of transportation, and pollution and energy use are two reasons often pointed out for transferring more transport from road to rail and sea (Rodal, 2002). Another reason is the safety aspect with the fact that rail transportation is safer than road transport (Rodal, 2002). There are, however, also limitations and challenges in the railway, for example when it comes to flexibility, interoperability and profitability.

Challenges in the railway

The landscape of Norway, as well as the climate and settlement makes railway operation somewhat hard (Ministry of Transport and Communications, 2015). The railway sector is exposed to competition from other transportation means that for example are more flexible. Future changes that will affect the sector are described to be related to aspects such as population growth, pressure on land areas near large cities, environmental challenges and expectations from customers (Jernbanegruppa, 2011). Some of the challenges are related to the capacity of the current infrastructure, as the system is locked to restrictions such as tracks. In fact, in Norway the majority of the rail line, almost 95 per cent, only has single tracks (Norwegian National Rail Administration, 2015).

The railway sector is also facing some challenges in the coming years related to long term goals and strategies for the sector. Some are already being dealt with, others need more time. The challenges are related to further development of the infrastructure with a relation to other transportation services, time-consuming decision processes, inadequate funding for long-term investments, lack of capacity and low standard on current infrastructure, lack of resources and competency in the railway sector, lack of a system for incentives for railway operations, deficiencies in the organization of the sector and insufficient cooperation on hub development and payment system (Jernbanegruppa, 2011). In the

future, the sector requires investments and upgrades on the rail system, which are not only related to costs, but also time. Investments and upgrades in the rail usually have a perspective of at least 20-30 years, which again mean that it takes time to update and adapt to new requirements.

These upcoming challenges have been considered and are a basis for the planned reform for the sector in Norway. Also changes in the organization of the sector are planned. For example, the way the sector is organized today hinders equal conditions for both current freight operators and future passenger transport operators when it opens up for competition.

Incompatibility issues

The railway systems across Europe have developed over time in different countries, also with regard to policies and regulations. These differences need to be considered when melting the different systems together (Martí-Henneberg, 2013). There has over time been and still are technical challenges across Europe in the rail systems for interoperability. Still today there are differences between technical systems in Europe including differences in track gauges, electrification systems, train protection systems, warning systems and control systems (Smith et al., 2012). Most countries in Europe use the standard gauge size (1435 mm); however some countries use wider gauges (e.g. Russia (1524 mm), and Spain and Portugal (1668 mm)). Also the electrification systems differ between and even within countries, where both the voltage and currents (direct and alternating currents) can be different. In Europe there are five main electrification systems in addition to the lines that are non-electrified. Also within Norway there are different solutions, where most stretches are electrified, however some still use diesel-trains, and therefore require different trains on the lines. The locomotives and carriages also vary between countries, for example are the Norwegian carriages broader than in other European countries (except for Sweden) and can for that reason not operate in Europe (Rodal, 2002). The European carriages can however operate in Norway.

In rail interoperability is crucial for internationalization. Without compatible technical systems it will not be possible to operate trains as an open European market. However, there are not only technical issues that make internationalization difficult. Factors such as organizational aspects and customs in different countries also play an important role. There are safety requirement such as licenses and the safety certificates, that are split into part A and B. To be able to operate in Norway, foreign companies need a license and a safety certificate part A from their own country and a safety certificate part B in Norway (Norwegian Railway Authority, 2015b). This is also valid for Norwegian companies that want to operate abroad. A problem is that it can be quite difficult to get a safety certificate for a different country. This requirement needs to get simplified and harmonized so that companies easier can operate between countries. Another non-technical example is that manual hand signals differ even between Sweden, Denmark and Norway.

About ERTMS

The aspiration of having an interoperable railway across Europe requires technologies and operational procedures that facilitate both the interoperability and also safety, capacity and efficiency (Smith et al., 2012). ERTMS is meant to be a common European train control command system facilitating for interoperability removing the technical barriers that hinders this. Norway is through the EEA committed to implement the system and adopt it into national regulations. A change to ERTMS also means modernization of the signal systems and other technical units in Norway, which will give a more stable and reliable system. The system will enable more efficient train services, higher safety and reliability, reduction of maintenance and life cycle cost, further increase in cross-border train traffic and environmental-friendly solutions (Norwegian National Rail Administration, 2014). Within 2030 the system should be completed across the country.

Railway safety aspects

The railway is among the safest transportation means in Europe and in Norway and the level of safety has gradually improved since 1990 (European Railway Agency, 2014). The safety in the Norwegian railway is described as good, and also reliability and punctuality has increased in recent years.

Numbers from the Norwegian Railway Authority (2015a) show that between 2009 and 2014, there have been in average 25 railway accidents per year in Norway. In 2013 and 2014 there were respectively 31 and 32 train-related accidents with respectively 4 and 5 fatalities (the number for 2014 are preliminary), and 3 serious injuries (Norwegian National Rail Administration, 2015). The most common cause for accidents is collision with an obstacle (Norwegian Railway Authority, 2015a). For example, each year there is a great number of animal fatalities on the tracks. For 2013 and 2014 the numbers were respectively 2152 and 1447 (Norwegian National Rail Administration, 2015).

Statistics show that the number of fatalities for rail passengers was 0.46 per billion person kilometers for the period between 1992 -2011 in Norway (Elvik, 2012). The number for 2002-2011 were as low as 0.07. Compared to Europe (EU-27) the fatality risk per billion passenger kilometers between 2008-2012 for railway passenger was 0.13 (European Railway Agency, 2014). Trend in the number of accidents related to trains for the period 2005 to 2014 is increasing especially for collisions and derailments (Norwegian National Rail Administration, 2015).

Many aspects are contributing to railway safety: technical system, trains, train drivers, operators (e.g. signalers and controllers) and regulations. There are also underlying conditions that contribute to railway safety such as organizational factors and safety culture.

Traditionally, there has been a high focus on regulations in the railway sector, and the culture for safety is special in the sector. Knowledge of the safety regulations for the railway is aa core competency for train operations (Rosness, 2008). The strong focus on regulations in the rail is according to Rosness (2003) related to three system characteristics of the railway; it is a tight coupled system, the activities of the system are distributed over large geographical areas and the communications happens through means with low capacity, such as signals.

Also accidents that have happened in the rail sector in large degree affect safety in the sector. Organizations learn from accidents, both organizations directly affected by the accident and other organizations. But not only organizations learn, the whole sector learns (Størseth & Tinmannsvik, 2012) and learning also happens across borders. Research by Størseth and Tinmannsvik (2012) based on two accidents in the maritime and rail sector, show that the accidents have led to changes such as increased safety consciousness, a safety management shift towards risk based safety management, barrier thinking and a range of technology measures. At the same time they also found that procedures and management system became overwhelming, very comprehensive and rigid.

Earlier accidents often result in changes of regulations. For example after the Nidareid accident in 1921 in Norway, the operation regulations for the rail in Norway were revised. Two trains collided and six people lost their life and 12 were injured in this accident that happened in Trondheim. The cause of the accident was many misunderstandings, which again could be related to system weaknesses(Rosness, 2008). Another example is the Tretten accident from 1975, where also two trains collided. After the accident, where it was concluded that the train passed a red signal, it was found that the only way to hinder a train from passing a red signal was to implement a system that automatically makes the train brake. NSB followed this conclusion up by later implementing automatic train stopping systems (ATC) on parts of the railway net (Rosness, 2008).The last major rail accident on the passenger transport in Norway was the Åsta accident in 2000 where two passenger trains collided at Åsta. One was coming from the north, the other from the south. In the collision and the following fire 19 people died. The investigation report stated that the cause was either a malfunction in the signal system or a human error. After several accidents around 2000, risk analyses were conducted leading to several smaller and larger changes (Rosness, 2008). Also changes related to inspections and investigations can be traced back to the accidents.

To maintain safety in the rail system both design and management of the system is important. During operation of the system maintenance of physical means such as tracks, vehicles and control systems is important for safety (Elms, 2001). An example of a safety principle in the rail is called the "single

error principle", which means that one single error should not lead to fatalities or serious injuries. This principle has been in the regulations (FOR 1999-12-23 nr. 1402) since 1999, and is further built into new technical systems in the sector (Rosness, 2008). Another example is the Common Safety Method (CSM) for risk assessment in the railway system. These methods give a framework for Hazard Identification, Risk Analysis and Risk Evaluation and are implemented though a European Regulation ((EU) Nº2015/1136). Further, maintenance of human aspects through training and qualifications, and monitoring the safety climate and culture should be done.

But even with rules, regulations and safety systems errors can still occur in the railway system leading to incidents and accidents. This can be errors such as breakdowns of the train, to errors on the infrastructure or human errors. There are many safety systems and barriers implemented in a railway system to ensure safe operation. There are systems in the rail such as more types of blocking systems that are supposed to ensure that two trains are never in the same block of a stretch. There are systems for stopping trains automatically for example if a train passes a red signal called the Automatic Train Control (ATC).Other common safety measure are fencing around tracks and protection of crossing by gates, signals and bells. Not all stretches have the same safety systems. Across Norway there are varieties between lines, where some have fully automatic train control (FATC), others have partially automatic train control (DATC) and some do not have automatic train control (Norwegian National Rail Administration, 2015). The same is for traffic control where some lines have centralized traffic control (CTC), but not all. The lines that have FATC and DATC also have CTC (Norwegian National Rail Administration, 2015). The barrier model "*Defense in depth"* illustrates simply how barriers in a system work, and how failures of more barriers can lead to an accident (Reason, 1997). To avoid collisions there are for example several barriers: (1) signals and block systems, (2) departure procedure, (3) traffic clearance, (4) automatic train control, (5) direct communication and (6) power cut on lines with electric traction (Elvik, 2012). All these barriers must fail before an accident can happen.

From a literature study by Kyriakidis et al. (2015) it was found that human performance contributes to many railway incidents and accidents. For example between 1990 and 2009 in Europe, more than one-third of the accidents were caused by human errors such as passing a signal at danger, the second main cause was signaling and dispatching errors followed by over speeding (Evans, 2011).

Smith et al. (2012) write that "failures by the management structure to recognize bad practice will require the emphasis on safety training and driver understanding to be re-evaluated". This shows that many aspects need to be considered when it comes to railway safety. Based on a literature review and an analysis of 479 rail accidents in Europe and the U.S., Kyriakidis et al. (2015) identified safety culture as the most occurring performance shaping factor (PSF) among organizational factors related to serious accidents. An example is the derailment accident in July 2013 in Santiago de Compostela in Spain where the main cause was found to be excessive speed. Excessive speed and inadequate breaking was a human error that could have been mitigated with train control system (Smith et al., 2012).

3.4 Internationalization in the railway transportation

The rail sector is obviously different from air, road and sea as the nature of the system and its characteristics makes it more restricted. This also influences the degree of internationalization and how far the process has come. When it comes to operation, there is a small degree of internationalization in Norway especially on the passenger transport. On the freight transport there are both more companies as well as some more foreign operators.

Liberalization is a mean on the way to internationalization in the sector. One of the aims of the railway packages in the EU is to maximize competition in the railway services. By opening up and ensuring equal premises for competition more actors will get the possibility to operate in the European countries.

Experiences from restructuring n in the railway sector

The railway is organized in many different ways across Europe and across the world. There are also differences in what changes that have been implemented in the different countries. Liberalization of the sector allows for more internationalization. The degree of liberalization in terms of deregulation[16] and privatization of the railway sector and how long ago the new structures have been implemented, differ between countries in Europe. Experiences and the state of the art in Europe on the field will in the following be described.

Until now four railway packages have been introduced in Europe with the aim of liberalizing the European railways. The principles of the packages are being introduced to the EU countries through directives. The changes in the operating structure in Norway and other countries are based on these directives. Beria et al. (2012) write that there are variations in how different countries apply ideas such as having a natural monopoly that guarantees access for any operator. Further they state that the differences depend on the different starting points of the national rail companies. The conditions in the countries varies such as the situation of the networks, degree of congestion, effectiveness of intermodal competition, courts of justice, regulatory and antitrust institutions and therefore there is no equal way to introduce liberalization (Beria et al., 2012). Beria et al. (2012) conclude that the effects of liberalization in Italy, Germany, Spain and France are still modest and the process is still incomplete despite the introduction of several railway packages.

From studies done in the freight sector in Europe it was found that there are operational problems for new entrants, such as infrastructure discrimination, non-transparent or liberalized energy supply, monopolistic shunting services, safety certification, terminal access restricting trade and weak or discriminatory regulatory authorities (Zunder et al., 2013). Further barriers were identified for the new operators such as trust problems between partners, carriage availability, lack of single European driver certification and access to non-path infrastructure and services (Zunder et al., 2013). Some of these issues might also be relevant and come up with more internationalization in the Norwegian rail market.

