Improving the communication by IT during an incident with hazardous substances

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Stijn Frima

Student number: 4006216

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Graduation committee

Chairperson	: Prof. dr. ir. L.A. Tavasszy, Engineering Systems and services
First Supervisor	: Ir. M.W. Ludema, Engineering Systems and services, Transport and Logistics
Second Supervisor	: Dr. M.P.M. Franssen, Values, Technology and Innovation, Ethics/Philosophy of Technology

Preface

The idea for this thesis has its roots in a problem statement, written by Lori Tavasszy and Nils Rosmuller. They seemed to be concerned about the difference in pace at which the IT infrastructures of the logistics sector and the emergency services developed. Due to a lack of coordination between these two sectors, dangerous situations could arise during incidents on the road involving dangerous substances. If IT systems do not communicate with each other, the fire service might have insufficient information to deal with the incident. So were the suggestions.
I found this an interesting topic to study for two reasons. Firstly, the topic was of general interest. Incidents on the road are usually the result of human errors. Safety for disaster-fighting people during these incidents is the responsibility of the society as a whole. Secondly, it is a problem at the intersection between private and public sector. Two different worlds with two different sets of values. I could expect a subject with many aspects, not just the economic aspect that is so dominant in 'management of technology'. The latter was indeed the case, and that also turned out to be the cause of some difficult (for me!) discussions with my graduation committee: how do you determine the value of a design if you do not have a clear unit of measure (i.e. money)?

I would like to thank the graduation committee consisting of Lori Tavasszy, Maarten Franssen and Marcel Ludema (chairman).
Marcel was prepared to set aside time almost every week for a long period of time; as far as I am concerned, a period almost too long. As a first supervisor he helped me structuring my thesis and finding the right scope and focus.
Maarten helped me even over a much longer period of time. Actually he functioned not only as my second supervisor, but also as my scientific and methodological conscience. He often and rightly had to point out that I was confusing things. I didn’t like his comments all the time, but I have to admit that they led to major improvements in my thesis.
I spoke with ‘chair’ Lori less often than with Marcel and Maarten, but his contributions had always been constructive and guiding.

I would like also to thank many friends and fellow students, especially Maarten Schoemaker, Arthur Verwayen and Marit van Alphen. They all listened patiently when I tried to explain what I was researching and their advices appeared sometimes decisive. I even studied together with Arthur or Marit for weeks at a time in the same room. They did not tire of my constant questions and helped me through periods of doubt.
I am also indebted to some members of the ‘TU Delft community’, especially Joca le Grand and Marja Brand. Both offered me professional support. I must have been a most ‘time consuming’ client for them! They were also willing to receive and advise me almost every week.

Finally, I would like to thank my family, especially my brother Lodewijk, my sister-in-law Mara and my parents with whom I could always talk about the thesis. Their support went far beyond moral support. Both Lodewijk and Mara studied at a technical university and had some experience with hazardous substances in their work. They asked the right questions, reading earlier drafts of my thesis. Thanks to their experience as civil servants, my parents protected me from excessive errors in statements about government. Moreover, in times of Corona they often received me hospitably when I wanted to work somewhere else than in my lonely room in Delft.
Without all this help, I wouldn’t have been able to complete this thesis in this form.

Stijn Frima
Delft, April, 2020

Summary

This thesis is about incidents with hazardous substances on the road. The Dutch emergency services need information to deal effectively with this kind of incidents. They get much of the needed information from the logistics companies. More specifically, they receive this information from the truck driver on paper in the form of a bill of lading, when they arrive at the scene of the incident. The question studied in this thesis is whether the emergency services could get more reliable and more timely information from the logistics companies by means of IT. And if so, what are the options to realize this?

These questions are relevant and might be urgent, because both the logistics sector and the emergency services nowadays are investing in IT. On the one hand, more data will come available in digital form. So, this development may offer new opportunities to smooth communication between logistics companies and emergency services during incidents. On the other hand the logistics sector and the emergency services don't coordinate their innovation processes. So, there is a risk that potential synergy might not be realized. Fortunately, the national regulator (ILT: 'Inspectie Leefomgeving & Transport' (in Dutch)) will not let the information position of the emergency services deteriorate, but it would be a pity when obvious opportunities for improvement were missed. So, the objective of this thesis has become: to propose options for improvement of the information position of the emergency services during the handling of incidents with hazardous substances on the road. These options should make use of the fact that relevant digital data are stored in IT systems of logistics companies.
This leads to the following research question:

> *How should present and future IT, used by logistics companies and emergency services, improve the detection of and the response to an incident with hazardous substances on the road?*

Only IT systems are taken in account that are used or considered nowadays by the logistics sector and the emergency services. Furthermore, these IT systems should process data about hazardous substances. The most relevant ones are the eCRM-platforms, which store digital bills of lading (eCRMs) on behalf of all partners in a supply chain, i.e. supplier companies, transport companies and customer companies. The stored eCMRs meet high standards of reliability, because all financial transactions between the supply chain partners depend on it.
Another interesting application is eCall. This application can be installed in the on-board computer of cars; it sends an automatic notification message to the alarm centre (112), when an incident occurs. At this moment the eCall application is only installed in computers of passenger cars, but it is to be expected that trucks are going to use it too.
So the research is focused on these two IT innovations.

On the side of the emergency services we see the fire brigade, the police and the ambulance. The alarm centre is the 'spider in the web'; it takes care of all communication between people on the spot of the incident and the emergency services. Besides these organizations also two departments of the Dutch transport ministry are relevant: RWS ('Rijkswaterstaat') that takes care of the management of the national road system and of a safe, smooth and efficient traffic flow, and ILT (in Dutch: 'Inspectie Leefomgeving & Transport') which is the legal regulator for transports over the road.
Since the fire brigade is in charge when the emergency services have to deal with an incident with

hazardous substances at transport on the road, the research focuses on their role. The fire brigade serves in this specific instance as the representative of the emergency services.

For reasons, explained in the thesis, a research approach is chosen that strongly depends on semi-structured interviews. Representatives of the fire-brigade (the alarm centre included) and of the logistics sector were interviewed. In addition questions were asked to the ILT and a director of an eCMR-platform by e-mail. Of course the results were checked by consulting available literature.

It turned out that around twenty incidents with hazardous substances at transport on the road occur in the Netherlands - in average per year. Moreover, there are almost no deaths or casualties. So, the social and economic impact of this type of incidents is limited and doesn't justify large investments. Actually most incidents occur during the handling (loading and unloading) of hazardous substances, and not during the transport on the road.

The research is further demarcated by looking only at transports on the road falling under the ADR ('Accord européen relatif au transport international des marchandises Dangereuses par Route'; in English: European Agreement concerning the International Carriage of Dangerous Goods by Road). The ADR regulations are set by the UNECE (United Nations Economic Commission for Europe). For instance, a bill of lading is legally required for these transports; also Kemler boards on the backside of the truck must indicate what the truck transports and how high the risks are. These Kemler boards provides valuable information for the fire brigade today, and they will do so in the future. The limitation of the research to this type of transport (i.e. falling under ADR) can be made without loss of validity of the results, because the concerning transport companies are leading the way for the whole logistics sector. They have an extra incentive to invest in IT innovations, because they want to get rid of the paper bill of lading. So, when we wish to know the future direction of the logistics sector, we have to look at these more advanced transport companies.

During the research the UNECE published new guidelines which described a situation wherein the paper bill of lading could be replaced by a digital one, and which provided organizational and technical requirements to do this. This abstract description of the 'TP1/TP2 system' is adopted in this thesis as a normative evaluation and design criterion.

In the end four options for improvement were formulated:

1. An application in the on-board computer of the truck which can transmit the digital bill of lading (eCMR) and other valuable data directly to the alarm centre. If there is an incident the truckdriver can push a 'panic-button' (after which the digital bill of lading will be send) or – in serious cases - the digital bill of lading is to be sent automatically. The alarm centre (actually the GMS or the 'Geïntegreerde Meldkamer Systeem') transmits the data to the fire brigade and other emergency services. This option fits in the transition phase, as described by the UNECE guidelines.

2. The digital bill of lading is stored in so-called eCMR-platforms (for example Transfollow). When an incident occurs, the alarm centre has to retrieve these data. The alarm centre (the GMS) subsequently transmits the data as information to the right emergency services. This option realizes the Dutch part of the TP1/TP2 system, provided that the GMS is upgraded to a TP1 server in the sense of the UNECE guidelines.

3. All digital bills of ladings can be stored in a national register. When an incident occurs, the alarm centre can automatically retrieve these data and send them to the right emergency

services. This option realizes the Dutch part of the TP1/TP2 system, provided that the national register meets the requirements of a TP1 system in the sense of the UNECE guidelines. Functionally options 2 and 3 are almost identical.

4. The fourth option is a combination of option 1 on the one side and options 2 or 3 on the other side. It combines advantages of all options, but is more expensive. Obviously option 4 meets the requirements of a TP1 system in the sense of the UNECE guidelines.

During the research a set of evaluation criteria is drawn up. On the basis of these criteria one solution is valuated as the functionally best one, namely option 4. However, it would be take a long time to realize this option. Therefore, option 1 should be selected for implementation, at least for the start. It is second best, given the scope of the research and – importantly - it does not block realization of option 4 for the future.
But this choice appeared to be 'scope sensitive'; when broadening the scope from the Dutch to the European level and introducing more political objectives, option 2 or option 3 might be preferable.

Finally some recommendations are formulated, in particular to the ministry of Justice and Safety and to the national regulator ILT. A global implementation plan for improvement option 1 is added. Essentially the plan is very simple. Once the minister of Justice and Safety has publicly chosen option 1 and has made the necessary financial resources available, all stakeholders are expected to move in the right direction; with the ILT as catalyst and the UNECE as guide. It is not necessary to carry out this process under great pressure, because there is no conflict of interests. However it will be sensible to monitor the progress, because no urgency is felt by most stakeholders.

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1. Introduction

The subject of this thesis was induced by a document of the Institute for Safety IFV ('Instituut Fysieke Veiligheid') (Rosmuller & Tavasszy, 2018). Its problem statement hypothesizes that the fast IT innovation in the logistics sector could have consequences for the efficacy of the Dutch emergency services, i.e. the police, the fire brigade and the ambulance service, in particular when confronted with an incident with hazardous substances on the road. For instance, certain relevant information could become out of reach of these services, if the information infrastructure of the logistics sector were closed for them. Anyway the document stated that 'an exploration of the impact of new logistical IT services on the safety of logistical processes, especially in the event of incidents is lacking.'

Above mentioned document inspired to this thesis, because the subject seems to have some societal relevance (transport safety) and because it is scientifically interesting. There are two sectors – the logistics sector and the emergency services – which are more or less independently innovating their processes. In particular transport companies which transport hazardous substances by truck, are strongly investing in innovative IT systems. Their goal is to make their logistical activities more efficient. Especially they want to get rid of the paper version of the lading bill. The question is how the realization of these intents would affect the capacities of the emergency services to deal with incidents.
So, essentially the inspiration for this research came from that document of the IFV. It seems interesting to explore the impact of IT innovations within the logistics sector on the efficacy of the emergency services when handling an incident with hazardous substances on the road. Concrete questions arise, like: How do the IT innovation processes of both sectors interact? Which are the positive and negative opportunities? When and under which conditions synergies do arise, and when not? Such research must take technical aspects in account as well as organizational aspects, and maybe even political aspects.

These questions has leaded to the following research objective. Logistics companies (truck drivers) and emergency services are using - or will be using in the near future - IT to support their primary processes (administration, planning etc.). The objective is in principle to determine how this IT will affect the safety during an incident with hazardous substances. It is obvious that the eventual effect can only be indirect, namely via the information position of the emergency services: if the information position deteriorates, the safety could be compromised; if the information position improves, the efficacy might improve too. Soon became clear that only the positive side is relevant in this case, because the national regulator ILT (in Dutch: 'Inspectie voor Leefomgeving en Transport') will prevent any deterioration of the information position of the emergency services. Obviously the research can be limited to the detection and the response phase of the incident, for in this period of time the emergency services are actually dealing with the incident.
Consequently the main research question becomes:

> *How can present and future IT, used by logistics companies and emergency services, improve the detection of and the response to an incident with hazardous substances on the road?*

It appeared to be desirable to demarcate the subject further. Many IT innovations in the logistics sector will not affect the information position of the emergency services, even if they are aimed to improve the safety of transporting hazardous substances. For instance, logistics companies are experimenting with measuring the tire pressure of the truck during the transport (Appendix A).

This innovation will improve the safety of transports, but will not affect the information position of the emergency services when confronted with an incident. Therefore the scope of the research was restricted mainly to those IT systems which process and exchange information about the transport itself of hazardous substances. Special attention will be payed to IT innovations which are nowadays underway and could cause that other sources of information are abandoned, for example the replacement of the paper bill of lading by a digital one. So, the research looks forward to a time period of three to five years into the future.

In the next sections some concepts in the main research question will be clarified and the research will be demarcated.

1.1 Hazardous substances

Identifying hazardous substances

There are many hazardous substances. They are called hazardous because they are flammable, explosive, corrosive, radio-active and so on. Of course they are known by their scientific names; these are mostly used. But because of the danger around them and the need to avoid any misunderstandings, there are several coding systems. Most relevant in the context of international transport is identifying by UN numbers (United Nations numbers) (UN number, 2020). These are four-digit numbers, which are assigned by the United Nations Committee of Experts on the Transport of Hazardous Goods. They are published as part of their *Recommendations on the Transport of Hazardous Goods*, also known as the *Orange Book*. These recommendations are adopted by regulatory organizations responsible for monitoring the safety of the different modes of transport. In the Netherlands this regulator is the ILT (in Dutch: 'Inspectie Leefomgeving en Transport'). Another Dutch regulator monitors working conditions within organizations (Inspectie SZW), but this regulator is less relevant for this thesis research. For some examples of UN numbers, see the list 'Lijst van stofindentificatienummers of UN-nummers' (UN number, 2020).

Identifying hazardous properties of substances

When dealing with hazardous substances maybe it is nice to know the exact substances, but one really needs to know which hazardous properties the substance has. There are coding systems for specifying these properties. Many of them are actually pictograms, very suitable for people, but less for computers. The most relevant numeric coding system is formed by the hazard identifier ('Gevaarsidentificatienummer' or 'GEVI'). See the list 'Gevaarsidentificatienummer (GEVI)' for some examples (Gevaarsidentificatienummer, 2020).

Kemler code and Kemler boards

The combination of the UN number and the hazard identifier forms the ADR Hazard Identification Number HIN (the Kemler Code) (Recognition of hazardous goods, 2020). This code is displayed on Kemler boards which can be fastened at the backside of transport trucks, when transporting hazardous substances. So these Kemler boards supply in a comprehensive way the most relevant information about the transported substance.

Figure 1.1: A Kemler board: Hazard identifier 33 (very inflammable), UN number 1203 (petrol)

Information about hazardous substances for the fire brigade

The fire brigades use the services of the BIG (Brandweerinformatiecentrum voor gevaarlijke stiffen, established in Geel (Belgium). BIG maintains a data base (BIG Kaleidos) about hazardous substances. Once a year information about 20.00 hazardous substances is distributed on dvd. BIG developed also an app for Windows Mobile and Windows RT. BIG composes SDS's (Safety Data Sheets) conforming the applicable regulations, i.e. EC nr. 1907/2006 (REACH, see 1.2) and EC nr. 453/2010. These SDS's are available in Dutch. In these SDS's hazardous substances are identified by their scientific name.

Conclusion

The transport sector and the emergency services are not using the same coding systems for identifying hazardous substances and their properties. As long the communication between them is purely one between humans there is no problem, because in that case the scientific name will be used. If in the future there will be communication between IT systems of transporters and emergency services, the difference in used coding systems askes for some attention. It will not be a big problem.

1.2 The transport of hazardous substances in the Netherlands

The transport of hazardous substances by ship, by train and by truck

Several modes of transportation are used in the Netherlands to transport large volumes of hazardous substances (Jacobs & Ras, 2018). Only two percent of the hazardous substances is transported over the road, but this means: 525 thousand journeys by truck and a total of 9 million tons of hazardous substances. The majority of the hazardous substances is transported by ship over the inland water and via pipelines. The rest is transported by train (the transport by plane is neglectable) (Twee procent van het wegvervoer met gevaarlijke stoffen, 2015)
Most goods are transported in the province of South-Holland and North-Holland. This is largely because of the Rotterdam and the Amsterdam harbour and the surrounding petrochemical industry. Actually about half of all transport of hazardous substances take place in South-Holland in the neighbourhood of the Rotterdam harbour where 40% of the hazardous substances is being loaded. The volume the transport of hazardous substances seems to stabilize (Vervoer gevaarlijke stoffen gelijk gebleven in 2017, 2018).

It is no coincidence that most hazardous substances are not transported by truck. It is considered to be the most risky mode of transport. But because of the limitations of the other modes transport by truck is expected to stay. Thus it could be useful to study safety problems related to this mode of transport. For there must be some room for improvement. From a scientific point of view the safety problem is particularly interesting, because the characteristics of the logistics sector. It consists of many autonomous logistics companies who are interested in making money and less in dealing with incidents, which is the task of the emergency services. The situation is far more complex compared with the other modes of transport. Transport by train forms a very regulated sector with few stakeholders. There are relatively few ships that carry hazardous substances. And pipelines lie safely under the ground. Furthermore the logistics sector is strongly investing in IT innovations. In short: a 'moving world'.

Risk estimations

Though transport of hazardous substances by truck is considered to be the most risky mode of transport, the number of incidents on the road are very limited, according to all interviewees (especially Appendices D and E). There were no precise statistics found in literature. Neither registrations of incidents were found from which incidents with hazardous substances on the road could be selected. Here follows a summary of the findings from websites and so on:

- CBS: here is some information found about where and how many hazardous substances are transported (see above: (Twee procent van het wegvervoer met gevaarlijke stoffen, 2015)). Besides, CBS doesn't provide information of individual incidents.
- BRON (Bestand geRegistreerde Ongevallen Nederland; a register of Rijkswaterstaat (RWS)) is focused on wounded and killed people; the presence of hazardous substances is not registered (Verkeersveiligheid en ongevallencijfers, 2020)
  TNO: here is no information found about incidents with hazardous substances.
- Youtube video's, searched for incidents/accidents with hazardous substances on the road: these confirm that, if there are any incidents, the integrity of the transport is not affected. Trucks do fall over, but because of the firm containers in generally nothing happens with the cargo of hazardous substances.
- Google scholar (searched for incident/accidents with hazardous substances during transport on the road): only statistics about incidents in Germany before the year 2002 (Gwehenberger & Langwieder, 2002).

Phone calls were made and emails sent to several organizations:

- Institute for Safety IFV (Dutch: 'Instituut voor Fysieke Veiligheid'): no incident information is registered here.
- SWOV (Dutch: 'Stichting Wetenschappelijk Onderzoek Verkeersveiligheid'): this organization doesn't have incident information.
- SIMV (Dutch: 'Stichting Incident Management Vrachtauto's'; emailexchange via website): this organization didn't react.
- ILT: se below.

The most reliable source seems to be the national regulator ILT, because all incidents with hazardous substances on the road must be reported to this organization. The ILT doesn't have precise statistics about this subject, but the multi-year plan 2019-2023 mentions a risk analysis that is based on inspection results from the past and comments of organizations under surveyance and other parties (in Dutch: 'Meerjarenplan ILT 2019-2023'). The purpose of the analysis is to

make risks in the different sectors comparable. Actually the ILT doesn't think the risk around incidents with hazardous substances is very high. This risk is ranked at place 23 (of 33), and entails also loading and unloading of hazardous substances. This ranking is based on the consideration that there have been no deaths or injuries for years due to incidents with hazardous substances on the road. And the financial risks appear to be sufficiently covered by insurance companies. The ILT estimates the number of incidents on the road to be 20 a year at most (Appendix G).

Legal regulations

Because of the risks of hazardous substances, transport by truck is regulated. Most of the regulations are from the European level; transport by truck is not restricted to the Netherlands. The most relevant regulation relating to the subject of this thesis is the ADR treaty (Accord européen relatif au transport international des marchandises Dangereuses par Route (ADR, 2020). This treaty has been concluded in the context of the United Nations Economic Commission for Europe (UNECE, 2020a), and adopted by the European Union (Directive 2008/68/EC). The abbreviation "ADR" includes many annexes.
In the Netherlands ADR itself is an annex to the VLG (in Dutch: 'reglement betreffende het vervoer over land van gevaarlijke stoffen'), which falls under (in Dutch) the Wet vervoer gevaarlijke stoffen. The main enforcement authority or regulator for these regulations in the Netherlands is the ILT (Inspectie Leefomgeving en Transport). (In the context of this thesis ILT will mostly called 'regulator', because enforcement of the regulations are not the only relevant competence of this organization. The name 'enforcement authority' will be used, when only the enforcement competence is addressed.)
Not all logistics companies are obliged to meet the ADR. In this thesis the research will be restricted to the logistics companies which do so. They have to carry a paper lading bill and are interested to get rid of it. Most of them are investing in innovative IT to make their business processes more effective and efficient.

Another relevant regulation is REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals; Regulation EC nr. 1907/2006). REACH addresses the production and use of chemical substances, and their potential impacts on both human health and the environment (Registration, Evaluation, Authorisation and Restriction of Chemicals. 2020). The aim of REACH is to improve the protection of human health and the environment by identification of the intrinsic properties of chemical substances. One of the major elements of the REACH regulation is the requirement for companies to communicate information on chemicals up and down the supply chain. The regulation also established the European Chemicals Agency (Helsinki), which manages the technical, scientific and administrative aspects of REACH. Since REACH applies to some substances that are contained in objects (*articles* in REACH terminology), any company importing goods into Europe could be affected.
REACH is only relevant for this thesis, because the fire brigades work with so called Safety Data Sheets conforming REACH. For transport companies the ADR regulations are mare relevant.

Shipping documents, particularly the bill of lading

The ADR regulations make the bill of lading mandatory for many, but not all transport companies. The bill of lading is more than just a piece of paper, it is a contract, as can derived from the French name that is used internationally: CMR or 'Convention Relative au Contrat de Transport International de Marchandises par Route' (CMR conventie goederenvervoer, 2020). Supplier, carrier (transporter) and customer have to sign this document and to bear the responsibilities.

Anyway the bill of lading contains some data relevant for the emergency services when an incident with hazardous substances is happening (all data are in natural language):

- name and address of the supplier;
- name and address of the transport company;
- name and address of the customer;
- the usual indication for the nature of the goods (i.e. the hazardous substance);
- the gross weight of the goods (or the quantity of goods otherwise indicated).

Most logistics companies consider the paper version of the bill of lading to be an administrative burden. If they are obliged to comply they are interested in replacing the paper version by a digital one, the so-called eCMR. These companies are ready to invest in IT systems to support the eCMR.

As said not all companies which transport hazardous substances are obliged to comply with the ADR regulations. For example, for the transport of petrol in bottles the bill of lading is not mandatory. These companies will not lead the way to IT innovations which are relevant for this research. For the objectives of this thesis it will be sufficient to look to transport companies which comply with the ADR regulations. It is to be expected that the other companies will follow their example later on.

Conclusion

For the objectives of this research it will be sufficient to look only to the transport companies which have to comply with the relevant European regulations (i.e. ADR).

1.3 Theory of incident management

An *incident* is an event that could lead to a loss or disruption of services (Incident management, 2020). This is of course a definition from a business viewpoint; it doesn't refer to any dead or injured people and so on. In this thesis there will be spoken about an incident, if and only if an event is reported to the regional alarm centre (Dutch: 'meldkamer').

Incident management is a term describing the activities of an organization to identify, analyze, and correct hazards to prevent a future re-occurrence (Incident management, 2020). Naturally there is an connection with *risk management*. The International Organization for Standardization published a family of standards relating to risk management (ISO 31000, 2020). The purpose is to harmonize the large number of existing de facto standards, methodologies and paradigms that differed between industries, subject matters and regions.
Another relevant field of theory is that of *supply chain management*. In this literature we see in particular efforts to minimize the costs and risks within a chain, for instance by looking for an algorithm to optimize the route of transportation (El-Basyouny et al, 2009). Another interesting article is about the 'user requirements in the emergency response sector' for the Netherlands (Dieh et al, 2006). It results in a list with user requirements and lessons learned (for example the need for geo-information). A third paper focussed on the human factor when transporting hazardous substances (Janno & Koppel, 2017). Other papers focussed on risk assessments and scenario analysis (Okstad & Hokstad, 2011; Nicola et al., 2017).

In the Netherlands one usually distinguishes five phases of incident management; see figure 1.2 (Veiligheidsketen, 2020).

- Proaction (“Proaction is the removal of structural causes of insecurity.”)
- Prevention (“Prevention is taking measures to prevent insecurity that may occur and to limit undesirable consequences.”)
- Preparation (“Preparation is taking measures that enable a good response to a disaster or crisis.”)
- Response (“Repression, or response, is the actual fight against disasters and crisis.“)
- Aftercare (“Aftercare includes all activities that serve to return to the 'normal situation'.”)

In this thesis only the phases of detection and response are studied. Most generic literature about incident management focuses on prevention. There is less attention for detection and response. This is not very surprising. Detection and response depend strongly on contingencies at the moment of the specific incident. There will always be a need for improvising. Moreover, when confronted with an incident the dealing with it is mostly left to specialized organizations inside or outside the company. That’s why these two phases (detection and response) can be studied in isolation from the rest.

Figure 1.2: The ‘veiligheidsketen’ (Veiligheidsketen, 2020)

An incident during the transport of hazardous substances is usually detected by the truck driver, or else by a passing witness. The response comes from the emergency services. A more extensive description can be found in 3.1, but at this point it is important to notice that the dealing with incidents during the distinguished phases of the incident management cycle is not in one hand. Logistics companies and emergency services have both their own responsibilities, but their measures are not coordinated as would be possible within one company. Only the latter situation is usually the subject of literature on incident management. So, this literature doesn’t apply nicely to incidents with hazardous substances on the road. Because the emergency services are in the detection and response phase not well informed about the measures taken by the carriers in the prevention phase. Actually this coordination problem is the quintessence of this thesis. The underlying hypothesis is that this problem could be mitigated by a good organization of the exchange of information by IT systems.

Information plays thus a key role in the phase of detection and response. From the information perspective the two phases are also difficult to separate: about the same information is relevant

for detection and response as well. At the moment of detection one has to know *that* a more or less risky incident is happening, during the response one wants to know exactly *what* is actually happening. So for the goal of this thesis it is not necessary to discern between detection and response. The more one knows in an early stage the better.

It can be concluded that the relevancy of the theory of incident management for the research of this thesis is limited – given the scope of this thesis.

1.4 The distinction between information and data

The research objective is very IT (information technology) related, because in the end this thesis is about the exchange of information or data by means of IT. Davis and Olson (1985) observe that 'information' is an imprecise term as commonly used. They propose the following definition for the purpose of information systems (Davis and Olson, 1985, p. 200):

> '*Information* is *data* that has been processed into a form that is meaningful to the recipient and is of real or perceived value in current or prospective actions or decisions' (*italics by the author)*.

They continue (p. 201):

> 'The relation of data to information is that of raw material to finished product. (…) The information system processes data in unusable form into a usable form that is information to the intended recipient. The analogy of raw material to finished product illustrates the concept that information for one person may be raw data for another – just as the finished product from one manufacturing division may be the raw material for another division.'

So, the relation between the two concepts is subtle: the same thing has different meaning for different people. Actually in practice the terms 'information' and 'data' are frequently used interchangeably (Davis and Olson, 1985, p. 9). In this thesis is tried to use the terms carefully, but sometimes it will be necessary to follow common speech. Nevertheless the distinction is important for this thesis; it will structure more or less the research.

The definition above refers to the processing of data. This processing is done by an 'information system' (Davis and Olson, 1985, p. 6):

> 'A (…) information system is an integrated, user-machine system for providing information to support operations, management, and decision-making functions in an organization. The system utilizes computer hardware and software; manual procedures; models for analysis, planning, control and decision making; and a database.'

Notice that conceptually information systems can exist without computers (Davis and Olson, 1985, p. 7). In practice most information systems rely heavily on information technology (IT) to transmit, store and process data. So, the IT system can be seen as a most important subsystem of the information system. Nevertheless, the human aspect should never be neglected in any discussion about information systems. For example and in anticipation of later chapters, the alarm centre can be seen as an important information system for the emergency services; the GMS (in Dutch: 'Geïntegreerd Meldkamer Systeem') is then the associated IT system.

1.5 Conclusion and thesis outline

Logistics companies (truck drivers included) and emergency services are using - or will be using in the near future - IT to support their primary processes (administration, planning etc.). The objective of this research is to investigate how this IT will affect the safety during an incident with hazardous substances. The research may focus on the possibilities to improve the information position of the emergency services, because the national regulator (ILT) will prevent any deterioration of this position.
The research will be limited to the detection and the response phase of the incident (this is the time period that the emergency services are dealing with the incident). The European perspective will be taken into account, because this perspective is very relevant for the logistics sector that itself is internationally oriented. The research looks forward to a time period of three to five years into the future.

Consequently the main research question becomes:

> *How can present and future IT, used by logistics companies and emergency services, improve the detection of and the response to an incident with hazardous substances on the road?*

The outline of the thesis is as follows.

In chapter 2 the research approach will be described. This approach is mainly based on interviews and is chosen because of lack of empirical data. This approach is reflected in the further division into chapters of the thesis.
Chapter 3 focuses on the primary process, i.e. the handling of incidents with hazardous substances on the road by the emergency services. It will show the course of this handling in terms of steps taken by the directly involved people: the trucker, the operator in the alarm centre and the called emergency workers, especially the fire-fighters. In the same chapter special attention is payed to the information that the emergency services need for an optimal handling of the incident. The results will enable to evaluate the solutions or options which will be designed later on. Several evaluation criteria will therefore be set out in the final section of this chapter.