What type of actors and how many actors can operate in the sector depends on regulations and the infrastructure manager, as most of the restrictions comes down to permissions and technical restrictions. The internationalization of the sector can therefore mainly be divided into two parts, where the first concerns regulations and policies and the second concerns the operation.

Rules and regulations

The first part of the globalization process concerns regulations and policies. The changes in Europe are in many ways affecting the railway sector in Norway. Norway is not a part of the European Union (EU), but is through several agreements closely related to and cooperating with the EU member states. Through the EEA-agreement EU regulations are taken into national legislation. The regulations and policies are therefore important parts of the internationalization process going on in the railway sector and they affect this sector in many ways. Despite common rules and regulations, there are still large differences between the organizational structures of the railway in different European countries.

The Fourth Railway package suggested by the European Commission has the aim of establishing one European rail area. One of the main focus areas is "establishing consistent approvals procedures for rail interoperability and safety". The package wishes to open up for more competition and cross-border train services. However, more aspects of organization and operation of railway in Europe must then be more similar. To adapt to the new suggestions from the EU, and to get a better, more efficient railway in Norway, the government is open to change today's structure of the railway operation.

[16] Deregulation is by Johnsen et al. (2002) defined as removing or changing rules and regulations governing competition, in a way that changes the market from a monopoly (or similar) to an open market with free competition between entrants.

Interoperability
The other aspect concerns operation and in addition to restrictions coming from regulations, technical factors will influence the degree of internationalization. Physical differences such as electrification systems and sizes of gauges influence the technical possibilities of operation. This will affect cross-border operation. As mentioned earlier, there are already some systems with the aim to ensure interoperability between countries, but the railway system is far from standardized. One European rail will require a lot more standardization and common systems. A challenge for standardization is the long life span of the elements in the rail system. Therefore changing the systems across Europe will take time.

3.5 Implications of internationalization on railway safety

The Rail reform in Norway will lead to changes that can affect the safety. The railway system may become more complex with more actors. New requirements can come up and there might be more need for coordination between actors. There will be a need to have clear responsibilities for different aspects and of course for safety and emergency preparedness.

Experiences from reforms and organizations of the railway in other countries and how they affected the safety level in the railway sector can give an indication of aspects that need to be considered. As the systems are different with different regulations, organization, framework conditions, and also react differently, the findings from other countries are not necessarily completely transferable to the Norwegian rail.

With the implementation of the railway packages in Europe that are supposed to ensure interoperability in the railway systems, new challenges related to safety may arise. Johnsen et al. (2006) have looked at the safety culture at interfaces between organizations, which can be potential sources of safety problems. They focused on safety challenges related to several interfaces and stakeholders, e.g. interfaces between train drivers and rail traffic control centers (signalers) across borders, and interfaces between infrastructure and maintenance operators. They claim that one of the main challenges is to involve the different organizations and make them agree on common solutions. Further, competing organizations should learn from each other and exchange of experience should take place between the competing organizations. Kyriakidis et al. (2015) also emphasize the importance to improve safety culture and to develop proper and targeted mitigation measures for specific factors that influence safety in the rail system.

According to Longva et al. (2005) the rail safety would not be reduced because of increased competition and they did not find any documentation that some competition regimes are better for safety than others. Elvik (2006) summarizes that experience show that deregulation of rail rather has been associated with improved safety. In Johnsen (2004) following problems with deregulation that might have an impact on safety are summarized; a) more focus on finances that can lead to decreased maintenance and less safety controls, b) new organizational structures can lead to fragmented responsibility, c) new entrants can be more prone to accidents in an initial phase, d) increase in traffic can overload traffic control and lead to stress and increase the level of incidents and accidents, and e) changes in rules and regulations can make the follow up less good or the rules might not be appropriate. All of this influences safety. A study that looks at the implications of an expansion of regulated access to railway infrastructure in Canada and the United States to serve freight traffic, shows that a fragmentation of rail traffic among carriers might lead to a reduction of rail safety (Cairns, 2013). However, Evans (2007) concluded that there is no evidence that privatization of the rail in Great Britain have affected the safety in a negative way. Another study by Evans (2010) on rail privatization in Japan comes to the same conclusion. A study by Evans (2013) from the United States where there has been economic restructuring also shows that safety did not suffer in the process of change.

Another aspect to be aware of with a new organization is that new roles and restructuring can lead to loss of competence. It has earlier been mentioned that informal competence and knowledge transfer

between old and new workers might be affected by such changes, as well as the safety culture in organizations. Challenges related to railway liberalization is the larger diversity of both companies and workers that may cause the sector lose the qualified professionals due to absence of technical training programs in learning institutions, and less informal channels and knowledge transfer between senior personnel and workers (López Peláez et al., 2012). This can according to this study lead to a poor occupational health and safety with large workloads and worse psychological and physical conditions for the workers.

3.6 Conclusions

To be able to achieve one European rail companies need to have the possibility to operate in different countries. As it is today, there are still many barriers. There are technical barriers such as gauge sizes, electricity systems, locomotive and carriage sizes and operating systems. There are also organizational barriers such as regulations that restrict operation and safety certificates. And new challenges might arise such as safety climate and culture differences, working conditions and terms of employment.

Regulations play an important role in railway operations, both when it comes to framework conditions and safety. Rules and regulations affect how competition evolves and what roles different operators can take. Further opening up for more railway actors and internationalization therefore require regulations that promote safety and safety work.
Studies mainly show that organizational changes have not impacted safety in a negative way. However, challenges related to safety that might come as a result of the changes are found. Good preparations and planning are crucial to succeed with internationalization of the rail and at the same time have a high safety level. It requires training, common values and rules, and participation from the different actors.

Research topics that are not explored much in the literature, but might be of relevance for further internationalization are:

- Focus on efficiency and earning
- Terms of employment and working conditions
- Rail security

More competition can lead to better and cheaper services for the customers, meaning that operators manage to operate in a more efficient way. That is at least one of the aims of competition. The literature suggests that opening up for more competition in other countries has not affected safety in a negative way (Longva et al., 2005). The terms the companies are competing on will play an important role in maintaining a high safety level. It might also happen that safety will be a competitive advantage for companies, meaning that it will be very highly prioritized. Anyhow, proper regulations and terms of operation will be important when introducing more competition.

Working in the rail in Norway has usually been considered a safe job, looking at job security and working conditions as the companies were state owned. For employees in passenger transport it is still this way, but for freight transport the conditions are already changing as there are more private companies operating. Opening up the rail sector more might lead to new operating structures, such as more hiring of labor as it is in other sectors. Another example of a new structure is that one company wins a bid, and recruits companies under themselves, that can even be foreign, to do the work. What structures are allowed depends on the regulations. New structures in operation might lead to changes that will affect occupational safety and also safety in the whole railway system.

With further changes in transportation patterns, internationalization and upgrading of the railway system that comes with it, rail might play an important role as a national infrastructure. Aspects such as societal security should be considered. With the aim of transporting even more goods and passenger on tracks, the railway might be an aim for sabotage such as terror attracts. There have been examples, such as the Madrid train bombings in 2004, or the Mumbai attacks in 2008 with shootings at a train

station; where terrorist have had trains or train stations as targets. Also natural disasters such as floods and hurricanes can affect the infrastructure and put the rail system out of action by washing out tracks or cutting of power. Another aspect of security is related to cyber security. More and more systems are connected to internet, where hackers can get access from all over the world. Not only systems that are directly a part of the railway system might get attacked, but also systems that the railway is dependent on, such as power supply can be targeted. Taking control over a train by a computer might put many lives at danger.

It is suggested that these topics are studied and evaluated closer in further work. Further, it seems that regulations play a crucial role to promote safety in the internationalization of railway, and therefore the best means to control safety through regulations should be found.

4 Aviation: Organization and characteristics of the aviation industry

4.1 Principal actors in the aviation industry

International civil aviation organization (ICAO): A United Nations specialized agency established in 1994. Its aim is to administer the Convention on International Civil Aviation (Chicago Convention). Cooperates with the Convention's 191 member states together with industry groups to reach consensus and agreement on international civil aviation Standards and Recommended practices (SARPs) and policies in order to support: *"... a safe, efficient, secure, economically sustainable and environmentally responsible civil aviation sector"* (ICAO, 2015a). The SARP's inform the ICAO Member States how local operations and regulations comply with global norms so that over 100.000 daily flights are able to operate safely and reliably across the globe (ICAO, 2015a). Furthermore, ICAO also works with coordinating assistance and capacity strengthening for States in order to support aviation development objectives, including for example auditing States' civil aviation oversight capabilities regarding safety and security together with monitoring and reporting on various air transport sector performance metrics (ICAO, 2015a).

European Aviation Safety Agency (EASA): The authority for aviation safety in the European Union. EASA was established in 2002 and the staff counts over 700 aviation experts and administrators from all EU Member States (EASA, 2015). EASA's main responsibilities are type certification of new aircraft and parts, the issue of environmental awareness certificates, and approval of businesses/organizations. Also responsible for controlling the businesses/organizations which they have authorized, including inspections in member states. EASA is also involved within the EU External Aviation Policy as being: *"... a strong counterpart of other Aviation Authorities outside the EU (e.g. USA, Canada, Brazil) and a major contributor to the export of the EU aviation standards worldwide, in order to promote the free movement of EU aeronautical products, professionals and services throughout the world"* (EASA, 2015). Norway became an EASA member in 2005. According to the EEA Agreement (The European Economic Area Agreement), Norway is obliged to comply with similar regulations as the European Union member states within aviation.

EUROCONTROL: An intergovernmental European organisation with 41 member states dealing with issues relating to the safety of air navigation and being committed to building the Single European Sky. Over 1900 professionals work at EUROCONTROL (EUROCONTROL, 2015b).

Ministry of Transport and Communications: The Ministry is the supreme governing body for aviation in Norway. The authority is partly exercised through ownership control of Avinor, and agency management of The CAA. The Ministry also exercises authority through legal regulation, purchase of air transport services and grants to non-state airports (Regjeringen, 2015).

Civil Aviation Authority (CAA): The CAA has primary responsibility for supervision of the Norwegian civil aviation industry. CAA's primary duty is to ensure that aviation in Norway is safe and effective. The CAA should also be active with respect to a safe and socially beneficial aviation industry consistent with the overall objectives of the Government's transport policy. Audits are undertaken towards: airlines, aircrafts, training organizations and maintenance services. The CAA shall also ensure aviation against terror and sabotage as well as working for HSE for flight personnel. The CAA will also develop and update regulations including participation and influence the development of international rules. The CAA receives its income over the national budget as well as charges related to supervisory activities (Luftfartstilsynet, 2015a).

Avinor: Wholly owned company by the state under the Norwegian Ministry of Transport and Communications. The company is responsible for 46 state-owned airports, twelve of them in cooperation with the Norwegian Armed Forces. Avinor also operates control towers, control centres

and technical infrastructure for safe air navigation. Avinor is self-financed and the primary sources of income are airline passenger fees, commercial revenue and income from airport hotels together with parking facilities (Avinor, 2015).

Accident Investigation Board Norway (AIBN): Being a public body of inquiry, the purpose of AIBN investigations is to clarify the sequence of events including factors assumed to be of relevance in order to prevent future transport accidents. It started out investigating aviation accidents in 1989, and now also includes railway, road traffic and shipping accidents (AIBN, 2015).

Interconnected actors and recent trends in the aviation industry

ILO (2013) points out that the aviation industry is composed of various actors categorized as air transport, manufacturers, passengers, governments, freight, aviation services together with airports and services (ILO, 2013). All these actors (figure 1) affect the industry in various ways whilst at the same time being complementary, something Tufts (2014) describes as an *assemblage* of complementary elements that jointly affect the opportunity space one has within the industry. Moreover, Julsrud et al. (2011) consider different scenarios within Norway for the development of air services in the future. The authors conclude that a possible reduction in air services also involves a reduction in aerial tourism, which may result in lower revenues in municipalities where tourism is very important for value creation. The following quote from Julsrud et al. (2011) illustrate how today's world economy is interconnected: *"Liberalisation and deregulation of international trade and investment, in combination with the development of ICT, have thus fundamentally changed the dynamics of global competition and contributed to the growth of global production networks. Increased globalisation does not necessarily imply that the world economy has become more open, but rather that it has become increasingly interconnected- mainly due to the growth of integrated production networks"* (Julsrud et al., 2011:II).