Chapter 4 leaves the aforementioned primary process for a moment. It looks to the IT infrastructures used by the logistics sector on the one side and the emergency services on the other side. These infrastructures form the starting point for the IT options for improvement of later on, in chapter 6. But before chapter 5 pays attention to recently published guidelines of the UNECE, because logistics companies operate internationally: IT solutions which are not Europe-proof are not attractive for them.
In chapter 6 improvement options are designed. These options will be evaluated in chapter 7 by means of the criteria which are formulated in chapter 4.
Chapter 8 gives a summary of the conclusions of the research. After this some recommendations are given to some organizations, in particular the Ministry of Justice and Safety (in Dutch: ‘ministerie van Justitie en Veiligheid’) and the main regulator in this domain, the ILT (in Dutch: ‘Inspectie Leefomgeving en Transport’).
The final chapter discusses the experiences of the author and suggests some further research.

2. Research approach

2.1 The research structure and the research questions

In the Introduction the research objective and the main research question were drafted. At the base lies the observation that logistics companies and emergency services both are using IT to support their primary processes (administration, planning etc.). The objective is to determine how this IT will affect the safety during an incident with hazardous substances. The research will be limited to the detection and the response phase of the incident; the research looks forward to a time period of three to five years into the future. The aim of this thesis is *not* to improve fire-fighting methods *nor* to provide more information to the emergency services, but to improve the quality of the information they get. This is what will be meant by 'improvement of the information position by means of IT'.
Further it is assumed that the national regulator (ILT) will not let the information position of the emergency services deteriorate. For instance ILT will not allow the replacement of the paper bill of lading by a digital one in such circumstances. Consequently the main research question becomes:

> *How should present and future IT, used by logistics companies and emergency services, improve the detection of and the response to an incident with hazardous substances on the road?*

In the rest of the Introduction the meaning (in this thesis) of concepts like 'incident', 'IT' 'detection', 'response' and 'hazardous substances' were clarified. Also was discussed with which European regulations the logistics companies have to comply. Furthermore the distinction between information and data was explained: in short, when the word 'information' is used, the emphasis is on the meaning (the 'why' and the 'what'); when the word 'data' is used, the emphasis is on the form (the 'how') and the medium (the 'by which'). This distinction between information and data is useful to structure the research.

The research of this thesis is structured as follows. The following phases are distinguished:

Phase 1: Diagnosis about the primary process (chapter 3)

The purpose of this phase is to get *adequate descriptions* of the process of handling (detection and response) of an incident with hazardous substances on the road, as well as *normative criteria* for the designs of phase 3.
The description concerns in the first place the handling process itself.

> Research question 1 (RQ1):
> *How are the main actors operating just before (detection) and during (response) an incident on the road with hazardous substances?*

Secondly, a description is needed of the information the emergency services use to perform their tasks. This information use is assumed to be well-known; as said above: the aim of the thesis is to improve the information quality, not the information quantity.

Research question 2 (RQ2):
What information do the emergency services use just before and during an incident on the road with hazardous substances?

This diagnosis phase focuses thus on the primary process of dealing with an incident as well as the *information* used (and needed) during that process.

By answering these two descriptive questions it must become clear what improvements might be made to the *information position of the emergency services*. So, after this descriptive activity a *normative* step should be taken, the step of drawing up a set of criteria. This step is called 'normative', because choices are made about which aspects are considered relevant. The criteria from phase 1 will concern the quality of information for the emergency services. They are meant to evaluate in due time the *effectiveness* of the designed improvement options which will be designed later on in the research.

In summary, the deliverables of phase 1 are:
- Descriptions of the primary process of incident handling by the emergency services;
- A set of (normative) criteria to evaluate the designs of phase 3.

Phase 2: Assessment of the existing IT (chapters 4 and 5)

The purpose in phase 2 is to get *adequate descriptions of the IT infrastructures that are used today and in the near future within the logistics sector and the emergency services*. The reason for doing this is that the designs of options to improve the information position of the emergency services should be based on the situation of today. This is a normative statement: the better the designed IT solutions are in line with the existing IT infrastructures, the cheaper and easier it is to implement them. Therefore, also this phase will conclude with some *normative criteria* for the designs of phase 3.

Research question 3 (RQ3):
Which IT infrastructures are used by respectively the emergency services and the logistics sector?

This research question thus results in a *description* of the ways that both the emergency services and the logistics sector are storing, sending and receiving *data*. When answering this question the interests of the logistics companies should not be neglected, because they form the incentives to invest in IT, thus in the storing, sending and receiving of data. These interests are not with certainty in line with the interests of the emergency services. For instance, when the transport companies don't use the paper bill of lading anymore, some data may be not available for the emergency services.
This research question must be answered insofar relevant for the research objective. Focus is on the IT by which data are exchanged *between* the logistics sector and the emergency services. Not all IT systems and data communication connections will affect the information position of the emergency services (Introduction). It will be described how the logistics companies, the alarm centres and the emergency services nowadays exchange (or rather don't exchange) automatically information about an incident; the answering of these and the following questions applies only for transport companies which have to comply with the ADR regulations (1.2).

Because of the relevance of these regulations it is also necessary to *describe* some developments at the European level:

> Research question 4 (RQ4):
> *Which European IT developments are relevant for the future of the IT infrastructures of respectively the emergency services and the logistics sector?*

So, phase 2 will deliver *descriptions* of current IT infrastructures on the one hand, and the European vision of its future on the other. These descriptions should have normative implications for the design phase, because any design must start with the current situation. So just like phase 1, phase 2 will be concluded with the *normative* drawing up of a number of criteria for the improvement options, that will be designed in phase 3. These criteria will concern the properties of proposed IT solutions. In other words, they are meant to evaluate later on the *feasibility* and the *efficiency* of the designed solutions.

In summary, the deliverables of phase 2 are:

- A description of the IT infrastructures of the emergency services and the logistics sector;
- A description of the future of these infrastructures as advocated by Europe;
- A set of (normative) criteria to evaluate the designs of phase 3.

Phase 3: Design of improvement options (chapters 6 and 7)

The central question of this phase is: *which IT solutions could improve the information position of the emergency services?* Of course the evaluation criteria of previous phase are taken in account. Some of them will serve as design criteria. They are used to limit the number of improvement options to be worked out in the design phase. For instance, the existing IT infrastructures (phase 2) are used as a starting-point.

> Research question 5 (RQ5):
> *How can the data exchange between the IT systems (used by the emergency services and the logistics sector) be improved in order to make the detection of and response to an incident more effective?*

> Research question 6 (RQ6):
> *Which IT related measures should the emergency services, the logistics sector and government take in order to maximize the safety during an incident on the road with hazardous substances?*

These two questions have a normative character.
It must be remarked that 'IT related measures' (RQ6) does not refer only to the development and maintenance of IT systems. Just as important are matters like the awareness and education of people: a IT system that is not used, cannot be useful. Furthermore the distribution of responsibilities for the management of all these activities are to be included.
The resulting improvement options will be evaluated against the evaluation criteria (see phases 1 and 2).

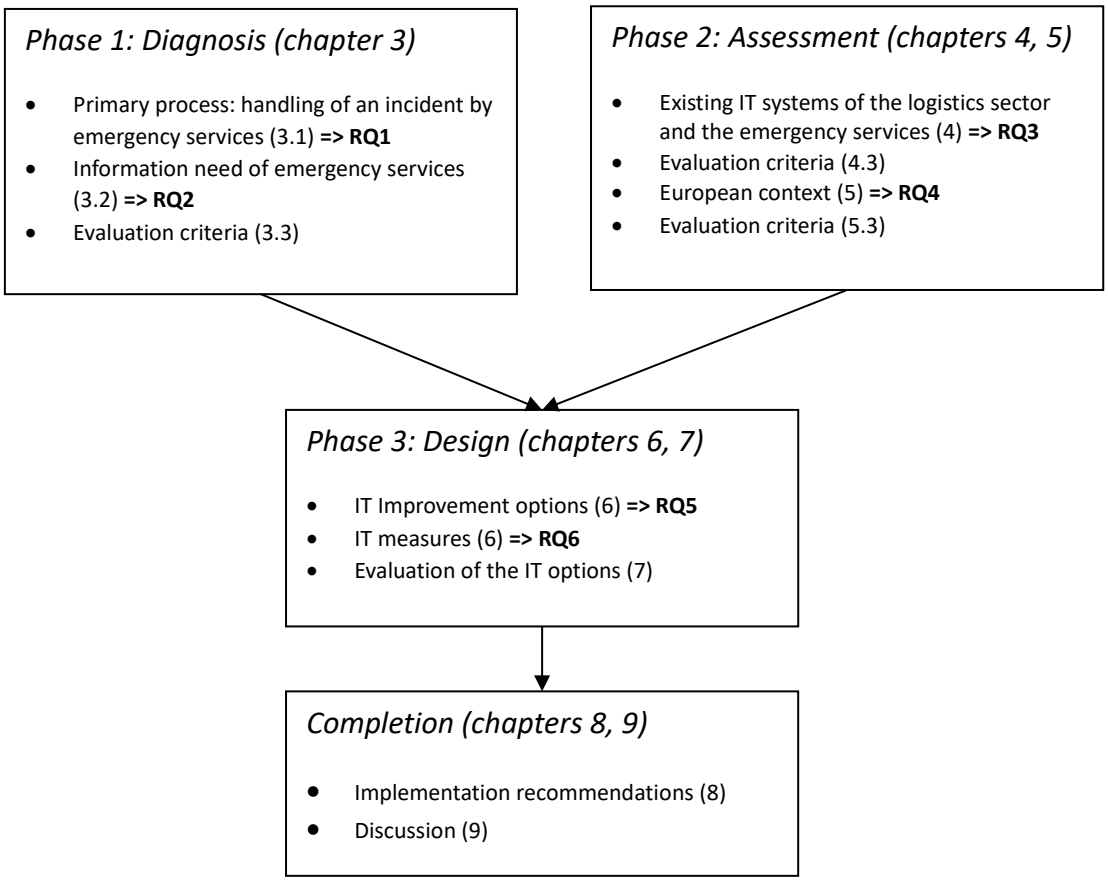
In summary, the deliverables of phase 3 will are:

- A number of options to improve the information position of the emergency services;
- An evaluation of these options based on the criteria drawn up in phases 1 and 2;
- The choice of the 'best' option.

Completion of the research (chapters 8 and 9)

The above mentioned phases describe the empirical part of the research. The results will mainly be based on interviews (see 2.3). After this some recommendations will be made. These are aimed at achieving the 'best' improvement option. The recommendations are mainly addressed to the Dutch government.
Finally some suggestions for further research will be made, and some experiences during the research will be discussed.

Scheme 2 shows the global structure of the research.



Scheme 2: The structure of the research

2.2 Alternative research approaches

The first steps in any research are almost standard: looking in the literature for previous research results, and for empirical data about the phenomenon under study. A lot of literature about the transport of hazardous substances over the road appears to exist. Some of this is used in chapter 2

to describe the context of this research. But there is less literature about *incidents* during the transport of hazardous substances over the road, which is not unexpected, because the number of such incidents are 20 a year at most (1.2). And there are no registrations or case studies or any other literature found about the *communication during an incident* between transport companies and emergency services (the alarm centre included). Of course there must have been communication, but there are no systematically collected data available. This fact excludes some research approaches in advance. This section describes some of the considered research approaches, and the reasons they were rejected.

Statistical analysis

On beforehand a statistical analysis seems not attractive for this specific research. Theoretically a statistical analysis could contribute to a problem diagnosis (phase 1 of 3.1): in what way (which information? which point of time?) the communication between the emergency and the logistics sector could be improved? But there are simply not enough empirical observations of this communication to perform an statistical analysis, as said above.

A statistical analysis is not helpful nor needed to get reliable information about the existing IT infrastructures (phase 2 of 3.1). The IT infrastructure of the emergency services is sufficiently known, because it is organized by the national government: the dominant components of this infrastructure are the GMS (in Dutch: 'Geïntegreerd Meldkamer Systeem') and C2000 (4.1). Statistical information about IT systems used by the logistics sector is missing; logistics companies keep valuable details secret. Moreover, for this thesis research these details are not interesting. Only relatively 'public' IT applications are relevant, when we want communication between the logistics sector and the emergency services. Moreover not only the IT infrastructures of today are relevant, but also future developments. Interviews with experts will do better for that purpose.

Case studies of incidents

It seems more attractive to do some case studies of incidents: which information is used by whom for which purpose. As a matter of fact this was the first approach considered. Even some incident descriptions were already collected in order to perform this case study. Obviously it is impossible to collect real time empirical data by attending incidents, because nobody knows when they will happen.

In the end there were several reasons to reject this approach. In the first place the found incident descriptions did provide information about what was happened, but they did not provide relevant information about the communication between logistics companies and emergency services. Even if a model of the verbal communication between truck drivers and fire-fighters could be derived, there were no incidents found during which a fire fighter tried to get data from the on-board computer of a truck. There would be no opportunity to compare different forms of communication. Moreover this approach would be very labour intensive (it would for instance the reading of (in Dutch) 'processen-verbaal').
In summary, an case study approach based on incidents of the past might at most partially contribute to phase 1 of the research, and wouldn't give any clues for the other phases.

Case studies of supply chains

Another possibility is to perform case studies of some specific supply chains in order to study the course of a regular transport of hazardous substances and in particular the use of IT systems. This could contribute to phase 2 of the research. In a way this is done in the thesis research, but not explicitly. One case is selected, namely the transport of waste substances by the NAM. But cases like this don't allow for conclusions about the likelihood of future IT innovations. And even supposed they do, then this method would be too unfocused. Logistics companies are above all interested in improving their logistical processes, they are not in the first place interested in the dealing with incidents. At best, some of their innovations will contribute to a more safe transport of hazardous substances by prevention (early warning and so on), not as much by detecting and responding. Given the research objective it is therefore more efficient to ask for specific IT plans, i.e. plans for introducing systems like eCMR and eCall. For these reason the NAM case is only used as a starting point to ask questions to logistics companies about their IT plans and priorities which could affect the work of the emergency services.

An exploratory approach

Maybe the previous conclusions could be expected. The research objective regards future developments so that direct observations are impossible. The obvious way is therefore to interview representative specialists, interspersed with desk research. This approach is discussed in next section.

2.3 The chosen 'step-by-step' approach

As said the research was divided in three phases: diagnosis, assessment and design (2.0). All phases should deliver some pre-defined results (section 2.1; see also scheme 2).

The deliverables of phase 1 ('diagnosis') are:
- A global description of the process of handling incidents with hazardous substances on the road by the emergency services.
- A set of criteria to value the improvement options. These criteria concern the effectiveness of the options for the emergency services.

The deliverables of phase 2 ('assessment') are:
- A description of the IT infrastructures of the emergency services and of the logistics sector.
- A description of the future IT infrastructure as advocated at the European level.
- A set of criteria to value the improvement options. These criteria concern the feasibility and the efficiency of the options for both the emergency services and the logistics sector.

The deliverables of phase 3 ('design') are:
- A number of options to improve the information position of the emergency services, making use of data stored in IT systems of the logistics sector.
- An evaluation of these options based on the criteria drawn up in phases 1 and 2;
- The choice of the 'best' option.

Finally some recommendations must be formulated for the most relevant stakeholders.

The general idea of the chosen approach is to proceed step-by-step. Each step of each phase should clarify and demarcate the researched problem further and indicate the direction of the next step. The research structure (2.1) must safeguard that 'the right things will be done'. The step-by-step approach should take care of the validity of the results ('doing the things rightly'). So, though all these steps should be results-oriented, each step might influence the scope of the research a bit. In other words: the approach involves a learning strategy.

The core of each step was originally planned to be an interview of a representative specialist (Appendices A – F). One step consists of the following activities:

- Formulate specific expectations (hypotheses) about the information to be acquired by the interview. The result is an rather detailed questionnaire.
- Select the representative specialist. In any case representatives from the world of the emergency services and from the logistics sector must be interviewed.
- Interview the representative specialist.
- Make a report of the interview and ask the interviewee whether the report is correct.
- Evaluate the results of the interview:
    - Which questions were answered? Is it possible to check and to extend the answers by studying some literature?
    - Which questions were not answered satisfactory? Is it possible to get more satisfactory answers in literature or by interviewing the same or another person? Is there an reason to adapt the scope of the research?
    - Determine the goals of the next step.

This step-by-step interviewing approach is consistently applied during phases 1 and 2.
In phase 1 (research questions 1 and 2) interviews were planned with the emergency services. Soon it became apparent that only the fire brigade and the alarm centre had to be interviewed.
In phase 2 (research question 3) partners of the transport chain of waste substances by the NAM were asked. The case served as a starting point, but the discussion was in general about the IT innovations of both the supplier and the carrier. A specialist of the alarm centre is interviewed, because the GMS (in Dutch: 'Geïntegreerd Meldkamer Systeem') is the most important component of the IT infrastructure of the emergency services, besides the communication network C2000.
Research question 4 (European context) is answered by means of desk research. Interviewing a representative of the European level was considered outside the scope of the research; after all the focus is on the national level.

Originally the idea was to have also interviews with the same representatives of the emergency and the logistics sector in phase 3 (research questions 5 and 6) in order to discuss the designed improvement options. Because of practical circumstances this didn't work out completely as planned. The consequence would be that the same persons were to be interviewed several times, which was considered too bothersome for them. Also the given time period for the thesis caused that the number of interviews had to be limited. So, after all the above described approach of interviewing step by step was only used during the analysis period (phases 1 and 2).

So the step-by-step method was left behind in the design phase, and replaced by desk research. Fortunately, the interview answers in the preceding phases (in particular in phase 2: description of the relevant IT infrastructures) hinted also to obvious options for improvement of the information position of the emergency services. On base of these results it appeared possible to formulate a number of improvement options and to evaluate them, without further interviews. All resulting

options were in a way discussed before, during one or more earlier held interviews. Some uncertainties could be removed by asking questions to relevant organizations per e-mail (Appendices G and H). And last but not least, it was possible to attend a special meeting of the ILT and some representatives of the logistics sector, which also confirmed most of the ideas behind the designed options (Appendix I).

In retrospect the three planned phases did merge a bit. In a rather early stage some improvement options (phase 3) were already discussed. Undoubtedly these discussions influenced the questions, asked in phase 2. That's why many systems and aspects of the IT infrastructure of the logistics sector could be neglected. It was for instance obvious (4.2) that the eCMR-platforms, the on-board computers of the trucks and eCall-like applications were the most relevant IT components for this research. One may wonder whether this intertwining of the phases has consequences for the validity of the research results. This question will be discussed in section 8.4.

2.4 Conclusion

The research of this thesis is structured in three phases:

- Phase 1: Diagnosis about the primary process (chapter 3);
- Phase 2: Assessment of the existing IT (chapters 4 and 5);
- Phase 3: Design of improvement options (chapters 6 and 7).

Each research phase aims to answer a number of research questions. The empirical data are acquired by means of semi-structured interviews of experts in the field.

The research is completed (chapters 8 and 9) by some recommendations to the Dutch government. Finally some suggestions for further research are made, and some experiences during the research are discussed.

3. How are emergency services dealing with an incident?

This chapter is about the 'Diagnosis phase' of the research (2.1). The current practice of incident-handling by the emergency services will be discussed. The goal is to answer the first two research questions. More specific, which real process we want to improve in the end? The discussion of this practice doesn't need to be very detailed, because this thesis isn't about the handling (detection and response) of an incident on the road with hazardous substances as such, but about improving the data exchange between logistics companies and emergency services during this handling. Nevertheless we need some information about how the emergency services operate in the case of incidents and which information they use, in particular to be able to evaluate options for future data exchange later on.

3.1 The handling of an incident with hazardous substances on the road

This section serves to give a general understanding of the physical handling of an incident on the road with hazardous substances. The exchanged information – dealt with in section 3.2 - is meant to optimize this physical handling process. Hence research question 1 (RQ1):

> *How are the main actors operating just before (detection) and during (response) of an incident on the road with hazardous substances?*

The actors: emergency services and the logistics sector

The position and tasks of the emergency services is regulated by law (in Dutch: Wet veiligheidsregio's, 2020) and Besluit veiligheidsregio's, 2017). a more informal description can be found in the 'Handreiking incident management transport over de weg met gevaarlijke stoffen' (Bril, 2016).

Ambulance service
During an incident different ambulance employees provide medical assistance to victims. The emergency service has employed so called GAGS ('gezondheidskundig adviseurs gevaarlijke stoffen'), who advise during the incident the 'officer of service' ('officier van dienst') about the safety of the medical personel, the victim support and possibly about the disinfection of the victims. In addition they advise about the measures in the vicinity of the incident.

Police
The police ensures – together with Rijkswaterstaat (see below) – that the other emergency services can operate (in Dutch: Politiewet, 2012). Policemen take control over the area of the incident and clear the area or evacuate the people. They accompany emergency services to the area of the incident. In the context of this thesis it is of less importance that the police collects evidence to determine the circumstances (in Dutch: 'proces-verbaal opmaken'). See article 3 of (in Dutch) the 'Politiewet, 2012', article 158 of the 'Wegenverkeerswet, 1994', article 17 of the 'Wet op de economische delicten, 1950', article 44 of the 'Wet vervoer gevaarlijke stoffen, 1995').

The fire brigade
The fire brigade must be at the site of the incident within 6 to 10 minutes (dependent on the specific situation) after the call-up of the alarm centre. After the arrival the brigade has the lead

when hazardous substances are involved (Wet veiligheidsregio's, 2010). The leading role is not just a legal formality. In the interviews the representatives of the fire brigade confirm this position during an incident with hazardous substances. 'I can say: "This road must be blocked (…)" or "You have to take care of these people"' (appendix D). The emergency services deliberate about the right approach, but the fire brigade decides *what* has to be done and *when* other emergency service workers may enter the area of the incident. Of course the other emergency services are responsible *how* they perform their tasks.
The main tasks of the fire brigade are: saving humans and animals, fighting the fire, defusing explosives and other hazardous substances, disinfecting the victims, measuring the hazardous substances in the surrounding area. Fire-fighters have the necessary knowledge (about the use of an explosion hazard meter, gas measuring tubes and pH-paper for determining of acid or alkaline liquids and other specialists equipment) and they wear protective clothing. When the fire brigade gets a notification of an incident with hazardous substances they can call for an advisor hazardous substances (in Dutch: 'AGS' or 'adviseur gevaarlijke stoffen'). The AGS is an expert in dealing with hazardous substances (Bril et al., 2016).
An important characteristic of the fire brigade is the number of volunteers. Nationally the staff consists of about 19000 volunteers and 5000 professionals (NOS, 2019). This characteristic may be relevant when considering measures like education and professionalization of the staff.

Rijkswaterstaat (RWS)
RWS cares for the management of the national road system in the Netherlands and takes care of a safe, smooth and efficient traffic flow (Incident management, 2020). Actually it is not an emergency service, but it has important tasks to do during the handling of an incident: taking care of an efficient traffic flow in the surrounding area and possibly redirecting the traffic flow; salvaging the wreck; informing road users. After the incident RWS organizes repairing the damaged road. RWS has its own 'traffic control centres', that quickly signal, when something is wrong on the large roads. It doesn't completely depend on the alarm centres.

During the handling of an incident each emergency service designates a 'officer of service' (OvD, 'officier van dienst') who stays in contact with the OvDs of the other emergency services. So in general there are three officers of service who coordinate the activities of the emergency services. The officer of the fire brigade has the operational lead in the case of and as far as there are hazardous substances. He is the first one who needs to know which hazardous substances are involved. Of course the ambulance staff have the same information need, but they get this information from the fire-fighter. The police is not directly involved with fighting the consequences of hazardous substances. Neither is RWS. Because this thesis is about the communication between the transporting company and the emergency services, the following conclusion is justified.

Intermediate conclusion 3.1.1:
The research can be limited to the fire-fighters as representation of all emergency services , without loss of validity.

The alarm centre
The alarm centre (in Dutch: 'meldkamer') is the 'spider in the web', as the Dutch call it (appendix B). The alarm centre receives notifications of an incident (in this thesis an event is an incident, if it is reported to the regional alarm centre; see 1.3). It ensures that the right emergency service will be alerted. For this reason all emergency services are represented within the alarm centre. Each centre has access to the integrated alarm system (GMS, in Dutch: 'Geïntegreerd Meldkamer Systeem'). This system uses the communication system (C2000), that is used by all Dutch

emergency services.

The logistics sector

For this thesis especially the transport companies (or carriers) and their clients (suppliers and customers) are relevant. After all, the focus of this research is the communication between transporting companies and emergency services. The clients decide which hazardous substances are transported, and they select the way of transporting. The selected transport company decides how those substances exactly is transported (by which truck and so on). Many truckers carry a bill of lading with them during a transport of hazardous substances. For the purpose of this thesis this bill of lading is important, because it records relevant information about the specifics of the transported hazardous substances. However, not every transport company has the obligation to use a bill of lading. European regulations (i.e. ADR, see 1.1 and 1.2) determine for which transports a bill of lading is demanded. The transport companies which have to comply with these regulations feel a strong incentive to innovate their administrative processes to get rid of the paper lading bill (Appendices A and C). They are at the forefront of IT innovation within the logistics sector.

Intermediate conclusion 3.1.2 (see also the conclusion of 1.2):
This research can be limited to the more innovative transport companies which have to comply with the European regulations and are investing in IT, without loss of validity.

The interviews with a transport company (Appendix A) and a client (Appendix C) learn that a regular transport of hazardous substances has three steps: loading, transportation and unloading. These three steps may occur more than once, because more carriers can take part of the supply chain. The most incidents arise during the loading and unloading (the 'handling'). Nevertheless the need of attention for incidents during the transport is widely felt. There are two reasons mentioned in the interviews:

- The safety measures during loading and unloading are considerably sharper (Appendices D and F). The logistics companies should be able to manage these risks (a.o. there may be a company fire brigade). This is not the case during transport on public roads.
- In practice the emergency services and especially the fire brigade frequently come in action without a good reason (Appendices D and E). If better information can lessen the number of unnecessary interventions, costs can be saved.

Intermediate conclusion 3.1.3:
The fact that most incidents occur during the 'handling' of hazardous substances is not a sufficient reason to neglect incidents with hazardous substances during transport on public roads.

The national regulator ILT

The ILT is the national regulator in the Netherlands (1.2). It has the authority to stop trucks on the road and to inspect the compliance with (a.o.) the ADR regulations. Its view on the digital bill of lading is very important for the logistics sector, because of its wish to replace the paper bill of lading by a digital one. The position of the ILT is basically indifferent about the way the bill of lading will be made available, provided that it gets the information it needs in an user-friendly way (Appendix I).

Detecting and responding in the case of an incident with hazardous substances on the road

Thanks to the interviews the handling of an incident with hazardous substances on the road can be described as follows (see scheme 3.1):

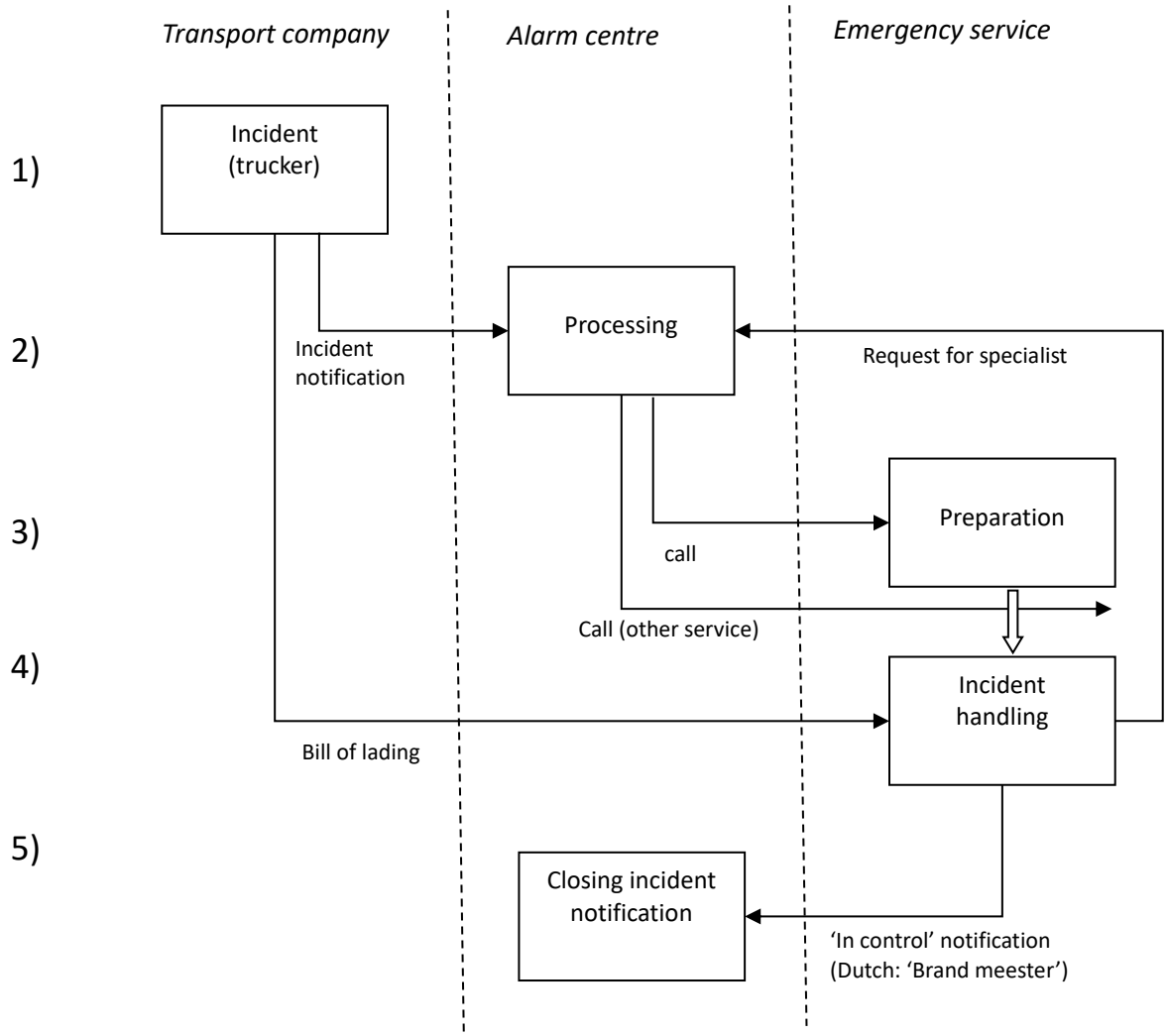
1) When during the transport of hazardous substances on the road an incident occurs, the truck driver or a bystander notifies the alarm centre (sometimes the incident is already signalled by the control room of RWS). When the truck is provided with eCall or a comparable vehicle alarm system (which nowadays is rarely the case), automatically a call is generated to the 112-centre with the GPS position and the number of occupants in the vehicle.
2) The alarm centre asks some standard questions to the notifier. On base of the answers the alarm centre notifies a number emergency services. When hazardous substances are involved, primarily the fire brigade will be called and provided with all available information (the following steps concern especially the fire-fighters.)
3) The fire-fighters make - on basis of the available, but mostly incomplete information assumptions about what's going on (scenario's). On this basis they prepare themselves; for instance they choose their protective clothing. Then the fire-fighters depart to the place of incident.
4) Arrived on the spot of the incident after 6 to 10 minutes (possibly guided by police) the fire-fighters explore the situation again and determine what they are going to do. This takes some time (Appendices D and I). Mostly they can see then the (digital) bill of lading and the Kemler board. They don't take the information, that they get from the trucker and witnesses, for fully reliable because of the stress of the moment. If they feel the need they call the transport company and take measurements with their own instruments. If necessary they call the alarm centre for more specialized emergency services, for example helicopters or divers.
5) When everything is under control, the fire-fighter notifies the alarm centre (in Dutch: 'Brand meester!').