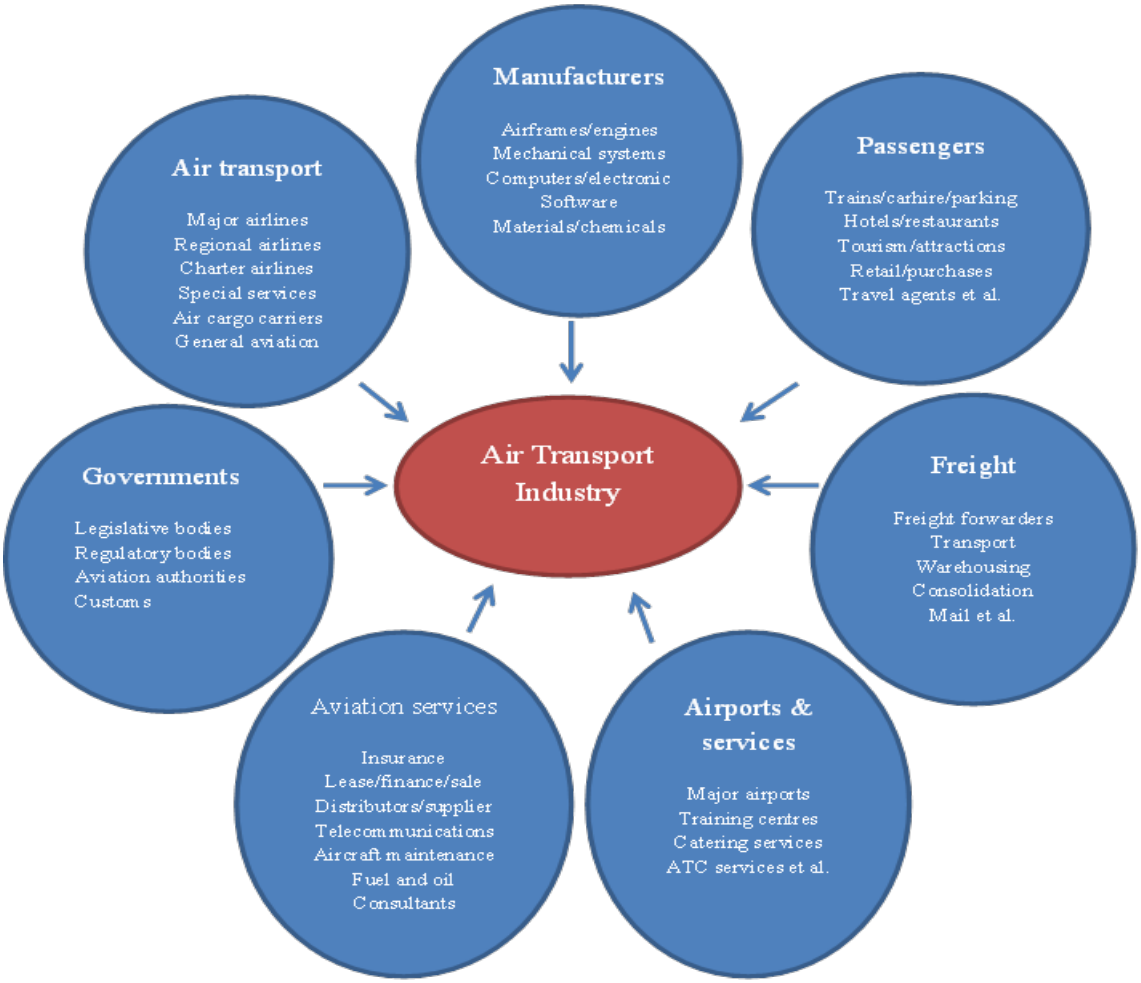

Figure 6 Overview of multiple actors in the aviation industry (Adopted from ILO 2013)

For example, without aircraft maintenance (aviation services) major airlines (air transport) will be unable to move passengers from A to B. Looking particularly at airlines (air transport) several aspects may be used to illustrate industry interdependency.

Airline business models

Cento (2009) presents 2 main types of airline business models based on how revenue is generated, the products offered, value-added services and target customers. Cento (2009) distinguishes between full-service carriers (FSC) and low-cost carriers (LCC). Table 1 outlines the main characteristics of each model.

Table 4 Airline business models (based on Cento, 2009 and Underthun & Bergene, 2014).

	FSC	**LCC**
Examples of carriers	SAS, United, Lufthansa	Ryanair, Norwegian, Southwest
Characteristics	Core business: Passengers, cargo maintenance, high flexibility, HS-network, global player, high cost level, high prices	Core business: Passengers, low flexibility, PP-network, secondary airports, regional player, low cost level, low prices

Percentage of passengers	66	22

Cento (2009) defines the FSC as an airline company evolved from former state-owned flag carriers through the deregulation processes. Looking at for example the element of global player, it means that FSCs are domestic, international and intercontinental actors flying short-, medium- and long haul flights from their main hubs. On the other hand, LCCs operate point-to-point networks (see below) offering no connections at their airport bases, destinations being continental only within the EU or US (Cento, 2009).

Airline network

A network is particularly important to any airline. According to Cento (2009), the network is strategically important; *"... as it is the main driver for generating revenue and costs as well as a source of competitive strength or weakness"* (Cento, 2009:29). Network management thus consists of four phases, namely 1) network strategy 2) network design 3) alliances 4) network planning. Without going into more detail on the different phases, it is worth noting that one distinguishes between two main types of networks (network design), the hub-and-spoke (HS) and point-to-point (pp) network. The HS network implies that all routes originate from a main hub, whereas the PP network is structured around the idea of point-to-point connections. The HS design implies inbound and outbound traffic from a major hub, while the PP design means traffic originating from one or few airports, or bases (Cento, 2009). We can see in this regard how the aviation industry is interconnected. For example, Cento (2009) points to the fact that the PP strategy seldom reaches its ideal configuration meaning that all airports are connected to each other. The reasons are both economic and air-political. Furthermore; *"... not all the city-pairs have enough demand volume to justify the operation of profitable flights, or there may be difficulties for carriers to obtain slots at all airports, and finally, logistic costs of fleet rotation may make it convenient for the airline to develop operational bases"* (Cento, 2009:32).

Airline alliances and consolidation

Cento (2009) describes how international alliances and consolidation among air carriers emerged after the deregulation of the market, the major objective being to include as many destinations as possible by linking with the traffic routes of partners. Cento (2009) argues for the following reasons to enter into alliances:

- Air-political: Having no traffic rights together with being excluded from controlling a foreign carrier with these rights.
- Economical: The airline's own costs/rights do not fit a given market.
- Infrastructural: Slots might be unavailable.
- Financially-related: The airline lacks resources in order to develop new markets.

For an airline, the fact that one enters an alliance could lead to increased market densities and reduction of fixed costs by way of utilizing code-share agreements (Pels, 2001). There are however various forms or levels an alliance can take ranging from mere codesharing and prizing to routes in joint venture followed by merger of shares and finally, a full merger. An example of the former is the global networks of Star Alliance, Skyteam and Oneworld, while an example of the latter is the first cross border merger in Europe in 2004 between KLM and Air France into the Air France-KLM group (Cento, 2009).

Air Traffic Management (ATM)

Smout (2011) illustrates how the aviation industry depends on a global infrastructure by describing how the global airspace is divided into 190 flight information regions. According to Smout (2011), air carriers' cost for using the airspace amounts to only 3-5 percent of their total spending. However, ATM (air traffic management) greatly influences the amount of fuel air carriers' use- fuel that represents 30 to 35 percent of an airline's overall costs (Smout, 2011). According to ILO (2013) citing

the International Federation of Air Traffic Controllers' Association, 160 air navigation service providers (ANSP) exist in numerous locations employing 200.000 people. The Single European Sky (SES) initiative in Europe thus aims to deliver more capacity and improve efficiency of the ATM system in Europe (Odoni, 2009).

Conditions of employment

One finds the following information on Air Transport Action Group's website; *"... over 58 million people are employed worldwide in aviation and related tourism. Of this, 8.7 million people work directly in the aviation industry"* (ATAG, 2015). According to Harvey & Turnbull (2001), labour has historically been the major cost component for airlines. The challenge is that airline management cannot control for example fuel costs equally as staffing. According to ILO (2013) referring to the United States Department of Transportation, decline in employment within the industry is connected with factors like outsourcing, growing share of LCCs flying newer planes with smaller crew, and technology which has taken over tasks like ticketing. Bergene and Underthun (2012) argue in their report for three main challenges associated with globalization in the transport sector, namely externalization and flexibilization, flags of convenience and challenges related to retaining competencies in Norway. Use of employment agencies in aviation related to aircrew is an example of the former. Outsourcing, together with subcontracting related to also ground services and catering are thus seen as ways for airlines to minimize cost. Moreover, airlines tend to establish new bases outside their home country together with also outsourcing call centres. However, despite outsourcing being viewed as a way for airlines to reduce their costs, IATA (2011) argues that outsourcing also has a negative side by way of airlines losing control over their value chains. Furthermore, Bamber et al. (2009) illustrate outsourcing in relation to collective bargaining by providing two examples of outsourced workers. In the case of British Airways, outsourced workers fell outside the company's collective bargaining. In the case of Lufthansa workers continued within the former collective framework.

Roles in the aviation industry

IATA (2011) presents a framework for conceptualizing the forces involved regarding airline industry profitability. The five forces are: 1) Intensity of rivalry, 2) threat of new entrants, 3) customers' bargaining power, 4) suppliers' bargaining power, 5) threat of substitutes. The argument is that profitability is a function of the interaction among the five forces and their respective strengths. Thus; *"... these forces shape the behavior of the actors and determine both the overall value created in the industry and the way in which this value is divided among them"* (IATA, 2011:30). The government's role is defined in this context in terms of how it affects each of the five forces, as in "intensity of rivalry"; *"... government effects rivalry at all levels, often in conflicting ways. Policy differences across countries can severely distort competition if policies at home give an airline key advantages in foreign markets"* (IATA, 2011:43).

Figure 2 illustrates various roles (see above for a more detailed description of the actors) involved in the aviation industry based on Foss (2015). *Transport demand:* entails users related to passenger transport and air cargo. The demand for the service is related to individual users- leisure as well as professionally, private companies and public entities. For example when it comes to cargo flights, the fish farming industry has a considerable need for transporting fish products to the Far East. *Transport regulation and enforcement* consists of all roles responsible for regulating and monitoring the aviation industry. Internationally we have ICAO and the EU commission through EASA. Nationally there is the Ministry of Transport and Communication and the CAA Norway. *Transport service provision* consists of all the roles providing, organizing and delivering the transport services. Examples are airlines like Norwegian, SAS and Widerøe together with ground service companies such as Aviator. *The Transport network management* implies roles related to owning, managing and operating the aviation infrastructure. The main owner is the Norwegian Ministry of Transport and Communication via Avinor. There are also private companies involed, for example in relation to Torp airport. The *Transport support services* include the roles offering services for operating elements within the transport system. For aviation this can be GPS providers used for navigational purposes.

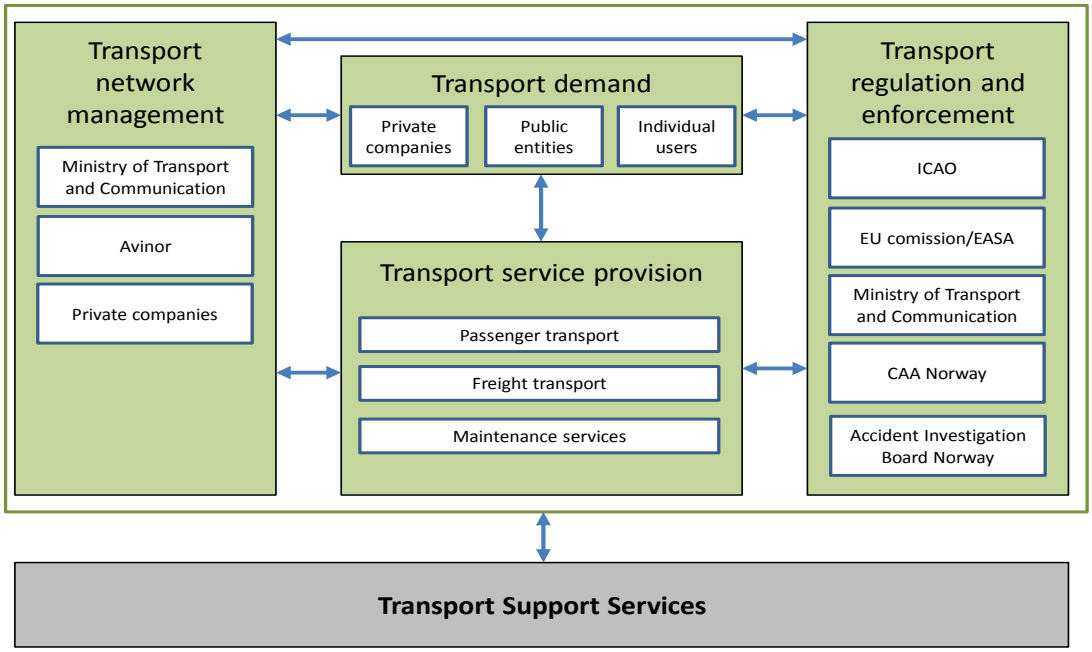

Figure 7 A framework of transport roles and responsibilities (Foss, 2015).

Industry crises

Being employed in civil aviation has meant significant changes over the past 10-15 years. The industry has seen crises which have led to changes. Some crises have been manmade whereas others have been the result of nature. The following crises have affected the industry (ILO, 2013):

The terrorist attacks on September 11, 2001

These attacks had a devastating effect on the entire industry with both American and European carriers significantly reducing their available seat kilometers the following winter. The attacks resulted in uncertainty about which legal liability airlines had. A law was introduced in 2001 which limited company responsibility and provided direct support (Goodman, 2008). At the same time, a significant cutback of employees was also implemented. European airlines cut 10 per cent while North American airlines cut 20 per cent. Ground services, aircraft manufacturers together with airports were also affected. Moreover, aircraft orders were canceled (ILO, 2003). However, it is worth noting that the industry already had challenges ahead of September 11 with soaring fuel prices and low customer satisfaction (Belobaba & Odoni, 2009).

The SARS outbreak in 2002-03

The Severe Acute Respiratory Syndrome (SARS) epidemic which lasted from November 2002 to July 2003 caused more harm to the aviation industry than 9/11 and the Iraq war combined. The global air traffic declined by 18.5 percent, however, airlines in Asia together with airports in Hong Kong, Singapore and Seoul were hit particularly hard. Here traffic was down by as much as 40-60 percent (Essenberg, 2003).

The economic crisis in 2008-09

Being sensitive to economic cycles, the aviation industry was consequently hit hard during the economic crisis of 2008-09. In the US, all airlines except Southwest Airlines were forced to reduce capacity. Lufthansa for example reduced working hours and British Airways froze wages. In

Scandinavia, Scandinavian Airlines (SAS) reduced their capacity with 40 percent (Harvey & Turnbull, 2009).

The challenges related to the volcanic eruption in Iceland in 2010

According to ILO (2013), the volcanic eruption in Iceland in April 2010 resulted in the largest halt in civil aviation since the Second World War. The total cost for the breakdown was estimated at $ 4.7 billion and a total of 100.000 flights were cancelled the first week.

International anchorage and corporate responsibility

Based on their report on the role and significance of aviation in a globalised world, Julsrud et al., (2011) put forth three drivers for globalisation, globalisation seen as; *"... development towards increasingly interconnected global circuits of production, distribution and consumption"* (Julsrud et al., 2011:1). The drivers are:

- The liberalisation of world trade fueled by organizations such as the International Monetary Fund (IMF) and the World Trade Organization (WTO). Also, the single European market also facilitates for increased trade among countries. Furthermore, The collapse of the Soviet Union together with China and India both becoming more integrated into the global economy further stimulate trade growth.
- The reduced cost of transport and communication also fuels globalisation processes stimulating growth in the flow of products and materials where the development of for example commercial jet aircraft played a significant part. Importantly, the development of the internet and new information and communication technologies (ICT), including effective dissemination of information is also important in this context.
- *Competition* implies no longer national boundaries. Two effects are derived from this; spread and integration implying that enterprises need to be present in global growth markets and to be able to integrate activities in a global manner. Conclusively, global competition has fundamentally changed how enterprises organise for business, including growth and localisation.

Aviation has become a formidable industry with a significant social impact. The following quote from ILO (2013) is indicative of the industry's international importance: *"Without air travel, mass international tourism would not exist, nor could global supply chains function. Some 40 percent of high-tech sales depend on good quality air transport, and there is no alternative mode of transport for perishable commodities such as fresh food or cut flowers"* (ILO, 2013:2). The aviation industry in Norway has had a quantitative major growth in the last 10 years, a development which must be seen in light of the industry's economical and political importance (Underthun & Bergene, 2014). Within Norway, Underthun and Bergene (2014) refers to statistics collected from Avinor showing that both the number of passengers and number of flights have increased considerably over the last 10 years, respectively 87 and 17 percent. According to Julsrud et al. (2011) Norwegian companies become more and more integrated within global production networks, resulting in air services, together with information and communication technologies, to assume pronounced roles. In their report on the significance of aviation for Norwegian industry, Julsrud et al. (2011) argue that travel is fundamental in order to develop new markets and business relations. Air travel is thus seen as a precondition for being able to operate as a global enterprise:

"There is a clear trend towards increasing intercontinental travel by Norwegian company personnel, especially to destinations in the USA and Asia. The motives for air travel are industry specific, but a common motivating factor is the need for face-to-face contact in developing relationships of trust, which is of particular importance in knowledge based project cooperation and joint venturing. This underscores the need for physical meetings and air travel, and the greater orientation of contemporary Norwegian business activities towards the Asian market may contribute to reinforcing this development. Air cargo from Norway has been gaining increasing importance during recent

years, largely due to the increased transport of fresh salmon to markets in Asia and the USA" (Julsrud et al., 2011:I).

Air travel is essential for the tourist industry in Norway, which is reflected in the fact that almost all inbound tourism over the last 10-12 years has been based on air travel (Julsrud et al., 2011). Moreover, Lian et al. (2005) explain that Norway's oil & gas production depends on a good route network, particularly in regions where this industry is heavily established. Furthermore, the Norwegian health sector is also highly dependent on aviation. This applies to travel on both regular scheduled flights related to health, as well as explicit ambulance flights (Lian et al., 2005).

Liberalization and market (de)regulation

The aviation industry has historically dealt with different types of regulatory frameworks. Underthun and Bergene (2014) list 3 types of frameworks in the period between 1919 and through the seventies: 1) Bilateral agreements 2) Agreements between airlines about the route network 3) Agreements on price negotiated through IATA. As a result of the Paris Convention in 1919 independent states were awarded sovereignty over their national territory (Underthun & Bergene, 2014). This meant that the states themselves decided on where one could be flying, the number of airlines on various routes, frequencies and with what capacity (Lucio et al, 2001). According to Bergene and Underthun (2012) airlines operating within the above bilateral agreements also made agreements between themselves involving how to share profits and costs, which meant that airlines avoided losses on less attractive routes together with avoiding competition regarding the frequency on routes. *"The bilateral agreements specified the traffic rights for each operating carrier, the number of airports in which they operate, the number of carriers, and the frequencies of flights between the fixed airports. Those airlines were, in practice, the national flag carriers of each country (state-owned)"* (Cento, 2009:14). Since 1947, IATA's primary function was to determine the tariffs for air travel, something that made competition very difficult. However, IATA's role today is more advisory in the sense that one offers guidelines for an industry characterized by heterogeneity (Underthun & Bergene, 2014).

Market deregulation

The United States domestic market started to be liberalized in 1978 (Cento, 2009). Anderson et al. (2005) describe the major marked consequences to be; 1) entry of low cost carriers 2) mergers among main carriers 3) growth in number of travelers 4) decline of air fares 5) increased variability in fares 6) emergence of the HS system. Following the US deregulation, the EU Commission began efforts to liberalize the aviation industry in the late 1970s whereas; *"... three policy packages were agreed in 1988, 1990 and 1993, and full deregulation came into force in 1997. The Third package was the most important one as, by then, pricing capacity and access were fully deregulated"* (Cento, 2009:15). Furthermore, the carriers are allowed to compete freely on routes, frequencies, prices, together with service levels. In addition, previous limitations on cross-border mergers within the EU were removed. Nevertheless, most countries still limit foreign ownership of airlines, restricting it to less than 50 percent (ILO, 2013). *"Lifting restrictions on ownership could bring air transport to the same situation as in the shipping industry: that ownership and nationality (flag state) are two different things. One argument for current regulations is that lifting restrictions on ownership could lead to flags of convenience for airlines"* (ILO, 2013:20). Cento (2009) cites Brueckner and Pels (2003) regarding deregulating effects on routes and fares. In the late 1990s the following changes materialized:

Further development of the HS strategy by former flag carriers
Rise of airline' alliances
Growth of low-cost carriers

Single European Sky and Open skies

EU adopted in 2004 a legislative framework for the creation of the single European sky where one wanted to create a consistent European airspace with more capacity, which was introduced in Norway from 2007 (Underthun & Bergene, 2014). The Single European Sky is a legislative framework for European aviation with the primary aim: *"... to meet future capacity and safety needs through legislation"* (EUROCONTROL, 2015a). A particular focus is on establishing targets in specific areas

like safety, network capacity, effectiveness and environmental impact together with being supported by research through the Single European Sky ATM Research, providing advanced technologies and procedures for the modernization and optimization of future European air traffic management (EUROCONTROL, 2015a). EUROCONTROL assists the European Union regarding both regulatory and technological elements related to the Single European Sky via:

Drafting implementing rules, guidance and technical regulatory material for the implementation of SES regulations
Assisting member states in exercising their regulatory functions
Identifying needs for new regulations for the complex new ATM technologies and procedures delivered by SESAR (EUROCONTROL, 2015b).

The liberalization mentioned above only applies within the EU / EEA. Air traffic to and from countries outside the EU and EEA, remains governed primarily by bilateral agreements (Underthun & Bergene, 2014). However, the EU and the US have negotiated the Open-Skies agreement which allows European airlines the opportunity fly without any restrictions from any point in the EU to any point in the US. Cento (2009) refers to three aspects which could be crucial for the future of aviation:

All European carriers are recognized as community air carriers. All airlines in EU are classified identically.
It is possible to fly from any point in the EU to any point in the US and vice versa.
Flights are allowed beyond the US towards third countries, meaning one can use the US as stopover.
Yet, the agreement still poses some limitations. Foreigners are not allowed to own more than 25 percent of the voting shares in any US airline, the percentage being 49 percent the other way around. Also, the US domestic market is totally closed to foreign airlines including cabotage, which is forbidden (Cento, 2009). Although the deal can strengthen competition in the market, including reducing rates, this will depend on how companies react. For example; *"... rather than to compete, the airlines using hub–spoke networks stick to their fortress hubs, and enter alliance agreements. The lack of competition on low-density routes may be intrinsic to the aviation sector; demand may be too low to allow more than just a few (or even one) carrier to obtain a profitable market share"* (Pels, 2009:84).

Aviation in the change through regulation
However, Lucio et al. (2001) points to the fact that even tough liberalization and the fact that one does no longer operate with separate national markets characterizes the aviation industry, regulations per se are still in place regarding safety. Cf. the Treaty of Rome article 85 and joint European safety rules (EU, 2015) adopted by the European Commission based on technical guidance from EASA. *"The proper implementation of the rules is regularly monitored by the Commission with the assistance of EASA which carries out regular standardisation inspections in all Member States"* (EU, 2015). The fundamental regulation (EU, 2015) now consists of:

Airworthiness and environmental protection of aircraft
Aircrew
Air operations
Aerodromes
ATM/ANS
Air Traffic Controllers

The following quote sums up the role of the joint European safety rules, they: *"... constitute the backbone of the EU aviation safety system. They provide for a uniform level of requirements for the operators, manufacturers and aviation personnel, thus facilitating the flow of products, persons and services in the internal market, and allowing for mutual recognition of certificates, reducing the administrative burden and workload for the national authorities and the industry"* (EU, 2015).

According to Underthun and Bergene (2014) these technical and safety regulations come in addition to the economic regulations outlined earlier, cf. deregulation of the market.

Being a member of EASA, Norway is obliged to follow similar regulations as EU member states. Moreover, the Norwegian Aviation Act with appurtenant regulations also regulates aviation in Norway. Many of the regulations are contained in the Regulations for Civil Aviation (BSL). However, Underthun and Bergene (2014) point out that more and more of the Norwegian regulations implement EU legislation. Yet one still finds special Norwegian rules.

The EU adopted on 29th January 2014 the new EU fatigue management regulation (Flight and Duty Time Limitations and rest requirements, FTL) for crew members in civil air transport. The rules will be implemented with effect from 18 February 2016 (Luftfartstilsynet, 2015b). One of the main objectives of the regulations is to harmonize the regulations within the EU including limiting national regulation. According to EASA, the new regulation is research based including risk assessments together with best practice (EASA, 2015b). Some of the new rules entail:

- A reduction of the maximum duration concerning night operations from 11 hours and 45 minutes to 11 hours
- More flights will be defined as night flights
- The total flight and service time for 12 consecutive months is limited to 1000 hours compared to the current 1,300 hours

However, for some countries, the new regulations mean a tightening of current regulations, while for others it means a weakening (Underthun & Bergene, 2014).

In 2012 the EU adopted new rules on air operations. The "EASA OPS" will be implemented with effect from October 28, 2014. This new legislation is due to EASA having been extending its area of authority to encompass air operations requirements. EASA-OPS will regulate aviation operations involving any aircraft, whether we are talking about airplanes, helicopters or gliders, and replaces the current national regulations. States cannot maintain national special regulations within the scope of EASA OPS (Luftfartstilsynet, 2015b).