It is easy to verify that time savings are possible, if the truck driver adds the bill of loading to the incident notification when sending this to the alarm centre. In that case the fire brigade gets information about the transported hazardous substances after step 1) instead of during step 4). This means time savings of at least 6 minutes and sometimes much more (because the fire brigade can prepare itself more effectively). This is confirmed by the interviews with the fire-fighter department.

> 'We are happy with any relevant and reliable information as long as it is available quickly.' (Appendix D)'
>
> 'The focus of your research should (…) be on obtaining the information from the digital bill of lading sooner, as soon as possible after an incident. For this, IT systems must be linked to each other, and information must be shared with the fire brigade's systems. The focus should not be on communication between the fire brigade, police, ambulance and alarm centre, because that usually works well.' (Appendix E)

So, the time gains might be substantial. Also the reliability of the information is an important issue, because after arrival (step 4)) the fire-fighters often need time to take their own measurements when they don't trust the available information. And they do often so (Appendix I).

Intermediate conclusion 3.1.4:
If the fire brigade have more complete, reliable and especially timely information about the involved hazardous substances, the time savings would be substantial.



Scheme 3.1: Simplified model of the handling of an incident notification (see description in the text)

3.2 Information use of the emergency services

The previous section underlined the importance of complete, reliable and timely information. The next question is *which* information the fire brigade uses to make their operational decisions. Given the objective of the thesis research this question is primarily aimed at the information that the emergency services might receive from the transport companies, but it is also important to have a general idea about all the information they use. For if most information must and can come from other sources than from the transport companies, the information exchange between emergency services and transport companies wouldn't be very relevant. So, this section is concerned with the second research question 2 (RQ2):

> *Which information do the emergency services use just before and during an incident on the road with hazardous substances?*

The '*Handreiking incident management transport over de weg met gevaarlijke stoffen'* quite precisely documents which information the firefighter emergency service needs in different phases

of the handling of the incident (Bril et al, 2016). Summarized there are four categories of information:

1. Information about the hazardous substance (GEVI-number etc.);
2. Information about the type of transport (bulk or general cargo) and the vehicle;
3. Information about the situation at the spot (leakage, fire, the position of the vehicle, victims, traffic jam);
4. Information about the environment (urban, undeveloped, water supply for fire extinguishing) and about the weather (wind direction for instance).

It is clear that het information which the transport company (i.e. the trucker) can supply, doesn't meet all needs of the fire-fighters. The transport company has only the first two of the above mentioned categories of information: information about the hazardous substance and about the type of transport. Of course the truck driver may be able to tell something about the situation on the spot, but all the rest of the incident information has to come from other sources or has to be collected on site

Moreover, the interviews with the fire-fighter department learn that fire-fighters don't use information about hazardous substances directly. They think in terms of scenario's to decide about how to prepare themselves and to handle the incident. The following citations may illustrate the point (Appendix D):

> 'You can discern nine types of hazardous substances, but that is not very important during the transport. More important is what can happen. (…) It makes a difference whether it is transported in one big container or in 10.000 1L bottles.'
>
> 'The hazardous substance itself is less relevant, because the fire-fighter is primarily concerned about scenario's. When the substance is leaking, or has to be covered or has to be sealed. Or if the substance stinks that is not relevant. It is relevant how the substance affects your body, because that determines which type of clothing you choose. Some substances demand a certain type of clothing. A stand 'blusoverall' is especially useful against heat. Wearing them fire-fighters can enter burning locations. We (the firefighters) have learned how far you can go and when you have to go back. The 'blusoverall' also protects the wearer against chemicals; it contains kevlar. When small particles hydrochloric acid hit the clothing, than it damages the clothing, but not the person wearing it. We have other clothing that better resists these chemicals. There fire brigade works always under pressure. Hence the psychological factor is also very important.'
>
> 'Some things seem very dangerous, but they aren't really. Other things seem harmless, but precisely these are dangerous. The fire brigade (…) must act on base of very incomplete information. The notification message gives most times only an indication, and must be interpreted professionally.'
>
> 'Actually ideal information doesn't exist. If it would exist, then it could only be provided by an accidentally passing fire-fighter. We are already happy when there is some relevant and reliable information, *if it is timely' (italics by the author)*.

In summary, the fire-fighter needs four categories of information in their mutual context to evaluate the situation on the spot. It is not very interesting that hazardous substances are involved, when the container is fine and stable. An (incident) scenario is the result of professional reasoning

and describes the most probable course of events: Is there a danger of explosion? Is there poison leaking? Is it possible to breath? Have people to be saved under dangerous circumstances? Can the fire pass over to other buildings? How can we approach the site? On basis of this kind of information the fire-fighters make their preparations and take their actions. If they think it necessary they take measurements with their instruments to be sure, for the risks are high.

In Appendix 1 of the '*Handreiking incident management transport over de weg met gevaarlijke stoffen'* (mentioned above) is attempted to formalize the concept 'scenario'. A typology of hazardous substances forms the starting point for specifying five standard scenario's. There are scenario's for situations with flammable gas, flammable liquid, toxic gas, acids/alkalis, LNG. Per described situation attention is given to:

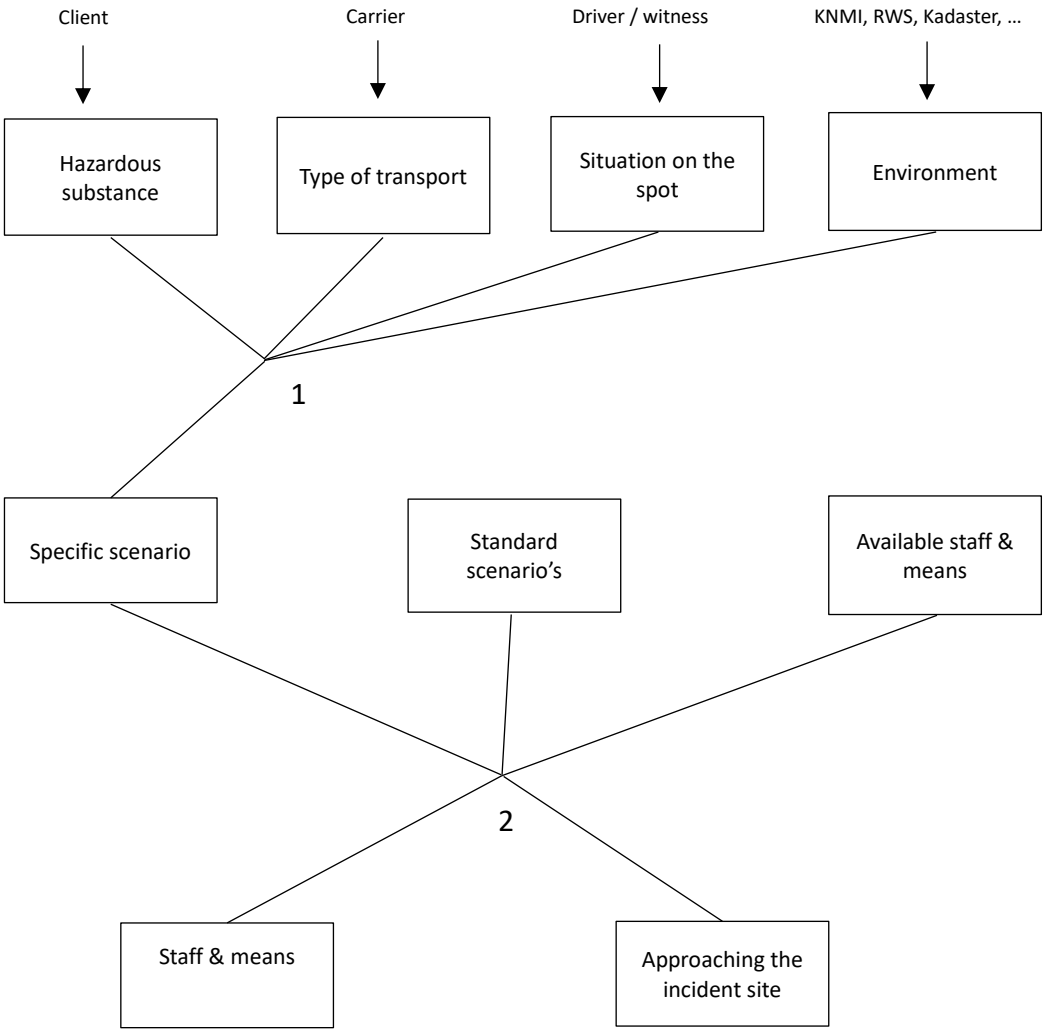
- Type of incident (breakdown, unilateral collision, head-tail collision, …);
- Way of packaging (tank, bottles, container, …);
- Kind of damage image (number of involved cars, damage to the car, leakage, fire, ...);
- Damage development in the broad sense (outflowed hazardous liquids, damage in the vicinity, traffic jams), …);
- Possible escalation.

In the above mentioned appendix is stressed that scenarios are developed by different organizations; there is no definite standard, though there is some relation with the in 1.1 mentioned SDS's (Safety Data Sheets). As said, in practice the fire-fighter mainly acts on the basis of own knowledge, experience and common sense. The standard scenarios are just a tool and can be considered as the result of years of experience.

Scheme 3.2 shows the decision process of translating incident information via a specific incident scenario to decisions about actions of the fire brigade. It is a precedence scheme, which means that one-sided dependency relations are represented (it is no flow diagram): the four categories of information are needed to determine a specific scenario, and so on. The first sub-process translates all available incident information in the most probable specific incident scenario. The second sub-process derives the following decisions from this specific scenario with the help of a number of standard scenario's:

a) which people and which means are needed to handle the incident properly;
b) the manner in which the site of the incident can be approached (which route, which type of vehicles, necessity of the helicopter).

The decision-making process may be partially 'repeated' (though it is not a flow diagram), when the originally selected scenario appears to provide an insufficient image of the actual incident. Notice that decision making process is distributed over the alarm centre and the fire-fighter department. The alarm centre decides which emergency services are called. It is able to do so thanks to the presence of fire-fighters in the centre. The called fire-fighter department decides at a later moment how to operate on the spot. Actually all the information processing is performed by experts of the fire brigade. (IT - especially artificial intelligence - might support this information processing in the future.)



1. Translation of incident information to the specific incident scenario
2. Decision making about: (1) staff & means for handling the incident, (2) way of approaching the site of the incident

Schema 3.2: Information analysis of the handling of an incident

Intermediate conclusion 3.2.1:
The transport company has relevant information for emergency services confronted with an incident with hazardous substances, namely:

- Information about the transported hazardous substances;
- Information about the type of transport.

Intermediate conclusion 3.2.2:
In the phases of detection and response a quick translation of incident information to action scenario's is crucial. At this moment this is done by experienced fire-fighters.

Intermediate conclusion 3.2.3:
According the fire-fighter department complete information about an incident at the moment of the notification message is an illusion. Professional experience is needed to select the most probable incident scenario.

The information need of the logistics sector
Something must be told about the information need of the logistics sector, because it is important to know to what extent the information needs of the logistics sector and the emergency services are in line. In 1.2 the bill of lading is characterized as a contract. Because of this, all parties of a supply chain have a real interest in reliable and up-to-date information about the substances before, during and after the transport. (To a certain extent this also applies to transports which don't have to comply with the ADR regulations.) Consequently the quality of the information about transported hazardous substances is a shared interest for the logistics sector and the emergency services. However logistics companies do not want that unauthorized third parties have access to their information, though they do not in principle object that emergency services have access to their information when confronted with an incident (Appendix A).

3.3 Conclusions inspiring to criteria (1)

This thesis aims to propose and evaluate some options for improving the information exchange between emergency services (i.e. the fire brigade) and transport companies. Of course the value of information must be related to the improvement of the handling of incidents during the detection and response phase. For that reason section 3.1 describes that handling process. Section 3.2 describes the information that the fire brigade (as representant of the emergency services) uses during this incident handling.
The purpose of this last section is to (normatively) derive some qualities which the used information should have. This will be done by drawing up a set of criteria to assess improvement options later on.

Most criteria have two versions, because they can be formulated as a constraint or as a desideratum. When formulated as a constraint the criterion contains a sort of limit value which may not be exceeded; an option does or does not satisfy to such constraints ('yes' or 'no'). When formulated as a desideratum the criterion defines a sort of measure with which options can be weighed in terms of 'more' or 'less'.

The first duo of criteria concerns the completeness and the reliability of the information about the incident that the emergency services get via the truck (3.1, 3.2).

Criterion 3.3.1 (constraint):
The information about the incident must be at least as complete and reliable as the information on the paper bill of lading (3.2).

Criterion 3.3.1 (desideratum):
The information about the incident must be as complete and reliable as possible at the moment of the notification of an incident. It is about two categories of information (3.2):

1) The information about the transported hazardous substances is complete and reliable.
2) The information about the type of transport is complete and reliable.

The next criterion concerns the timeliness of the information about the incident that the emergency services get via the truck (3.1, 3.2). This criterion indicates the best opportunity to improve the information position of the emergency services, because nowadays the fire brigade has no or little information before the time of arrival. See Interim conclusion 3.1.4.

Criterion 3.3.2 (desideratum):
The information about the hazardous substances and the type of transport must be timely. Ideally this information should be available for the fire brigade at the same time as the notification of the incident itself.

The next duo of criteria is also very important, because the emergency services always work under pressure during incidents. They don't have time to do complex searches for information.

Criterion 3.3.3 (constraint):
The information about the hazardous substances and the type of transport must be at least as easy accessible as currently via the paper bill of lading (3.2).

Criterion 3.3.3 (desideratum):
The information about the hazardous substances and the type of transport must be accessible in a user-friendly way.

4. Data exchange between logistics sector and emergency services

This chapter is about the first part of the 'IT Assessment phase' of the research (2.1). The previous chapter discussed the informational perspective (which information and why?). This chapter focuses on how the transport company, the alarm centre and emergency services nowadays do exchange (or rather do not exchange) *data* about an incident automatically. This is the subject of the third research question (RQ3):

> *Which IT infrastructures are used by respectively the emergency services and the logistics sector?*

The answering of this question applies only for transport companies which have to comply with the ADR regulations (Intermediate conclusion 3.1.2).