The safety state in the aviation sector

"Aviation safety is the concern of the whole world. Its importance is unanimously recognized. While air transportation is by far the safest mode of travel, as measured by the ratio between the number of accidents and that of passenger/kilometers, it is susceptible to inherent risks of flight, the use of force, and, more dangerously, terrorist acts. From time to time, when major aviation related accidents or tragic events take place, the whole world is shaken. Consequently, aviation safety has been and will be a matter of vital importance for governments, industry, the academic community and the traveling public" (Huang, 2008:5).

Huang (2008) point out that safety concerns in aviation is often associated with preventing accidents. However, as the events of 11 September 2001 demonstrated, aviation safety includes but is not limited to operational flight safety. Aviation safety goes beyond only accident prevention extending to political, strategic and legal dimensions. Aviation safety includes preventive, remedial and punitive measures and therefore should be considered more broadly including risk management per se (Huang, 2008). According to Huang (2008), risk management may involve suspension of a pilot's licence to temporary grounding of specific aircrafts at specific moments in time. Furthermore; *"... a particular safety standard is very attractive from a technical point of view, but it may not be cost-effective or may even be economically prohibitive to implement. In that case, a careful policy judgement is needed to determine what standard should be imposed. Consequently, aviation safety requires a multidisciplinary approach: technical, economic, managerial, and, obviously for the purposes of the present study, legal"* (Huang, 2008:7).

ICAO defines aviation safety as; *"... the state of freedom from unacceptable risk of injury to persons or damage to aircraft and property"* (Huang, 2008:6). ICAO's fundamental strategic objective is improving the safety of the global air transport system (ICAO, 2015b). ICAO thus constantly works to strengthen global aviation safety by setting the Standards and Recommended Practices (SARPs) necessary for aviation safety, security, efficiency and environmental protection on a global basis. The following activities are in focus (ICAO, 2015b):

- Policy and Standardization initiatives
- Monitoring of key safety trends and indicators
- Safety Analysis
- Implementing programmes to address safety issues

Approximately 3.2 billion passengers flew commercially in 2014, an 5% increase compared to 2013. Figure 3 illustrates the total number of accidents vs. number of fatalities for the period 2010-15. There is an 9% increase in the number of accidents from 2013 to 2014, the amount being 98 accidents in 2014.
According to ICAO (2015b), the 904 fatalities in 2014 is the highest number for five years. The high number is in large part related to Malaysia Airlines Flight MH 370 and MH 17. Moreover, the global accident rate increased from 2.8 accidents per million departures in 2013 to 3.0 accidents per million departures in 2014, a 7% increase. Nevertheless, the number of fatal accidents decreased in 2014 by 7, the lowest number in recent years (ICAO, 2015b).

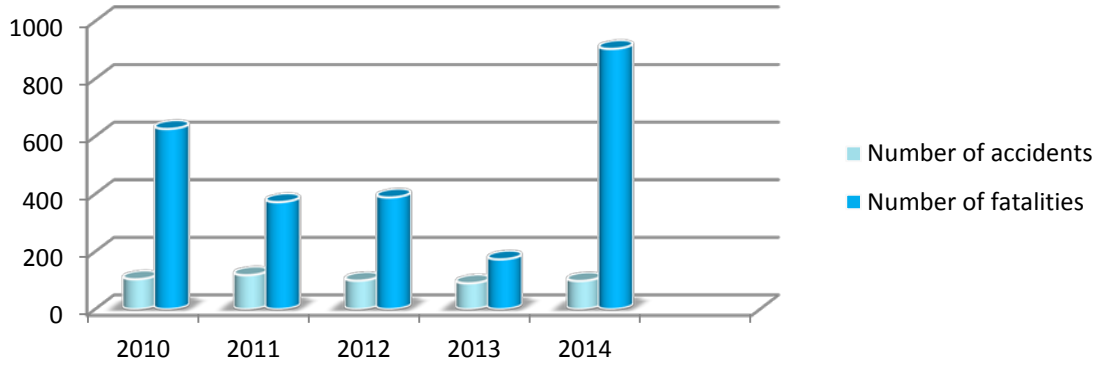

Figure 8 Accident records for scheduled commercial flights 2010–2014 (adopted from ICAO 2015b)

When it comes to potential challenges for aviation safety in the light of internationalization and globalization, it makes sense to see this in relation to some of the topics highlighted earlier. For example, Bergene and Underthun (2012) put forth 2 main challenges associated with globalization, namely externalization/flexibilization together with flags of convenience. These are challenges that may also have safety consequences. In terms of outsourcing, Quinlan et al. (2013) highlights risk factors in relation to aircraft maintenance; *"fail to draw upon recognised failure mechanisms associated with outsourcing/subcontracting trends in other industries, such as economic pressures, contingent employment, training deficits and poor regulatory oversight that can undermine safety outcomes"* (Quinlan et al., 2013:284). Also, despite outsourcing being viewed as a way for airlines to reduce their costs, IATA (2011) argues that outsourcing also has a negative side by way of airlines losing control over their value chains. Moreover, in terms of "flags of convenience" ICAO (2013) cites The International Transport Workers' Federation (ITF) regarding new working conditions and possible implications relevant also for aviation safety. In the maritime sector, the "unbundling" as to ownership, nationality and safety standards have resulted in some ship-owners to reduce employment standards and conditions for their workers, including the most relaxed safety standards and oversight for ones operations (ICAO, 2013).

Relying on Safety Management Systems, ICAO advocates a strategy comprised of both proactive and reactive safety analysis and risk management processes (ICAO, 2015b). This can be seen in view of regulatory and standardized approaches to safety, something that Roelen and Klompstra (2012) problematize by pointing to the challenges associated with actually defining the aviation safety performance indicators within any given safety management system. Furthermore, the role of EASA is important in terms of regulation and safety. Consider the implementation of the new EU fatigue management regulation (Flight and Duty Time Limitations and rest requirements, FTL) for crew members in civil air transport aiming at harmonizing EU regulations. As mentioned for some countries,
the new regulations mean a tightening of current regulations, while for others it means a weakening (Underthun & Bergene, 2014). For example, the US allows a maximum of 9 hours flight time during night conditions while the new EU regulations states 11 hours. This kind of examples creates concerns among employees, considering that fatigue is traditionally a well-known cause of accidents in the aviation industry (Underthun & Bergene, 2014).

5 The Road sector

5.1 Organisation of the road sector

The roles in the road sector can be allocated to 5 different role domains as shown in Figure 1:
The ***Transport demand*** subdomain covers all roles that demand or request a transport service, e.g. a company that wants to move a transport item from A to B or a person that wants to be transported from C to D. An entity covering all the responsibilities related to this domain is called a Transport user (short for Transport service user) or just User. A car driver and a bus passenger are typical examples on Transport users. A wholesaler who needs to move the goods from his warehouse to the individual shops is also a typical example. The Transport user may be an individual person, private company or organisation requiring a transport service. It could also be a public authority, e.g. a city transport authority purchasing public transport services.

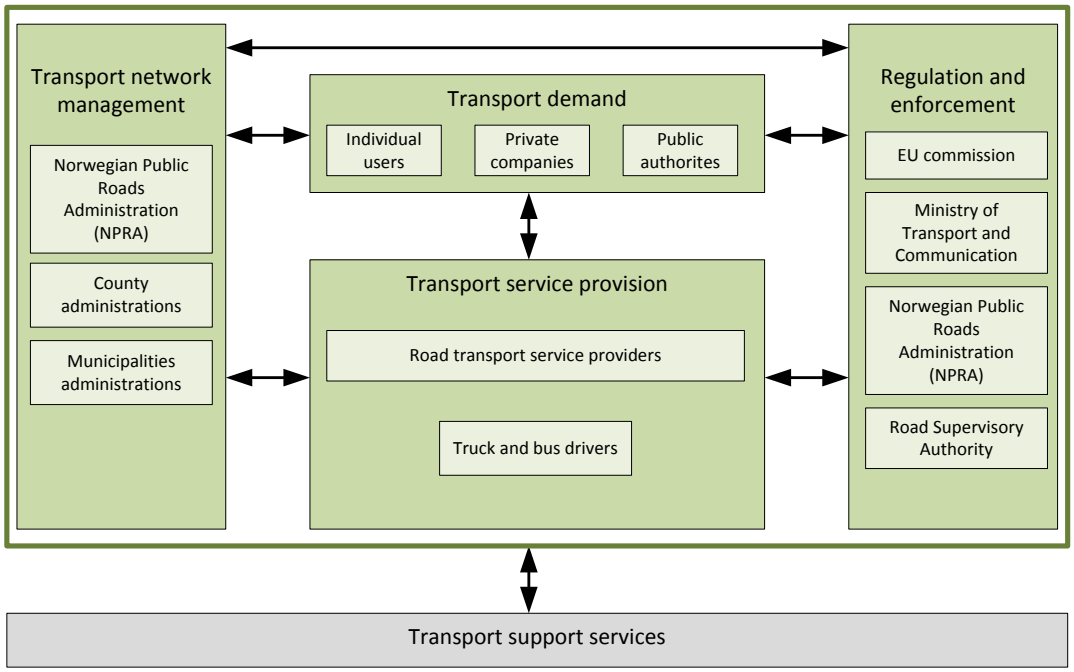

Figure 9: Road sector organisation

The ***Transport service provision*** subdomain includes all roles that sell and sign contracts related to a transport service, organises and deliver the transport service and manages/manoeuvres the transport means, e.g. truck or bus, used for the transport service.

Typical actors fulfilling the responsibilities of a road transport service provider are national and international freight transport companies, e.g. DHL, and public transport companies, e.g. Ruter in Oslo and AtB in Trondheim.

The road freight transport service market is a highly competitive one where price is the most important criterion for commissions (Tretvik et al., 2014; Holguín-Veras et al., 2006). Transport service providers are a heterogeneous group consisting of relatively large third party logistics operators and carrier firms of various sizes. The Norges Lastebileier-Forbund (he Norwegian Truck owners association), who is the largest trade union for heavy goods vehicles (truck) owners, performs an annual survey among their members. According to the survey for 2014, the Norwegian truck business typically consists of many small firms, as 62 % of the firms have 5 or fewer employees.

The ***Transport network management*** subdomain covers all roles related to the management, operation and maintenance of the road infrastructure. It also covers all roles related to the utilisation of the infrastructure, e.g. the management of vehicles in a road network. The most typical actors fulfilling the responsibilities of road network management are the Norwegian Public Roads Administration (Statens vegvesen) and the regional and local authorities in charge of county and municipality roads.

The ***Regulation and enforcement*** subdomain includes all roles related to the regulation and monitoring of the road transport domain. The subdomain includes typical roles as transport departments and authorities, financial authorities etc. preparing and issuing laws, regulations, prescriptions and recommendations on how the transport in the Norwegian road infrastructure shall be carried through and controlled and/or monitored.

Typical actors in this domain are the European and national transport authorities. The EU commission issues EU Directives for road transport that have to be transformed to Norwegian laws and regulations. The Ministry of Transport and communications issues laws and regulations for road transport, e.g. Act relating to road traffic (Vegtrafikkloven), Act relating to Commercial transport (Yrkestransportloven), Act relating to Roads (Vegloven) and Regulation relating to Public transport (Forskrift om offentlig persontransport). The Norwegian Public Roads Administration (NPRA) issues regulations that are permitted by Norwegian laws. One typical example is the Regulation on road vehicles (Forskrift om tekniske krav og godkjenning av kjøretøy, deler og utstyr (kjøretøyforskriften)) settled by the NPRA and permitted by the Act relating to Roads.

The NPRA has both regulator responsibilities and enforcement responsibilities, e.g. the Regulation on road vehicles is settled by the NPRA and enforced by NPRA by its vehicle controls. The vehicle controls are as given by the EU directives *Directive 2014/45/EU on periodic roadworthiness tests for motor vehicles and their trailers and the repealing Directive 2009/40/EC Text with EEA relevance* and the directive *Directive 2014/47/EU on the technical roadside inspection of the roadworthiness of commercial vehicles circulating in the Union and repealing Directive 2000/30/EC Text with EEA relevance*.

The Road Supervisory Authority (RSA) is a professional body under the Ministry of Transport and Communications and is mandated to monitor and supervise the activities of the Norwegian Public Road Administration (NPRA) with regard to the national road network. The RSA conducts risk-based system supervision. This means monitoring whether the NPRA has adequate and effective quality control systems to ensure that mandated requirements for traffic safety are met.
The ***Transport support services*** covers all roles that provide any type of service that could be used to operate a transport system. Their core business is not related to transport but their services are used to enable and/or facilitate an effective and secure operation of a transport system, e.g. the communication services provided by a telecom operator or the positioning services from the GPS system. In Norway the transport support services are provided by Norwegian operators, e.g. Telenor and Netcom for communication services used by transport users and transport service providers and are less relevant for globalisation so far.