4.1 Compatible codes and coding systems

The first question to be answered is which 'language' is used in the data communication. From the literature (1.1) it turns out that generally the communication is in natural and/or scientific language, not only between the logistics sector and the emergency services, but also within the logistics sector itself (between transport companies, suppliers and customers; the data communication within companies is not studied). For instance in the digital bill of lading (eCMR) the scientific name is used to indicate a hazardous substance (1.2). Indeed everything is focused towards the direct use of information by people, because all relevant decisions are taken by humans. Apparently so far there is no incentive to use codes to make the data communication between computers more efficient and reliable. In summary the information about hazardous substances is only processed by humans.
Given the rapid developments within the transport sector it cannot be ruled out that in the future logistical planning of the supply chain will be automated further. Maybe companies will consider to standardize their coding systems for hazardous substances and relating dangers then. The UN number and the hazard identifier, combined in the Kemler code, will be then obvious candidate standards, because the transport of hazardous materials on the road always has to comply with the ADR regulations (1.1 and 1.2). However, during this thesis research no examples have been found.
Of course also the experienced fire-fighter knows the meaning of Kemler boards, but usually he checks the presence of hazardous substances with his own instruments before coming into action (3.2).

Intermediate conclusion 4.1.1
Most logistic companies and emergency services identify hazardous substances by with their scientific name within their automated systems. The only exception appears to be the Kemler code, that as a physically board is attached to the trucks during the transport of hazardous substances; maybe this code is recorded in some automated company systems too.

Intermediate conclusion 4.1.2
The current use of coding systems for hazardous systems is in the short term no obstruction for the communication between the logistical sector and the emergency services.

One final remark on this subject. Although coding systems for hazardous substances are hardly used today, this does not apply to other coding systems, for instance Vehicle Identification Number(s), license plate codes and codes for containers. These coding systems are widely used, also outside the domain of the transport of hazardous substances. It is therefore assumed that they form no problem.

4.2 Software and hardware (IT systems)

The logistical sector invests strongly in IT systems (Appendices A and C). The purpose is always to make the activities of loading, transportation and unloading more effective and efficient. As said in the Introduction (chapter 1) most of these IT systems are not relevant for the objectives of this thesis. It is sufficient to restrict the research to only those IT systems which process and exchange information about the transport itself of hazardous substances (see also 3.2). And of course also IT systems by which truckers can communicate with emergency services are interesting.

All carriers, suppliers and customers have their own IT systems, which support their respective logistical processes. Relatively new are the IT systems that have to support the entire supply chain. In this thesis these systems are named 'eCMR-platforms' (Appendix H). These systems are typically not owned by one of the partners in the supply chain, but by an independent IT service company which has been notified by the NIWO (Dutch: 'Nationale en Internationale Wegvervoer Organisatie'). The partners in the supply chain (carriers, suppliers and customers) have access to the platform of their choice and can follow the transport from step to step. Larger companies are connected by a standard API (Application Programming Interface); smaller companies usually access via a portal created by these platforms. As the name suggests the digital bill of lading (eCMR) is the most relevant set of data stored in the system: the access to the eCMR of the trucks underway is the common element of these IT-systems. Remember that the eCMR is actually a contract between carrier, supplier and customer (1.2). So, all partners are interested in reliable data. Besides the eCMR, more data are stored in the eCMR-platform, i.e. the identification data of the truck or train that transports the products.

The best known example of an eCMR-platform is TransFollow, that momentarily has a market share of around 50% worldwide (in the Netherlands 75%; Appendix H). Nevertheless most transport companies have to deal with more eCMR-platforms, and they don't find this situation ideal (Appendix A). 'Roaming' between the existing platforms is not possible at this moment (Appendix H). 'Roaming' means automatic switching form one eCMR-platform to another for instance when passing national borders. Efforts are made to establish one European eCRM-platform, or at least to standardize interfaces. This would reduce their problem, but the outcome is uncertain.
Note that these eCMR-platforms do not *process* any data. They only *store* up-to-date transport data so that parties of the supply chain have access to them. The real data processing is done by people or the IT systems of transport companies, suppliers and the customers.

More advanced transport and client companies want to get rid of the paper bill of lading, because it is inefficient (Appendices A and C). This is as yet not always acceptable for the ILT (that has no access to the existing eCMR-platforms at this moment).

Intermediate conclusion 4.2.1
More advanced transport companies are investing in using the services of eCMR-platforms. They would prefer one standardized European eCMR-platform.

Transport companies don't have dedicated IT systems to communicate with alarm centres or other emergency services. The truckers use their mobile phone in the case of incidents. Someway this is remarkable, because trucks do have an on-board computer. It must be possible without many problems to install an application like eCall on this computer. Some passenger cars do have already eCall installed on their on-board computer, that notifies automatically the alarm centre in the case of an incident; applications like this are expected to be introduced for trucks (Appendix A). Until now an application like eCall is not a priority for most logistical companies, presumably because such application doesn't improve directly logistical processes. They are less interested in improvement of the handling of incidents by emergency services.

To complete the picture it must be noted that logistics companies don't invest in IT just to improve the efficiency of the transports. They of course have a real interest in improving the safety of their transports. For instance, they are experimenting with measuring the tire pressure of the truck during the transport (Appendix A). However, such IT applications don't influence the information position of the emergency services when confronted with an incident. Therefore they are not discussed in this thesis.

The IT infrastructures of the emergency services seems to evolve independently from those of the logistics sector. The emergency services can of course access data bases about hazardous substances (via mobile phones and tablets). Most communication between these services and the alarm centre goes via telephone (Appendix B). In general there the fire brigade doesn't contact with the truck driver before it arrives at the location of the incident, let alone that there is communication between on-board computers.
The alarm centre is seen as the 'spider in the web' (Appendix B). As long the fire brigade is not yet at the location of the incident, all information is exchanged via this centre. The GMS (Dutch: 'Geïntegreerd Meldkamer Systeem') is the most important tool for the centralists. This system is much like a very advanced telephone service. It is able to suggest which emergency services need to come into action, but only after manual input of incident data.
The alarm centre has also access to camera images about the situation on the roads, to data bases about hazardous substances, the weather forecasts and so on.

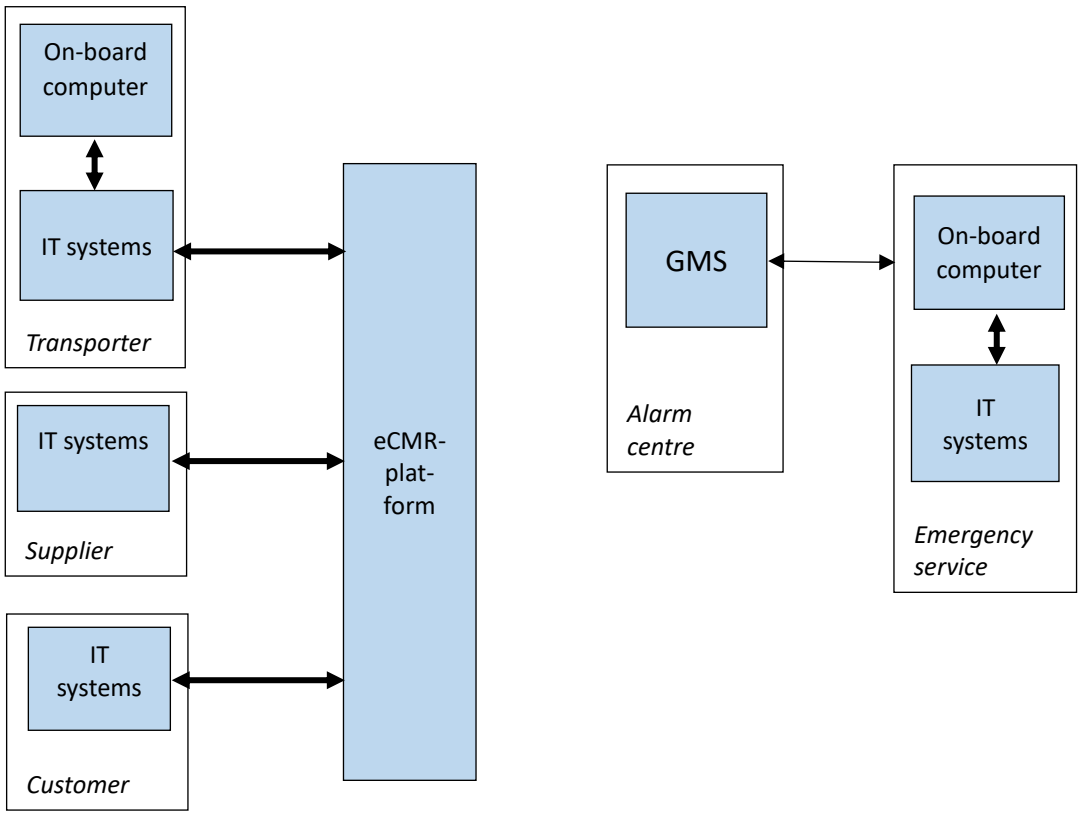
Intermediate conclusion 4.2.2
IT is in the emergency sector above all used as a communication tool. Mobile phones and tablets remain important; a lot of communication is done via these devices and on paper (the paper bill of lading). The GMS is more like a data communication system than a data processing system.

Scheme 4.1 gives an overview of the current situation with respect to the IT-systems. For reasons of simplicity only one transporter, one supplier, one customer, one eCMR-platform, one alarm centre and one emergency service are drawn. In reality there are many more. Note that there are

no structural data communication connections between the logistics sector and the emergency services.

From the interviews with in particular the representatives of the logistics sector (Appendices A and C), eCMR-platforms and eCall-like applications appear to be IT innovations which could play a role in the communication between the logistics sector and the emergency services on the short-term. It is important to notice that – though these two innovations are not yet matured fully – there is no risk that future implementations of those two types of systems will cause problems in the communication. The primary purpose of eCall is to communicate with the GMS of the alarm centre; that will not change. For the eCMR-platforms holds the same. They are bound to be upgraded to TP2s (see chapter 5 and the options, designed in chapter 6) which explicitly aim to establish secure data communication between the logistics sector and the emergency services. No doubt new technologies will be considered in the future. Block chain technology could for instance enhance data security substantially. But the ADR regulations will always safeguard that communication with the emergency services remains possible (chapter 5).

Intermediate conclusion 4.2.3
The logistics sector expect that two IT innovations could facilitate the communication between the logistics sector and the emergency services: eCMR-platforms and eCall-like applications.



Scheme 4.1: IT systems (logistical sector, the alarm center and emergency services)

Legenda: ⟷ computer-computer communication
⟷ human-computer communication

4.3 Conclusions inspiring to criteria (2)

Some intermediate conclusions have been drawn in the previous sections. The main conclusions are:

- Nowadays there are no structural data communication connections between the logistics and the emergency sector, which could be used during an incident with hazardous substances. Though about all interviewees acknowledge that the handling of an incident could benefit from a timely availability of the bill of lading.
- The automation of processes within the logistical sector develops independently from the emergency services. (Note that this research is restricted to the more innovative transport companies; so this conclusion must be drawn with some care.) If this results in the disappearance of the paper bill of lading, there is a risk that emergency services sometimes will be less informed in the future than at present. This risk seems limited for two reasons. Firstly, the national regulator (ILT) will not let the information position of the emergency services deteriorate. Secondly, Kemler boards provide anyway a lot of relevant information; these boards remain physically attached to the truck.
- In particular eCMR-platforms and eCall-like applications are promising to establish data communication between the logistics sector and the emergency services.

Before starting the design of improvement options (chapter 6) some criteria can be drawn up to assess improvement options in terms of feasibility and efficiency. Again there are 'constraints' and 'desiderata' (compare 3.3).

Because of the first conclusion the following criterion is an obvious choice.

Criterion 4.3.1 (constraint):
Each considered improvement option must propose a way of connecting systems of the logistics sector and the IT-systems of the emergency services.

The point of view of the emergency services

Criterion 4.3.2 (desideratum):
The costs on the side of government must be as low as possible.

This criterion doesn't tell anything about how much safety measures may cost in Dutch society, in terms of *money* as well as *time*. A balance between efficiency and effectiveness is always sought in formal government documents. In Dutch:

> '… Alzo Wij in overweging genomen hebben, dat het wenselijk is om de brandweerzorg, de rampenbestrijding, de crisisbeheersing en de geneeskundige hulpverlening, met behoud van lokale verankering bestuurlijk en operationeel op regionaal niveau te integreren, teneinde een doelmatige en slagvaardige hulpverlening te verzekeren, mede op basis van een gecoördineerde voorbereiding, en daartoe veiligheidsregio's in te stellen.'
> *(Wet Veiligheidsregio's; geldend van 01-01-2020 t/m heden)*

Statements like this don't help to assess the weight of cost criteria in a political context. Immediately after a disaster substantive budgets might be made available. In more peaceful

periods these budgets may be reduced. This leads to the rather vague conclusion that the investments on the side of government must give an optimal social(!) return on investment.

At present the handling of incidents with hazardous substances on the road does not have a very high priority because of the low number of incidents (about 20 incidents/year; see 1.2). For this reason the willingness to invest (money and time) is assumed to be limited.

Time is sometimes a very important and underestimated issue. When money is lacking, the government can provide more by shifting priorities. But if a solution takes too much time to implement, nothing can be done. So, in some cases this desideratum should nearly be treated as a constraint, for instance when government is dependent on the cooperation with other parties at the national or European level. Legislation could theoretically solve the problem at the national level, but this instrument is considered as too costly in terms of time.
The following two constraints make criterion 4.3.2 more specific:

Criterion 4.3.3 (constraint):
The government will not introduce legislation to enforce the cooperation of third parties.

This constraint seems reasonable, because of the limited risks involved (< 20 incidents per year), though one representative of the fire department wouldn't exclude the possibility of new regulations:

> 'There must be a national system and a duty and/or wish to be connected to this. It should preferably be a kind of intrinsic wish from those involved, but if necessary it can be enforced by law.' (Appendix E)

Criterion 4.3.4 (constraint):
The GMS of the alarm centre (the 'spider in the web') must remain the main communication channel between the logistics company and the fire brigade (3.1 and 4.2).

The point of view of the logistics sector

Of course also the logistics sector has its own interests. The criteria are rather straight-forward, assuming that no laws or regulations force companies to do something more than now (criterion 4.3.3).

Criterion 4.3.5 (desideratum):
Access to sensitive company information must be blocked for unauthorized third parties.

Criterion 4.3.6a (desideratum):
The financial costs for the logistics companies must be minimal.

Criterion 4.3.6b (desideratum):
The financial investments for the logistics companies must improve their business process within a reasonable time

The two latter criteria these criteria emphasize the importance that the logistics sector attaches to cost-effectiveness. Many logistics companies are willing to invest in improvements of the information position of the emergency services, but not at the expense of their economic return. The first criterion states that the costs for logistics companies must be zero or at least very limited,

or they have to be compensated by government (subsidy).
But that is not the whole story. Logistics companies wish to improve the effectiveness and efficiency of their primary process. They want for instance to replace the paper bill of lading by an digital one. If investments contribute to that goal, the logistics companies are ready to invest substantially. The second criterion states that logistics companies are more positive about investments if they improve their business process (independently of eventual subsidies). A typical quote:

> 'The most important thing is that our client has a need. If they want to digitize, we will think with them. *It must of course be cost effective for us.* If the bill threatens to end up unilaterally at Den Hartogh, we ask the question: how are we going to resolve that together? This was *not* necessary in this case, because *we really see the possibility of improving efficiency,* especially by reducing paperwork: the digital bill of lading is 13 euros cheaper than the paper bill; so TLN and logistics associations in the Netherlands are really interested. It also provides a good relationship with the customer' *(italics by the author)*. (Appendix A)

Criteria 4.3.6a and 4.3.6b can be made more specific by requiring that all improvement options should avoid divestments in the existing IT infrastructures (4.2):

*Criterion 4.3.*7 *(constraint):*
Investments in IT infrastructures of the logistics sector (on-board computers, eCMR-platforms) should not be written off.

5. An European vision on IT infrastructures of the logistics sector

This chapter is about the second part of the 'IT Assessment phase' of the research (2.1). The existing IT infrastructures of the logistics companies and the emergency services (as described in chapter 4) are not the only relevant starting points for the design of improvement options. The European vision on data communication between the logistics sector and the emergency services is also very important when taking decisions about investments in IT.

The ADR regulations are most relevant for the transport sector (1.2); see also Intermediate conclusion 4.2.1. Until recently it could be assumed that 'Europe' would be stable. All stakeholders complained about the slow decision-making process at the European level (Appendix I):

> 'One central portal would be the ideal solution. Each (authorized) person should be able to log in. (…) But if we should wait for Europe, then we will wait for another 10 years.'

However, during the writing of this thesis new information about the ADR came available. The *Guidelines for the use of RID/ADR/ADN 5.4.0.2* were published (UNECE, 2020b). These guidelines have no legal force, but they make the European vision on IT infrastructures within the logistics sector in relation to the national regulators and the emergency services more explicit than before. It enables to answer the following research question (RQ4):

> *Which European IT developments are relevant for the future of the IT infrastructures of respectively the emergency services and the logistics sector?*

5.1 The 'TP1/TP2 system' connecting the logistics sector and the emergency services

The purpose of the above mentioned guidelines is to fill a regulation gap that was left in the ADR regulations (UNECE, 2020b: Introduction):

> 'RID/ADR/ADN 5.4.0.2 allows the use of electronic data exchange to meet the documentation requirements of Chapter 5.4, provided the procedure for capturing, storing and processing the data meet the legal requirements as regards evidential value and availability during transport in a manner at least equivalent to that of paper documentation. However, RID/ADR/ADN does not further define this equivalence. In order to satisfy to the goal of ensuring the availability of data, security and evidential value, web services, interfaces and a communication architecture supporting data communication must be implemented. These guidelines are based on the outcome of the working group on telematics as approved by the Joint Meeting (…)'.

In other words, these guidelines specify the possible requirements for carrying an electronic bill of lading (eCMR) instead of a paper one. The document advocates the coming of a so-called 'TP1/TP2 system' in the future. TP stands for 'trusted party', i.e. service provider systems which can be trusted because they meet certain strict conditions (UNECE, 2020b: Section 1):

> '(a) The system architecture (…)is based on the concept of 2 types of service providing systems called trusted parties TP1 and TP2. The model envisages a number of TP1s and TP2s;
> (b) TP2 holds the data required in accordance with section 5.4.1 of RID/ADR/ADN. A TP2 may be operated by a carrier or operated by a third party service provider for a carrier;

(c) TP1 provides services for sharing these data from TP2 with authorities and emergency services upon request;
(d) A TP1 also transmits the data from TP2 to other TP1 upon request; (…).'

A TP2 may be operated by a carrier or by a third party service provider. The latter is the more obvious choice, because an independent third party will be considered more 'trusty' than one of the competitors within the logistics sector. Existing eCMR-platforms (see 4.2) are likely to become future TP2s.

A TP1 can be publicly or privately operated. Strict requirements are imposed on TP1s and TP2s in order to guarantee the integrity of the machine-machine communication between TP1 and TP2. Both TP1s and TP2s must be registered (NB: A TP2 must be registered by a TP1). They both have to use WSDL (Web Services Description Language, an XML-based protocol). They have to use also encryption techniques, and so on. Actually the technical requirements must guarantee reliable and secure data communication. A TP1/TP2 system will in particular satisfy criterion 4.3.5 (section 4.3 of the guidelines). Stricter requirements are imposed on TP1s than on TP2s, in particular about data security and technical maintenance. The TP1-service must always be available (7x24). TP1s must pass a certification process and must be nominated by the state ('participant' in terms of the guidelines) in which it is established.

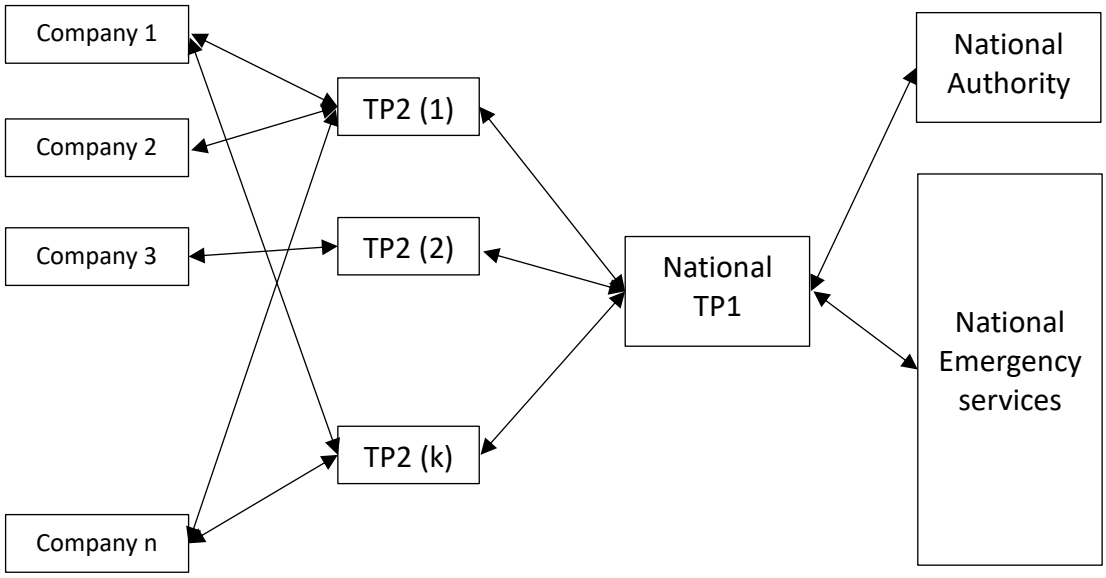
Particularly relevant are of course the data used by the TP1/TP2 system. Much of the information the emergency services need (3.2), is mentioned (UNECE, 2020b: Annex A, Section 1, 3):

- Vehicle Identification Number(s) and the BIC code for containers (if available or regulated);
- Status: beginning/end of the transport operation
- Transport document information (which must be digitally signed).

Notice that according these guidelines some coding systems shall be used for machine-machine communication. Therefore, if the Netherlands adopt these guidelines the coding of information may become an issue (see 4.1).

It is not stated explicitly in the guidelines, but the requirement that the state nominates TP1s, makes it possible to nominate precisely one TP1 per state. Logistics companies prefer one European TP1 (Appendix A), but they doubt strongly that this is possible in the short term, because of the slow decision making at the European level (Appendix I). However, one TP1 per state also offers advantages: data communication between on the one hand the emergency services and the enforcement authority and on the other hand one TP1-service is then relatively easy to realize. When all European states would implement the TP1/TP2 system in the same way, a system emerges that is very similar to the system that the logistics sector would like for streamlining their business (Intermediate conclusion 4.2.1). Because, by definition each TP1 is able to transmit data from an TP2 to other TP1s upon request (see above citated text). Actually in this way a sort of roaming function would be realized (4.2). *For that reason in this thesis is assumed that the Dutch government will nominate one TP1 server or none.*

Scheme 5.1 depicts the TP1/TP2 system that the Dutch government could aim for (see 5.3). The TP1/TP2 system consists of two types of 'trusted partners': one national TP1, and a number of TP2s. This system connects the (international) logistics sector to the national emergency sector (the emergency services and the national regulator (ILT)) by data communication services (the arrows).



Scheme 5.1: The architecture of the TP1/TP2 system in a national context

5.2 The 'transition phase'

The guidelines provide also requirements for the transition phase (UNECE, 2020b: Annex A, Section 4 and 5). The duration of the transition phase depends only on the situation of the enforcement authority and the emergency services:

> 'As long as there are emergency services and relevant authorities that are not connected to the TP1/TP2 system, on board information is *also* necessary' *(italics by the author).*

Subsequently Annex A of the guidelines lists *extra* requirements for the trucks and their on-board computers. These requirements apply as long as government fails to connect with the TP1/TP2 system. The requirements don't seem unreasonable. Most important is that the information position of the emergency services will not deteriorate (UNECE, 2020b: Annex A, Section 4):

> 'The data must be displayed on a screen that is equivalent to paper both in terms of character size and readability (visual representation without layout requirements (e.g. PDF format) on a screen of at least 10 inches or an optimised and structured representation that makes it possible to display on the respective screen (at least 3.5 inches) all the required substance-related data for a dangerous goods entry) in different light conditions. Operation of the reader must be easy and intuitive and give inspectors/the emergency services unrestricted access to all relevant dangerous goods information.'

Further, the guidelines specify some transitional requirements specific to road transport (UNECE, 2020b: Annex A, Section 5):

> 'Instructions shall be affixed in the drivers cab on how to access the electronic dangerous goods data in case the driver is incapacitated. The front and back of the vehicle must be marked with a note indicating the use of an electronic transport document. If it is not possible to affix this mark to the back for structural or other obvious reasons, it may be affixed on both doors of the driver's cab.'

5.3 Conclusions inspiring to criteria (3)

The previous sections lead to the following conclusions:

- The *Guidelines for the use of RID/ADR/ADN 5.4.0.2* of UNECE provide a technical specification of a two-layer TP1/TP2 system. The aim is to allow emergency services and regulators access to information about hazardous substances during their transport on the road. Realization of a TP1/TP2 system benefits also the logistics sector.
- The guidelines do not specify the number of TP1s and TP2s, neither who has to initiate such a system. This is left to public and private stakeholders.
- The logistics sector prefers one European TP1, but has doubts about the feasibility in the short time, because of slow decision making at the European level. One TP1 per nation state is the next best solution for the logistics sector.
- In line with the last conclusion it is assumed that the Dutch government will nominate one TP1 or none.
- The guidelines specify also a transition phase. The present position of the ILT is in line with this specification.

These conclusions give rise to some additional normative criteria.

Criterion 5a (constraint):
The improvement option must be compatible with the vision set out in the guidelines of the UNECE.

Criterion 5b (desideratum):
The more an improvement option realizes the vision set out in the guidelines of the UNECE, the better.

It is difficult to give weight to the last criterion. As mentioned above, the guidelines don't have legal force. Nation states may find their own way to fill above mentioned gap, as they did so far. At several places above the wish of the logistics sector is mentioned to get rid of the paper bill of lading for reasons of efficiency (3.1). This is a strong incentive for them to invest in IT, but investments will only pay off, if the national regulator ILT agrees with the chosen solutions. Until now the ILT is basically indifferent about the way the bill of lading will be made available, provided that it gets the information it needs in an user-friendly way. Therefore the ILT requires that layout and contents of the digital bill of lading are the same as of the paper one (Appendix G). This corresponds nicely with the transition phase as specified by the guidelines. But the ILT is not in the position to decide about adopting the TP1/TP2 system as a whole. That decision must be taken at a higher political level.

Though the outcome of this decision process is uncertain, from the viewpoint of the logistical sector an option will be more promising if it more or less fits in with the European vision. Logistics companies and providers of eCMR-platform services are more likely to invest in such options, because their business is international. In addition, some transports use more than one transport mode: the same container can be transported by train, boat and truck. The TP1/TP2 system is especially designed to meet needs like these.

It is more the question whether the Dutch government is willing to invest enough in the TP1/TP2 system. To realize this system fully, a lot of effort will have to be made to ensure that it can communicate with the emergency services. The technical specifications in the guidelines will not suffice.

6. Improving the information position of the emergency services

6.0 Requirements and constraints to the improvement options

This chapter is about the 'Design phase' of the research (2.1). Potential improvements of the data interchange between the logistics and the emergency sector are discussed to answer the third and partly the fourth research question.

> Research question 5 (RQ5):
> *How can the data exchange between the IT systems (used by the emergency services and the logistics sector) be improved in order to make the detection of and response to an incident more effective?*
>
> Research question 6 (RQ6):
> *Which IT related measures should the emergency services, the logistics sector and government take in order to maximize the safety during an incident on the road with hazardous substances?*

According Dasgupta (1989) a design problem is essentially some statement of requirements R which designers convert into some solution design D that satisfies R. There are there are two types of requirements (Pahl et al, 2007; p. 147):

> "*Demands* are requirements that must be met under all circumstances; in other words, if any of these requirements are not fulfilled the solution is unacceptable (…).
> *Wishes* are requirements that should be taken into consideration whenever possible, perhaps with the stipulation that they only warrant limited increases in cost, for example: central locking, less maintenance, etc. It is advisable to classify wishes as being of major, medium or minor importance."

The requirements for the improvement options (to be designed later in this chapter) are obtained from the evaluation criteria in the previous chapters. In particular the following constraints are functional requirements ('demands') for all options to be designed:

- The information about the incident must be at least as complete and reliable as the information on the paper bill of lading (Criterion 3.3.1).
- The information about the hazardous substances and the type of transport must be at least as easy accessible as currently via the paper bill of lading (Criterion 3.3.3).
- Each considered improvement option must propose a way of connecting systems of the logistics sector and the IT-systems of the emergency services (Criterion 4.3.1).
- Each improvement option must be compatible with the vision set out in the guidelines of the UNECE (Criterion 5). So, it must be possible to construct a mapping between components of the improvement options and the more abstract concepts of the TP1/TP2 system of the UNECE.

Other criteria (constraints) are even used to exclude design options a priori:

- The GMS of the alarm centre (the 'spider in the web') must remain the main communication channel between the logistics company and the fire brigade (Criterion 4.3.4).
- The government will not introduce legislation to enforce the cooperation of third parties (Criterion 4.3.3).

- Investments in IT infrastructures of the logistics sector (on-board computers, eCMR-platforms) should not be written off (Criterion 4.3.7).

So the starting point for the design is the description of the IT infrastructures of the logistics sector and the emergency services of today in chapter 4. We have observed that these infrastructures are not structurally connected.

The other evaluation criteria (i.e. desiderata) are not used as 'demand' requirements, but as 'wish' requirements.

It must remarked that the options below are not merely technical options. Some administrative and organizational considerations are playing a significant role. The reason for this is that there are more relevant aspects than only the technical functionalities. In particular, all stakeholders must 'trust' the solution, and sometimes the distribution of responsibilities is relevant for the stakeholders. See the warning in section 1.4 that the human aspect never should be neglected in any discussion about information systems.