5.2 System Characteristics related to safety

Describing parameters
A road transport system is on a high level described by the following parameters:

- The driver
- The vehicle
- The items transported
- The road infrastructure

The *driver* is any person that is allowed to drive a vehicle having gone through the driving licence training and having passed the examination. The drivers are in the age between 18 and 80 – 90 years for light vehicles. However, after the driver is 75 years he/she needs a health certificate which is given for maximum 5 years. When the health certificate expires the driver has to renew his driver licence but without any examination. A truck driver has to be minimum 21 years and a bus driver has to be minimum 24 years. The European driver licences are regulated by an EU directive (Directive 2006/126/EC).

Different categories of driver licence require different levels of education and examination where driving buses and heavy goods vehicles with trailers have the highest requirements. The driver training in Norway is defined in the guideline on driver training issued by the Norwegian Public Roads Administration (NPRA, 2005). All drivers involved in commercial transport, e.g. freight and passenger transport, shall have a certificate of professional competence in addition to the driver licence for heavy vehicles and buses. The certificate has to be renewed every 5th year and the renewal requires a 35 hours training course at an approved educational institution.
The driving and rest time for drivers involved in commercial transport are regulated by an EU Regulation (Regulation (EC) 561/2006). The driving and resting time is controlled by a digital speed recorder with a driver ID card inserted or an analogue speed recorder with discs. However, there are several ways of cheating the recording system according to the NPRA vehicle controllers.
Drivers of light vehicles in Norway are mostly Norwegians but there are also tourists and immigrants that may have a different driver training and culture. For heavy goods vehicles the situation is quite different as the number of foreign drivers in the Norwegian road transport system is increasing. The statistics from Statistics Norway (SSB, 2014) shows that it has been a trend since 2005 that the total transport work in mill. tonne km provided by foreign trucks is increasing. The statistics is based on truck surveys in other EU countries and there may be some uncertainties in the registrations. As shown in Figure 2 the trend so far is an increase in total amount of mill. tonne km provided by foreign vehicles. There is also an increasing trend in Third country vehicle transport, e.g. a vehicle from Poland transport goods between Germany and Norway. There is also an increasing trend in cabotage transport, i.e. a foreign vehicle having transported goods into Norway is providing transport services within Norway before the vehicle leaves Norway.

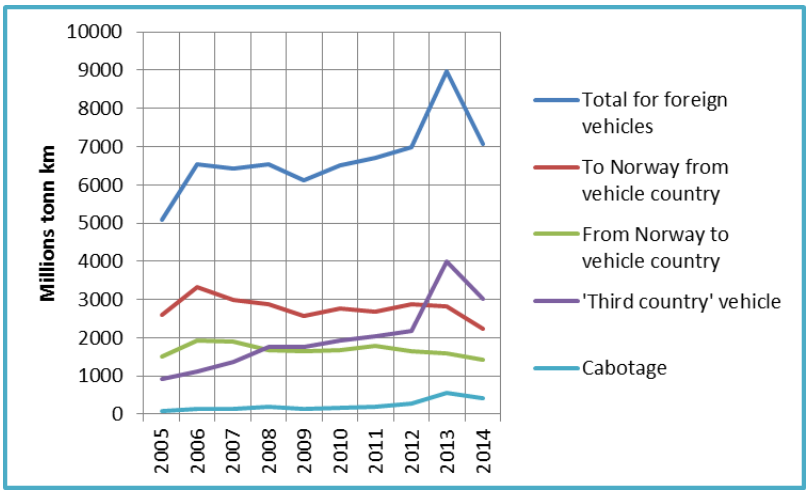

Figure 10 Transport work provided by foreign vehicles in Norway

The Norwegian Truck Association claims that foreign trucks are about 1/3 of all the trucks on the road. The claim is based on a registration on 20 different major road sections in Norway (NLF, 2015).
The Norwegian Public Roads Administration has issued a guide for foreign truck drivers (NPRA, 2015). In this guide, the Norwegian Public Roads Administration has gathered important information that foreign heavy-vehicle operators need to know in order to drive safely in Norway. The guide provides a list of required tyre equipment and wheel chains and a number of relevant laws and regulations applicable to heavy-vehicle driving in Norway. The Trucker's Guide is translated into English, Finnish, Lithuanian, Polish, Russian and German. The Trucker's Guide is available on the NPRA website, vegvesen.no/donnadiesel.
The *vehicles* of interest concerning this literature review are foreign trucks, foreign trucks with trailers and foreign buses. The Trucker's guide includes the Norwegian regulations concerning heavy vehicles to be used in Norway. Important issues related to safety are: Physical characteristics like length, width and height and weight parameters like axle loads and total permissible load. The guide also describes how the vehicle should be equipped during winter time, e.g. winter tyres and snow chains.

The *items transported* are goods and passengers. The guide described above lists all the different laws, regulations and rules related to the transport of passengers and goods. Crucial issues that are described in relation to safety and transport of goods are hazardous goods and placing and securing goods. Poorly secured cargo is the cause of many accidents. Because of this, the Norwegian Public Roads Administration carries out frequent inspections throughout the country.
The *road infrastructure* consists of the national roads (riksveger), county roads (fylkesveger) and municipality roads (kommunale veger). The standard of the road infrastructure varies considerably, both within each of the categories and between the three categories. The Norwegian Public Roads Administration has prepared two road maps for Norway (northern and southern part of Norway) including information on road sections that may be difficult to pass with heavy vehicles, tunnels and bridges with vehicle dimensions, axle load and type of goods restrictions, road sections that are closed during winter time, rest areas, toll stations, ferries etc. (NPRA, 2015). The road infrastructure availability may differ during the year as winter conditions with snow and ice will often cause slippery road surfaces that again have an impact on the road safety and passability.

5.3 Road safety

From a road safety viewpoint the safety in the road transport system is related to:

- The Driver behaviour where the behaviour is based on the training and experience of the driver, physical characteristics of the driver like age, sight and hearing abilities, driving culture, driver stress and fatigue and driver monitoring and enforcement of regulation violations.
- Vehicle and its cargo where the technical status of the bus and the vehicle and its trailer is very important as well as how the cargo is placed and secured on the vehicle and trailer. It is also of some importance that the vehicle supports the driver in his control of the vehicle, e.g. electronic stability program (ESP) and traction control systems (ETS).
- The road infrastructure where the road geometry, sight distances and the status of the road surface may have an impact on the safety.

Road accidents are related to one or more of the three bullet points above and are very often a combination of two or three of the bullet points, e.g. a driver is not trained and/or experienced in handling slippery road surfaces and the vehicle is not equipped for winter conditions, see Figure 3. This is often the case with foreign drivers and vehicles (Nævestad et al. 2014a).

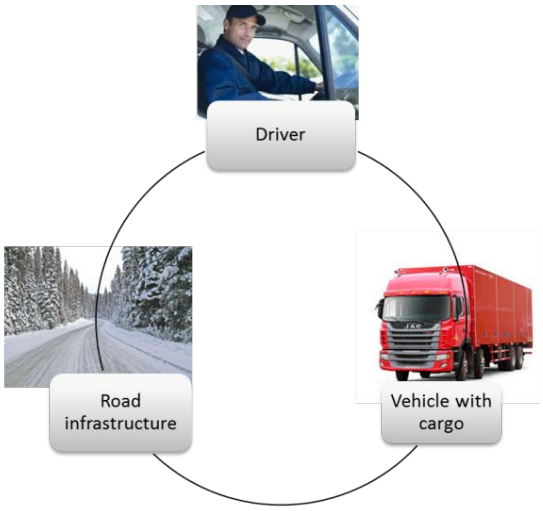

Figure 11 Interactions between driver, vehicle and infrastructure

The road traffic safety efforts in Norway are inspired by High reliability theory and James Reason's line of thought (Reason 1998) in that the road infrastructure system should have redundancy. The Norwegian parliament adopted Vision Zero in 2002, stating that it is human to do errors as a road user,

and such errors should not have fatal or very severe consequences. Therefore, Norwegian roads are built according to requirements on separation between driving directions and side terrains without dangerous hinders.

Still, the Norwegian topography is demanding with hills, mountains, rivers, fjords and coastlines. Therefore, many roads are narrow, steep and curvy, with no separation between driving directions and hilly side terrain. Winter conditions may be especially difficult, leading to special demands on driver skills and vehicle equipment.

5.4 Financing of Norwegian road infrastructure

The Norwegian road infrastructure is financed in three different ways:

1) Public grants from the state, county and municipality
2) Public grants and tolls collected from the road users
3) Public Private Partnerships where the road is built and operated by a private company or consortium of private companies and financed by yearly contributions/grants from the road authorities to the private company/consortium. The contributions/grants may also be partly based on toll collection from the road users.

Most of the Norwegian road projects have road safety, environment and efficiency as their main objectives. Road safety is often the main focus for many small road projects.

5.5 Interoperability

Interoperability is not an important issue concerning road safety and road transport management. European traffic signs and signals are more or less the same in the different European countries as they are based on the Vienna convention on Road Signs and Signals. This is a multilateral treaty designed to increase road safety and aid international road traffic by standardising the signing system for road traffic (road signs, traffic lights and road markings) in use internationally. Intelligent Transport System (ITS) services used for increasing safety, efficiency, environment and availability in road transport systems are all based on European (CEN and ETSI) and international (ISO) ITS standards.

5.6 Impact of internationalisation and global competition in the road transport industry

After the EU inclusion of Eastern European member states in 2004, combined with other structural changes in ownership and a general trend of globalization, liberalization and deregulation the road freight transport market in Western Europe has undergone significant changes (Kummer et al. 2014; Jensen et al. 2014). In the wake of these changes, the share of foreign goods vehicles on Norwegian roads is increasing. As Figure 4 shows, the road goods transport performance has increased by both foreign and Norwegian trucks in the period 2003 to 2013. However, foreign trucks have increased their share of road goods transport performance in Norway in the same period, from 16 % in 2003 to 24 % in 2013 (shown in Figure 5). The increase is notably due to more transport by goods vehicles registered in Poland and the Baltics (Nævestad et al. 2014a).

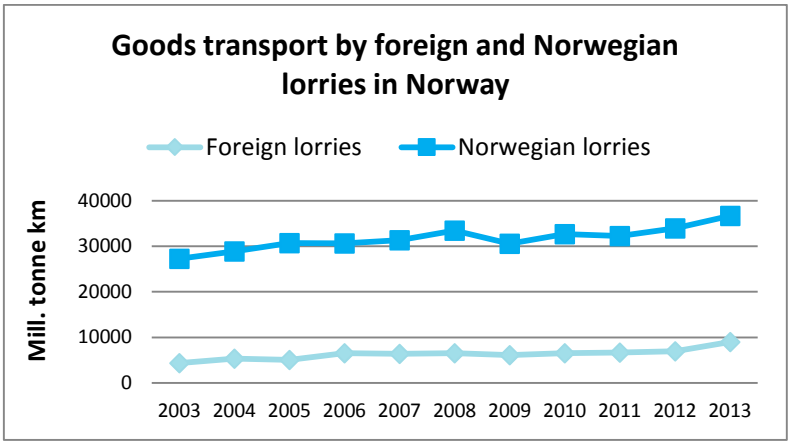

Figure 12: Goods transport performance (mill. tonne km), by foreign and Norwegian trucks. (SSB)

Figure 13: Share of road goods transport performance by foreign trucks in Norway. (SSB)

The increased share of foreign freight transport over the borders increases possibilities for cabotage, that is, foreign companies and drivers performing transportation services within Norway. Regarding the extent of cabotage in Norway, numbers from SSB show a significant increasing trend, see Figure 6. These numbers are based on national road goods transport statistics from other countries, and may be unreliable (Berglund et al. 2014).

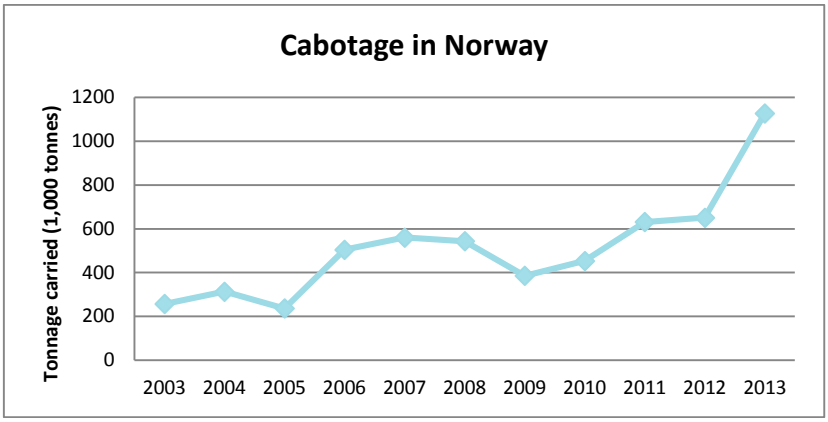

Figure 14: Road goods transport (cabotage) by foreign trucks in Norway (SSB)

The Norwegian freight transport service providers feel the pressure from cabotage to some extent. According to the above-mentioned survey from the Norwegian Truck owners Association (Norsk Lastebileier-Forbund), 13 % of the firms claim to have lost commissions due to cabotage.[17] The share of firms who are unsure of this increased from 22 % in 2013 to 26 % in 2014. Long-haul transport businesses seem to have noticed the increased competition the most, but there is also concern within the local distribution market.

5.7 Implications of internationalization on road transport safety

5.8 Driver and vehicle related safety

A range of studies have focused on identifying main risk factors in accidents involving trucks. An in-depth study of fatal truck accidents in Norway from 2005-2008 concluded that in the cases where the truck (alone or partially) caused the accident, speeding, driving errors, fatigue and inattention were the most important risk factors (Assum and Sørensen 2010). Mooren et al. (2014) point to analyses of 967 heavy vehicles in the US where factors like driver inattention, impairment, decision errors, and speeding were the major factors. It also found that vehicle factors such as brake problems were important as well as road, traffic and weather conditions. Mooren et al. (2014) further found that some particular features of management were associated with increased safety: management commitment, safety training, scheduling and journey planning, worker participation, vehicle and environmental conditions, size and nature of the organization and incentives.

Several studies have found practices that are used to minimize costs and maximizing sales to be associated with dangerous driver behaviour like speeding, driver fatigue and drug use, notably narrow time windows, trip-based pay inducing long work hours, and failures to manage subcontractors (Mayhew and Quinlan (2006).

Based on a survey among 300 long haul drivers in Australia, Mayhew and Quinlan (2006) found that the incidence of truck crashes was correlated with greater economic stress and longer working hours. Competition was found to result in acceptance of non-viable freight rates, excessive and illegal working hours, and stressed and chronically fatigued truck drivers. The more severe economic stress, the poorer was the OHS outcomes, and owner/drivers and small fleet drivers operated under the greatest stress.

Besides economic stress and the effects that this entail for safety framework conditions, increased international transport performance by foreign operators in a country may also lead to increased accident risk more directly. Nævestad et al. (2014a) found that the accident risk of foreign trucks is approximately two times higher than that of domestic trucks in European countries. For Norway,

[17] http://www.lastebil.no/Om-NLF/Publikasjoner/Konjukturundersoekelser

Nævestad et al. (2014) concluded that trucks originating in some parts of the EU had around 2.5 times the accident risk compared to their Norwegian and Danish trucks. Based on a recent literature study the authors concluded that at least four types of risk factors are important when it comes to foreign transport service providers on Norwegian roads (Nævestad et al. 2014):

1. Safety culture
2. Competence, training and experience
3. Technology and equipment
4. Framework conditions (competition and rules/enforcement)

Regarding safety culture, Nævestad et al. point out that it is plausible that drivers carry with them influences from the traffic safety culture in their home countries, that is, all factors that affect driving skills, attitudes and behaviours, and even equipment. This may be part of the explanation to the above-mentioned differences in accident risk.

Competence, training and experience is also a significant risk factor, because even though there are minimum requirements for training in all EU countries, driving in different countries entail various challenges that are specific to local conditions. This may be conditions like winter driving, mountain terrain and tunnels in the Nordic and alpine countries, and large shares of bicyclists in Denmark and the Netherlands (Nævestad et al. 2014).

Technology and equipment plays a safety role when it is in poor technical state and when adequate equipment for local conditions (like snow chains and winter tyres) are lacking (Nævestad et al. 2014a).

When it comes to framework conditions, Nævestad et al. (2014) distinguish between two types:

- Competition
- Rules/enforcement

According to Nævestad et al. (2014), it is somewhat uncertain if competition affects accident risk in a positive, negative or neutral way. They point to a study by Alvarez-Tikkakoski et al. (2011), who found that economic downturn in the Baltic region led to improved accident risk because unserious carriers were forced to exit the market. However, this study did not take into account the nationality of the carriers.

5.9 Challenges in safety regulations

The European Commission issues directives and regulations that shall ensure a minimum and common level of safety for transport on European road networks. Some examples are (EU-OSHA, 2015):

- Regulations on driving times, breaks and rest periods for drivers engaged in the carriage of goods and passengers by road
- A directive laying down the maximum authorised dimensions in national and international traffic and the maximum authorised weights in international traffic for certain vehicles circulating within the Community
- A directive on driving licenses

In principle all European drivers visiting Norway as drivers of trucks and buses should have the same education, training and working conditions and rules based on the European legislation that includes the following directives and regulations:

- *Directive 2006/126/EC on driving licences*
  Main objective: Clearer rules on EU driving licences ensure greater freedom of movement to EU drivers, reinforce road safety and help reduce fraud
- *Regulation (EC) No 561/2006 on the harmonisation of certain social legislation relating to road transport and amending Council Regulations (EEC) No 3821/85 and (EC) No 2135/98 and repealing Council Regulation (EEC) No 3820/85Regulation (EC)*

Main objective: Common rules on driving times, breaks and rest periods for drivers of lorries and buses in order to improve working conditions and road safety

- *Directive 2002/15/EC on the organisation of the working time of persons performing mobile road transport activities*
  Main objective: It sets out minimum rules for the organisation of working time for drivers supplementing the provisions of Regulation (EC) 561/2006 which lays down common rules on drivers' driving times and rest periods

The EU Directives and regulations shall be implemented in the European countries by their national laws and regulations. Hence, this implies that in theory there should be no major differences between the European drivers concerning education, training and working conditions. The directive says that the *Member States shall take the necessary measures to ensure that applicants for driving licences possess the knowledge and skills and exhibit the behaviour required for driving a motor vehicle*. *The tests introduced to this effect must consist of a theory test and then a test of skills and behaviour*. Annex II to the Directive describes a set of requirements that should be fulfilled by the driver licence applicants. However, the directives and regulations were issued as late as the last 10 – 12 years which means that drivers above 30 years may not have gone through an education and training in line with the directives and regulations. It may take decades before the whole population of European drivers will comply with a level of skills as intended in the directives and regulation. Hence, it seems as if there are no major challenges in the legislation itself but the time it takes to implement it in the same way in all countries and to bring all drivers up to a similar level of knowledge and skills based on the EC requirements.

In principle also all European trucks and buses should be on a common level concerning quality and functionality related to safety. This should be ensured by the following directives and regulations:

- *Directive 2014/45/EU on periodic roadworthiness tests for motor vehicles and their trailers and repealing Directive 2009/40/EC.*
  Main objective: To improve road safety by setting minimum requirements for periodic roadworthiness tests of vehicles and trailers in the European Union (EU).
- *Directive 2014/47/EU on the technical roadside inspection of the roadworthiness of commercial vehicles circulating in the Union and repealing Directive 2000/30/EC.*
  Main objective: To improve road safety and to reduce the negative environmental impacts of commercial vehicles. It sets out minimum requirements and harmonised rules for the technical roadside inspection of these vehicles within the European Union (EU).
- *Directive 2008/68/EC on the inland transport of dangerous goods*
  Main objective: Common rules for the safe and secure transport of dangerous goods within and between EU countries by road, rail or inland waterway. It also covers aspects such as loading and unloading, the transfer to and from another mode of transport, as well as the stops in the course of the transport process. It extends the application of international rules to national transport of dangerous goods.
- *Council Directive 95/50/EC on uniform procedures for checks on the transport of dangerous goods by road*
  Main objective: To see that European Union (EU) countries ensure that a representative proportion of consignments of dangerous goods transported by road are checked for compliance with the laws on the transport of dangerous goods by road
- *Directive 2000/30/EC on the technical roadside inspection of the roadworthiness of commercial vehicles circulating in the Community*
  Major objective: In the interest of road safety, environmental protection and fair competition, the EU is harmonising the roadside roadworthiness testing of commercial motor vehicles and their trailers within the EU. These are applicable to commercial vehicles intended to carry passengers or goods
- *Directive 2009/40/EC on roadworthiness tests for motor vehicles and their trailers*
  Major objective: this directive harmonises the frequency of roadworthiness tests and details which parts of motor vehicles must be tested. Increased road traffic presents similar safety problems in all EU countries. Minimum standards and methods must therefore be defined within the EU for both private and public motor vehicles.

- *Directive No 96/53/EC - dimensions and weights of commercial vehicles*
  Major objective: Sets out maximum limits for heavy goods vehicles, buses and coaches carrying out international transport within the EU

As for the driving licence there are several directives and regulations governing the quality and use of trucks and buses in European road network. However, it is also here a question of implementation of the directive in national laws and regulations as well as the national enforcement of the laws and regulations. Any differences here may have an impact on the road safety in those cases where a vehicle coming from a European country with a weak enforcement policy enters a country with different road and climate conditions. Brakes and tyres with low quality due to weak enforcement may cause safety risks in a country with many uphill and downhill road sections and road surfaces covered with snow or ice during winter time.

There are also other European directives that are relevant concerning legislation of internationalisation of road transport and road safety issues:

- *Regulation (EC) No 1071/2009 establishing common rules concerning the conditions to be complied with to pursue the occupation of road transport operator and repealing Council Directive 96/26/EC.*
  EU countries have not applied rules for admission to the road transport operator business (i.e. providing transport for goods or passengers), as set out in Directive 96/26/EC, consistently enough. In repealing Directive 96/26/EC, Regulation (EC) No 1071/2009 aims to address this shortcoming.
- *Council Regulation (EEC) No 3118/93 of 25 October 1993 laying down the conditions under which non-resident carriers may operate national road haulage services within a Member State*
  This Regulation lays down the rules for inland cabotage. It consolidates the internal market for the transport of goods by road by removing restrictions on carriers in the European Union (EU).
- *Agreement on the international occasional carriage of passengers by coach and bus (Interbus Agreement).*
  The technical conditions applying to buses and coaches providing international occasional services between contracting parties must be harmonised to a high degree in order to improve road safety and the way international transport services are organised and developed in Europe.

All directives and regulations are available on http://eur-lex.europa.eu/.

5.10 Conclusions

The internationalisation of road transport in Norway is increasing. The statistics from Statistics Norway (SSB, 2014) shows that it has been a trend since 2005 that the total transport work in mill. tonne km provided by foreign trucks is increasing. The statistics is based on truck surveys in other EU countries and there may be some uncertainties in the registrations. There is also an increasing trend in Third country vehicle transport, e.g. a vehicle from Poland transport goods between Germany and Norway. There is also an increasing trend in cabotage transport, i.e. a foreign vehicle having transported goods into Norway is providing transport services within Norway before the vehicle leaves Norway.

Concerning foreign trucks in Norway it has been found that trucks originating in some parts of the EU had around 2.5 times the accident risk compared to their Norwegian and Danish trucks. It has also been found that at least four types of risk factors are important when it comes to foreign transport service providers on Norwegian roads:

- Safety culture
- Competence, training and experience
- Technology and equipment
- Framework conditions (competition and rules/enforcement)

From a road safety viewpoint the safety in the road transport system is related to:

- The Driver behaviour where the behaviour is based on the training and experience of the driver, physical characteristics of the driver like age, sight and hearing abilities, driving culture, driver stress and fatigue and driver monitoring and enforcement of regulation violations.
- Vehicle and its cargo where the technical status of the bus and the vehicle and its trailer is very important as well as how the cargo is placed and secured on the vehicle and trailer. It is also of some importance that the vehicle supports the driver in his control of the vehicle, e.g. electronic stability program (ESP) and traction control systems (ETS).
- The road infrastructure where the road geometry, sight distances and the status of the road surface may have an impact on the safety.

Road accidents are related to one or more of the three bullet points above and are very often a combination of two or three of the bullet points, e.g. a driver is not trained and/or experienced in handling slippery road surfaces and the vehicle is not equipped for winter conditions. This is often the case with foreign drivers and vehicles in Norway.

The European legislation that already exists shall ensure that all European drivers fulfil the requirements set out in the European directives and regulation, e.g. in Annex II in the Directive 2006/126/EC on driving licences. However, different levels of implementation of the directives and different culture may cause some differences between the drivers coming from different European countries. As the directives and regulations are not more than 10 – 12 years it will take decades before the European drivers training and education is harmonised in practice.

There are several directives and regulations that shall ensure a common and minimum quality for vehicles used in European road networks. The legislative platform is present but just like the driver training and education it is a question of implementation and the enforcement of the directives and regulations. Differences in the national vehicle control regimes may cause that there are foreign vehicles in the Norwegian road network that do not fulfil the European minimum regulations. Norway has also driving conditions during winter time that can be quite challenging. New Norwegian regulations on winter tyres both for the truck and the trailer and increased controls are some measures implemented to balance the increased risk on Norwegian roads during winter time.

Safety in the road transport systems are related to the driver, the vehicle with its cargo (goods or passengers) and the road infrastructure. The internationalization of the road transport industry has changed the population of drivers and vehicles in the Norwegian road network. Hence, it seems relevant to formulate the research questions into the following:

- *Has the increased number of foreign drivers driving vehicles in the Norwegian road network had an impact on the road safety?*
  In more detail the research should look for any differences between foreign and Norwegian drivers in relation to training and experience of the driver, physical characteristics of the driver like age, sight and hearing abilities, driving culture, driver stress and fatigue, driver monitoring and enforcement and driver handling of placing and securing the cargo.
- *Has the increased number of foreign vehicles in the Norwegian road networks had an impact on the road safety?*
  In more detail the research should look for any differences between the vehicle technical and functional status of the bus, the truck and the trailer pulled by the truck.
- *Has the internationalization in road transport had an impact on the working conditions for the Norwegian drivers, e.g. more stress, causing a reduced level of road safety?*

6 Managing transport safety – Comparisons across sectors

We conclude this memo with two comparisons across sectors. The first comparison, shown in Table 1, shows the roles and actors in each sector. The roles are defined in detail in Chapter six in the first volume of this memo, "Theoretical resources". The table gives an indication of the organisational complexity of the transportation sector. The table also indicates a trend towards increasing complexity, in terms of the number of organisations involved and the number of organisational interfaces criss-crossing the operations. This trend is partly a result of the implementation of New Public Management philosophies, including tendering of public transport services. The organisational complexity is also a result of companies responding to increased competition, for instance airlines establishing separate employment agencies.

Table 2 provides a comparison of the four transport sectors with regard to the following system characteristics:

- What is transported?
- Infrastructure dependency, i.e. the extent to which transport operations need a complex infrastructure in order to operate.
- Working environment, working conditions and organisation of work.
- Standardisation and interoperability between countries.
- Coupling and complexity.
- Financing and economic conditions.
- Opportunity for transport operators to choose between different regulatory regimes.

The differences are too many to list here, but we may note that the sectors differ with regard to infrastructure dependency, with aviation and railways being more dependent on complex infrastructures than road and sea transportation. Partly as a consequence of this, railways and aviation appear to be more tightly coupled than sea and road transportation on a transport system level. Another relevant difference is that sea and air transport leave operators some latitude to choose their regulatory regime, in contrast to road and railway transport. International standardisation seems to be most extensive in aviation, with railways lagging behind due to heavy investments in national infrastructure e.g. signalling systems).

Table 5. Roles and actors in each transport sector.

Roles	Road	Railway	Sea	Air
Infrastructure management	Norwegian Public Roads Administration (NPRA), County transport departments and Municipality transport departments. (Entrepriseleverandører)	The Norwegian National Rail Administration (Jernbaneverket, JBV). Contractors. (Division of JBV into a Railway Directorate and an infrastructure state enterprise has been decided)	Norwegian Coastal Administration. Public harbours are owned by the municipalities. A few private harbours, mainly related to the petroleum industry.	Avinor Private airport owners
Utilisation management	Norwegian Public Roads Administration (5 regional traffic management centres (Vegtrafikksentraler)), County transport departments and Municipality transport departments. In some cases police.	The Norwegian National Rail Administration (Jernbaneverket). (Division of JBV into a Railway Directorate and an infrastructure state enterprise has been decided)	Norwegian Coastal Administration (Vessel Traffic Service). Private traffic monitoring on the Norwegian Continental Shelf (e.g. Statoil Marine).	Avinor Eurocontrol Occasional use of Swedish ATC services. Increased tendering of ATC services expected. The Royal Norwegian Air Force / The Norwegian Armed Forces and the police may impose restrictions on civil aviation.
Emergency management	Police, NPRA (5 regional traffic management centres (Vegtrafikksentraler)), Emergency medical communication centres (Akuttmedisinsk kommunikasjonssentral, AMK), local fire brigades	Police, The Norwegian National Rail Administration, The operators, Emergency medical communication centres (Akuttmedisinsk kommunikasjonssentral, AMK), local fire brigades, and others	Norwegian Coastal Administration (e.g. local pollution), Police, Petroleum companies/Norsk Oljevernforening for Operatørselskap (NOFO), IUA – Interkommunale utvalg for akutt forurensning, Redningsselskapet, Hovedredningssentralen, and others	Police, Avinor, Airlines, Hovedredningssentralen, Municipal Fire Brigades, and others
Transport demand management	Individual users, private companies, authorities and public entities.	Individual users, private companies, authorities and public entities.	Individual users, private companies, authorities and public entities.	Individual users, private companies, authorities and public entities.
Transport service management	Transport operators (road transport service providers), e.g. DHL (freight) and Ruter (public transport)	NSB, Flytoget, Ruter Forwarders (speditører)	Public entities such as counties, NPRA Forwarders (speditører) Ship owners (NOR, NIS, foreign registered)	Airlines, including cargo airlines and helicopter companies Regional health authorities Travel companies (Startour, Apollo osv.) Forwarders (speditører)

Roles	Road	Railway	Sea	Air
Transport operation management	Transport operators (road transport service providers), e.g. DHL (freight) and Ruter (public transport). Could also be a single truck owner with his truck.	NSB, Flytoget, SJ, Cargonet, Cargolink, CargoNet, Green Cargo AB, Grenland Rail AS, Hector Rail AB, LKAB Malmtrafik AB, Tågåkeriet i Bergslagen AB, Mantena (maintenance of rolling stock) Increased tendering of passenger transport decided.	Ship owners (NOR, NIS, foreign registered)	Airlines, including cargo airlines and helicopter companies Ambulance flight operators
On-board control and support	Drivers of Heavy goods vehicles and buses.	Train crews	Ship crews	Air crews
Transport item control and support	Not relevant for this project (intelligent goods)	Not relevant for this project	Not relevant for this project	Not relevant for this project
Regulation	The EU commission issues EU Directives for road transport. The Norwegian Ministry of Transport and communications issues laws and regulations for road transport. The Norwegian Public Roads Administration (NPRA) issues regulations that are permitted by Norwegian laws. DSB (Norwegian Directorate for Civil Protection)	EU commission ERA (The European Railway Agency) The Norwegian Ministry of Transport and communications Norwegian Railway Authority The Norwegian Labour Inspection Authority	UN (International Maritime organisation) OECD European Commission The Norwegian Ministry of Transport and communications Min. of trade, industry and fisheries Min. of climate and environment Norwegian Maritime Directorate Classification societies Flag state authorities for ships in foreign registry	EU commission (mainly through EASA) ICAO (provides recommendations) The Norwegian Ministry of Transport and communications CAA-Norway The Norwegian Labour Inspection Authority
Enforcement	The Norwegian Public Roads administration. The Road Supervisory Authority (Vegtilsynet) Customs authorities	Norwegian Railway Authority DSB (Norwegian Directorate for Civil Protection) Customs authorities	Paris MOU (Memorandum of Understanding) and other MOUs. Norwegian Maritime Directorate. Classification societies.	EASA CAA-N The Norwegian Labour Inspection Authority
Transport support services	Telecommunication service providers, e.g. Netcom, Telenor Meteorological services	Electricity suppliers Telecommunication providers (JBV?)	Loading / unloading services (dockers) Maintenance and other services Meteorological services	Ground service companies Telecommunication service providers Maintenance and other services Meteorological services

Roles	Road	Railway	Sea	Air
Other relevant roles and actors	Accident Investigation Board Norway (AIBN) Trade unions and employers' organisations	Accident Investigation Board Norway (AIBN) Trade unions and employers' organisations	Crewing agencies Accident Investigation Board Norway (AIBN) Trade unions and employers' organisations	Aircraft leasing companies Staffing companies/crew management companies Accident Investigation Board Norway (AIBN) Trade unions and employers' organisations

Table 6. System characteristics in each tranport sector.

System attribute	Road	Railway	Sea	Air
What is transported?	Persons and goods, e.g. containers. Often first or last link/leg of container transportation ("last mile").	Passenger short and intermediate distances, mainly within/between highly populated areas. Cargo, containers or large volumes, intermediate distances, limited by available infrastructure, intermodality with road.	Passenger transportation including ferry services. Certain categories of cargo (large volumes and weights, not urgent).	Passengers and cargo. Near monopoly on long distance passenger transportation. Urgent, high value cargo, low or moderate weight/volume
Infrastructure dependency	Roads and roadside infrastructures. Road traffic control centrals. Navigation aids. Terminals. Low degree of infrastructure management dependency.	Tracks including stations (meeting opportunities), power supply, safety systems, Rail traffic control centres, radio systems (GSM-R). High degree of physical infrastructure dependency.	Harbours, fairways, Vessel Traffic Centrals, pilot services, navigation aids (AIS, GPS), visual markers. Ferry services restricted to specific harbours. Low or moderate infrastructure dependency.	Airports, ATC, corridors, navigation aids (radio navigation, GPS). Restricted by available corridors and slots in controlled airspace. High degree of infrastructure dependency.
Working environment, working conditions, organisation of work	Organisational fragmentation / disaggregation. Extensive outsourcing. Many one-man companies. National trade unions and employers' associations important. Increasing mobility of employees. EU directives concerning control of resting hours.	Some organisational fragmentation through division of NSB in 1996, JBV to be divided. Mobility of employees limited by lack of standardisation and competence requirements. This may change due to ERTMS. ERTMS may affect train driver working conditions (information overload). Rather strong labour labour unions.	24 hour society on many vessels. High mobility of employees – race towards the bottom. Depends on regulatory regime (flag state), but may be influenced by tendering processes. Rather weak trade unions.	Increasing disaggregation / outsourcing in network carriers. Crews increasingly employed by separate companies. In general higher work intensity and longer work hours for crews. Network carriers establish low cost companies. High mobility of personnel.

System attribute	Road	Railway	Sea	Air
Standardization and interoperability between countries	Traffic signs and signal standardised in Europa (Wien convention). Common regulation for approval of vehicles and drivers. Many international standards regarding vehicle construction.	Detailed national regulations on traffic management. Major national differences. ERTMS: Common European train control system to be implemented in Norway by 2030. Some European standardisation of rolling stock. Train operators must have safety certificates and licenses. Common Safety Method (CSM) covers hazard identification, risk analysis, and risk evaluation.	Limited international standardisation concerning vessel construction. Sjekk vedr. klasseselskapenes rolle. International code of signals. International regulation of safety through SOLAS and the ISM code. International convention on standards of training, certification and watch-keeping of seafarers (STCW).	Extensive international or European standardisation of aircraft and operations, including instrumentation, air traffic control, crew competence and security measures.
Coupling and complexity	Loosely coupled and linear on transportation system level. Tighter coupling may occur locally (tunnels, urban congestions). Some technical systems may be complex.	Tightly coupled and linear on transportation system level. Some technical systems may be complex.	Mostly loosely coupled and linear on transportation system level, may be tightly coupled and/or complex locally. Some technical systems may be complex.	Considerable local variations on transportation system level, in general more tightly coupled than sea. Rather linear on transportation system level.
Financing, economic conditions	Infrastructure financed through national taxes and fees. Limited use of Private Public Partnership (financing, construction, maintenance). Some passenger transport is subsidised. Increasing use of tendering for passenger transport. Low entry costs for new operators. Most categories of cargo transport are not subsidised.	Infrastructure financed through national taxes. Cargo operators pay a small fee for access to the track. Most passenger transport is subsidised (in addition to free use of infrastructure). Increasing use of tendering for passenger transport. High entry costs for new operators. Most categories of cargo transport are not subsidised.	Infrastructure financed through taxes and fees. Domestic passenger transport is subsidised. Tendering is implemented for all domestic passenger transport (?). Most categories of cargo transport are not subsidised. Most cargo vessels have foreign flag and pay tonnage tax to tax havens.	Airport operations, ATC etc. financed through Avinor incomes (various fees and revenues …); cross-subsidising from large to small airports. Network carriers have faced increasing competition, and respond by efficiency measures (e.g. reduced turn-around time). Fuel amounts to 30 % of operating costs. Some categories of passenger transport are subsidised.
Opportunity to choose regulatory regime	No	No	Yes, cargo operators can sail under foreign flag. Domestic passenger transport must comply with Norwegian work environment regulations.	Yes, by registration of aircraft in a foreign country, and by choice of hubs for international operations. Use of foreign crews on domestic flights has been controversial.

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