6.1 Improvement option 1: Automatic notifying by the on-board computer

In this option the ('wish') requirement of timely information is optimized (from criterion 3.3.2): information must be available at the moment of notification. Because there is always a truck involved in an incident, it is intuitively logical to look whether the on-board computer of this truck can immediately provide incident data to the alarm centre. The on-board computer is the only IT device that is present at the spot of the incident with certainty. And systems like eCall which automatically generate incident notifications to the alarm centre, do already exist. One might think of a kind of 'panic button', with which the driver could send a notification to a 112-center. If in the case of a serious incident the driver isn't able to push the button, the notification must be sent automatically. If this notification (besides of course location information) would contain the digital bill of lading or minimally the Kemler code, substantial time savings could be reached. The alarm centre could immediately provide relevant incident information to the firefighter department. It will be even more effective when the GMS could translate the incident data into action scenario's, for instance by means of artificial intelligence (see 3.2). The fire-fighter would immediately know which equipment he should take to the incident. See scheme 6.1.

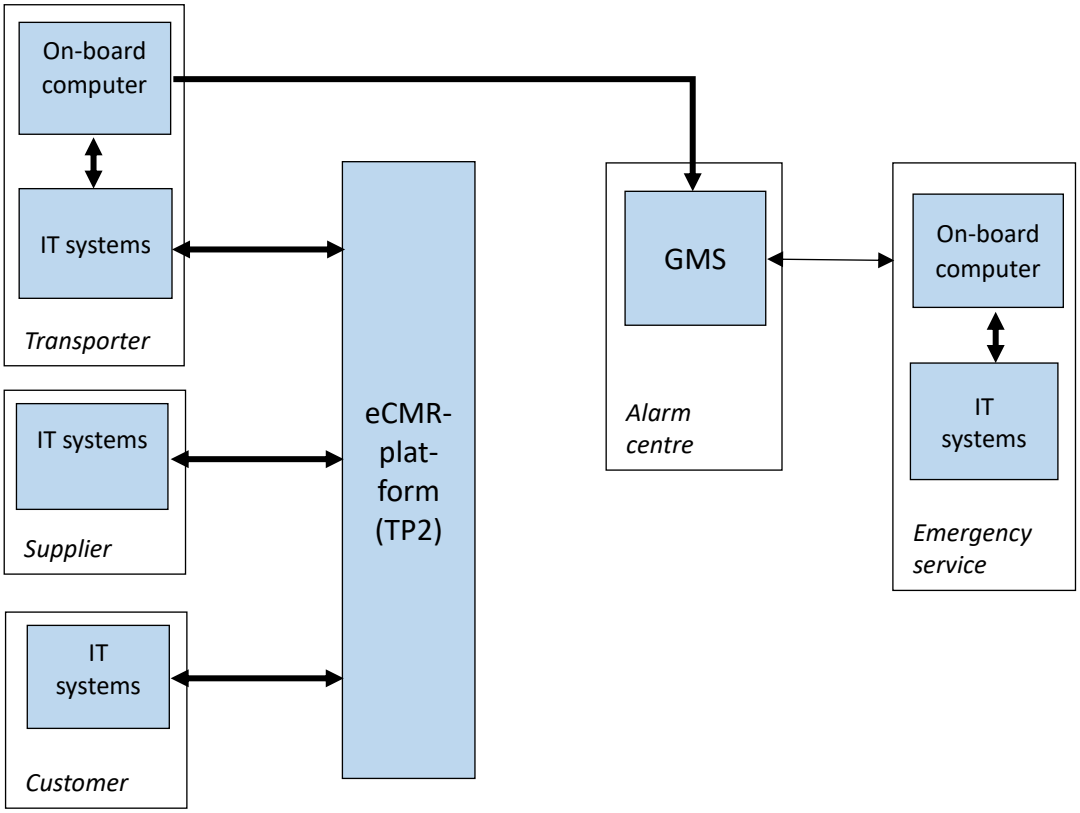
Necessary investments:

- Installation of an automated emergency notification system on the on-board computer of the trucks. A simple way to implement this is to extend an existing eCall-like application with a function which automatically encloses the eCMR as a PDF document into the notification message. More advanced solutions might be considered, but are more expensive.
- Building new functions in the GMS of the alarm centre so that the GMS can receive, process and send incident data including eCMR or a Kemler code. If the GMS doesn't need to process the enclosed data, but only transmit the whole notification message to the right emergency service, the present version of the GMS probably doesn't have to be adjusted even. This is the most simple way to implement this option, but maybe it is not very user-friendly. On the other hand, if one wishes a very advanced tool for the emergency services, then artificial intelligence may be considered to support the forming of 'scenario's', as mentioned in 3.2. However, such

investments are not strictly needed for substantial time gains. In the following is assumed that a simple, cheap solution is chosen.

This improvement option is discussed with a transport company (Appendix A) and a supplier company (Appendix C). Their reaction was positive in principle.

> 'If a calamity occurs, there should be a panic-button. A calamity doesn't occur often and therefore there is at the moment no return on investment for such an application. When we all (the logistics sector) are going to invest in digitalization, we should also invest in applications like that. Passenger cars are able to phone automatically 112; that is a rather simple application. It would be logical, if the same is possible for trucks.'
> *(Appendix A)*



Schema 6.1: Automatic notifying by the on-board computer of the truck

Legenda: ⟷ computer-computer communication
⟷ human-computer communication

The merits of this option are clear:

- It is the quickest way to transfer incident data to emergency services (given the limitation that all communication runs via the alarm centre).
- The IT is already available. The demanded investments therefore seem limited.
- The option provides also information about the location of the incident (GPS).

There is only one clear disadvantage, i.e. some risk for the quality of the data (except the timeliness) in two respects.
Firstly, one must be sure that the eCMR, stored in the on-board computer, is correct. Indeed the transport company noted that the digital bill of lading or the digital Kemler-code may be not up-to-date in the on-board computer, because it requires an extra action of the truck driver. The driver should not only secure the Kemler board physically, but also enter data into the on-board computer. No control on this action has been organized in the current working process. Actually, nowadays the truck driver doesn't enter anything into the on-board computer (Appendix F), while he is responsible for loading the truck according the paper bill of lading (Appendix C). The driver is properly trained to deal with hazardous substances he transports. Naturally he has a great interest in the safety of his truck, but his interest in administrative procedures may be more doubtful (Appendix F).

> *From the interview with the truck driver (Appendix F):*
> The administration (bill of lading) is mainly on paper. The on-board computer gets its data from the planning centre. These data are not up-to-date with certainty, neither always reliable. It is for instance possible to load two different hazardous substances into the truck-container; this is not always correctly administrated in the computer.
> The driver does not enter anything himself into the on-board computer; all data come from the planning centre. The computer communicates via a 3G-connection, but nothing is communicated during the transport.

This first concern about the quality of the data in the on-board computer was mitigated after the interview with the transport company. An email was received stating that this option was already discussed with emergency services. Indeed it is hardly conceivable that the national regulator ILT agrees with the use of the eCMR, if its reliability doesn't match the reliability of the paper bill of lading. As a matter of fact the ILT did agree with an experiment that was in line with this option 1 (Appendix G):

> 'The chosen solution is inspection of the eCMR on the spot via an application on the on-board computer without consulting a manual. (…) The need of law adjustments was discussed for a moment, but they didn't appeared necessary. (…) ILT was basically indifferent about the way the application is implemented, provided that it gets the information it needed.'

A second reason why the quality of the data could be doubted, is the lack of data security provisions. It is easy to send false notification messages to the alarm centre. Of course this problem arises for all notification messages to the alarm centre, thus also within the context of the other proposed options. Though, these are superior in this respect.

Finally the mapping of this option to the European TP1/TP2 system:

'TP1/TP2 system' (Guidelines RID/ADR/ADN)	*Improvement option 1 (automatic notifying)*
TP2	(eCMR-platform)
TP1	--

Actually this option does not take in account the TP1/TP2 system which is endorsed by the UNECE. But it is not incompatible with this system. In the contrary, the guidelines foresee a transition phase that actually is a simpler variant of this option. So, investments in this option are not completely lost, if ultimately the TP1/TP2 system would be adopted by European states. Moreover, this option is Europe-proof in yet another way. The 112 emergency number applies to 50 European countries. So, international transport companies can also expect return on investment from this option. This option seems to be a no-regret option.

Conclusion

Option 1 aims to ensure that emergency services have information about the dangerous substance and the mode of transport *as early as possible*. So, the main 'design criterion' is: timeliness of information. The option is realized by installing an eCall application into the on-board computer of the truck. This application can automatically send an incident notification to the alarm centre, which also contain the information wished for.
The needed investments are relatively small. This option satisfy the requirements of the transition phase as specified by the guidelines RID/ADR/ADN of the UNECE.

6.2 Improvement option 2: Alarm centre access to the eCMR-platform

The second improvement option tries to optimize the information reliability ('wish' requirement from criterion 3.3.1): the reliability and completeness of the information must be maximized. This can be realized by building on the most reliable data (eCMRs) available. Therefore the alarm centre should get access to the concerning eCMR-platform, if an incident has been reported. These data are very reliable, because they are meant to be used for all financial transactions around the transport: the supplier and the transport company want to be payed and the customer does not want to pay too much. All parties do what is necessary to make sure the information in the eCMR-platform is up-to-date and precise (supposed there are no criminal intentions). The way to implement this is that these platforms should meet all requirements to TP2 servers (UNECE guidelines, 5.1); this is supposed to be a private initiative. Furthermore, the GMS should be upgraded (by government) to a (national) TP1 server. See scheme 6.2.

Necessary investments:

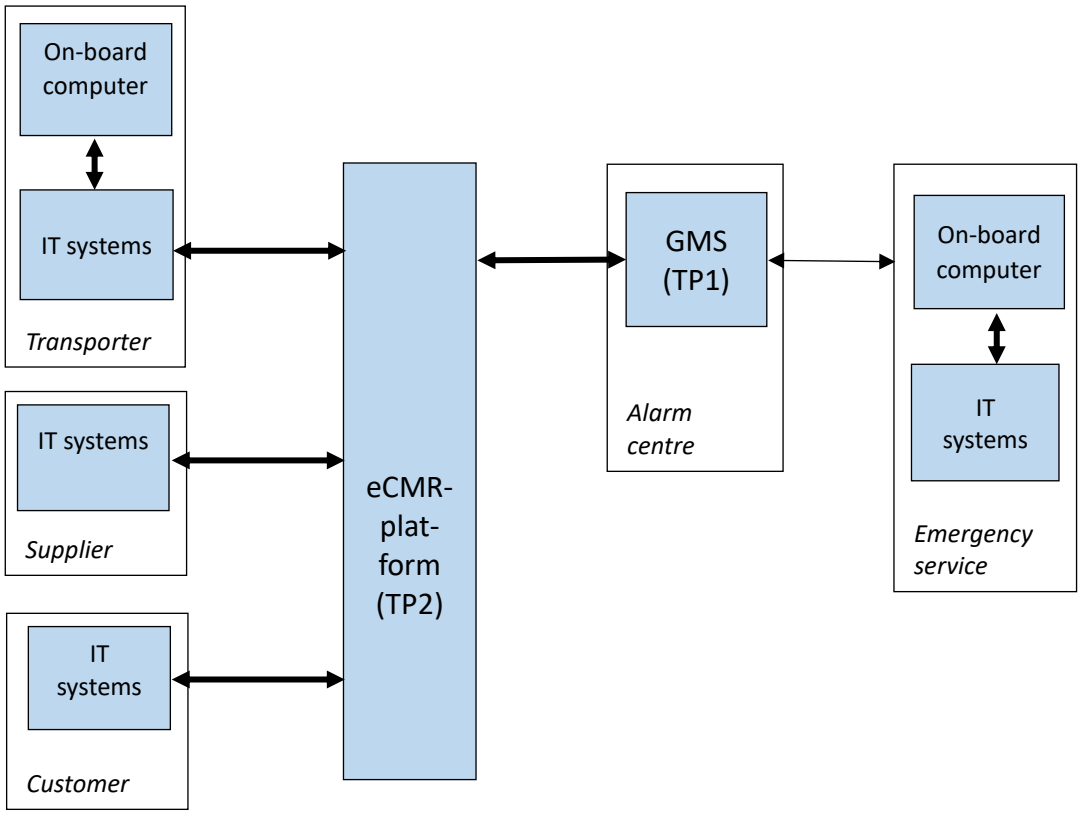
- The alarm centre has to get controlled access to eCMR-platforms. This new function of the GMS must be very user-friendly. This is a non-trivial application, because several systems are used within the Netherlands and Europe. Actually the GMS must become a TP1 server, while maintaining all its present functionality (5.1). The necessary investments will be substantial.
- The eCMR-platforms must support access to eCMRs by means of for instance the license plate code of the truck. More precisely, they must become TP2 servers (5.1). It depends on the existing implementation of the platform whether the investments are substantial.

The advantages of this option are:

- The alarm centre has direct access to reliable information about a transport in the case of an incident. The data security is well guaranteed.
- The investments in the technology are difficult to assess, but perhaps acceptable (see below).

But there are some disadvantages:

- The organisation of the data exchange is rather complex, because there are several eCMR-platforms today and maybe more tomorrow. See below.
- Furthermore, the logistics sector prefers an European solution, i.e. one European register having the functions described above. This disadvantage disappears, when all European states adopt the UNECE guidelines fully, but this is uncertain.



Schema 6.2: Alarm centre access to the eCMR-platform

Legenda: computer-computer communication
human-computer communication

Option 2 is functionally suboptimal, because the centralist has to take action to retrieve the eCMRs (which are automatically provided by option 1). It will be difficult to spend the time between the notification to the alarm centre and the arrival of the fire brigade at the site of the incident useful. Once arrived at the site the fire brigade can fully profit from the reliability of the data.

The most serious objection against this improvement option seems to be that there are several eCMR-platforms today. Four eCMR-platforms are admitted and used in the Netherlands, and eleven in Europe (Appendix H). Nowadays Transfollow has a 75% market share, but the market is just starting up. Anyway, an eCMR must be easy to find in the case of an incident. No time should be wasted searching for the right eCRM-platform (which seems inevitable as long as roaming isn't possible). This problem is however solved, if the GMS of the alarm centres is upgraded to an TP1-system and all eCRM-platforms are upgraded to TP2s (as assumed). In this situation the ILT is expected to agree with this option, because the strict conditions of the UNECE guidelines are met.

But the necessary adjustments of the GMS will be non-trivial, and may thus be costly for government.

The mapping of this option to the European TP1/TP2 system is straight-forward:

'TP1/TP2 system' (Guidelines RID/ADR/ADN)	*Improvement option 2 (GMS as TP1 server)*
TP2	eCMR-platform
TP1	GMS

This option is discussed with a transport company (Appendix A). It objects that the option maybe admits uncontrolled access of third parties (outside of the supply chain, for instance the ILT) to operational data of the transport. But it is to be expected that under the strict conditions of the UNECE guidelines this option will be acceptable for the logistics sector. Moreover, nothing is said about the *technical implementation* of the TP1-functions into the GMS. The most logical way to do this is by means of a more or less *independent subsystem, loosely coupled to GMS*. The technical picture looks then very much like scheme 6.3. But this said, this option implies a 'public' TP1. In order to take the opinions of the logistics sector seriously, the next option offers a private alternative.

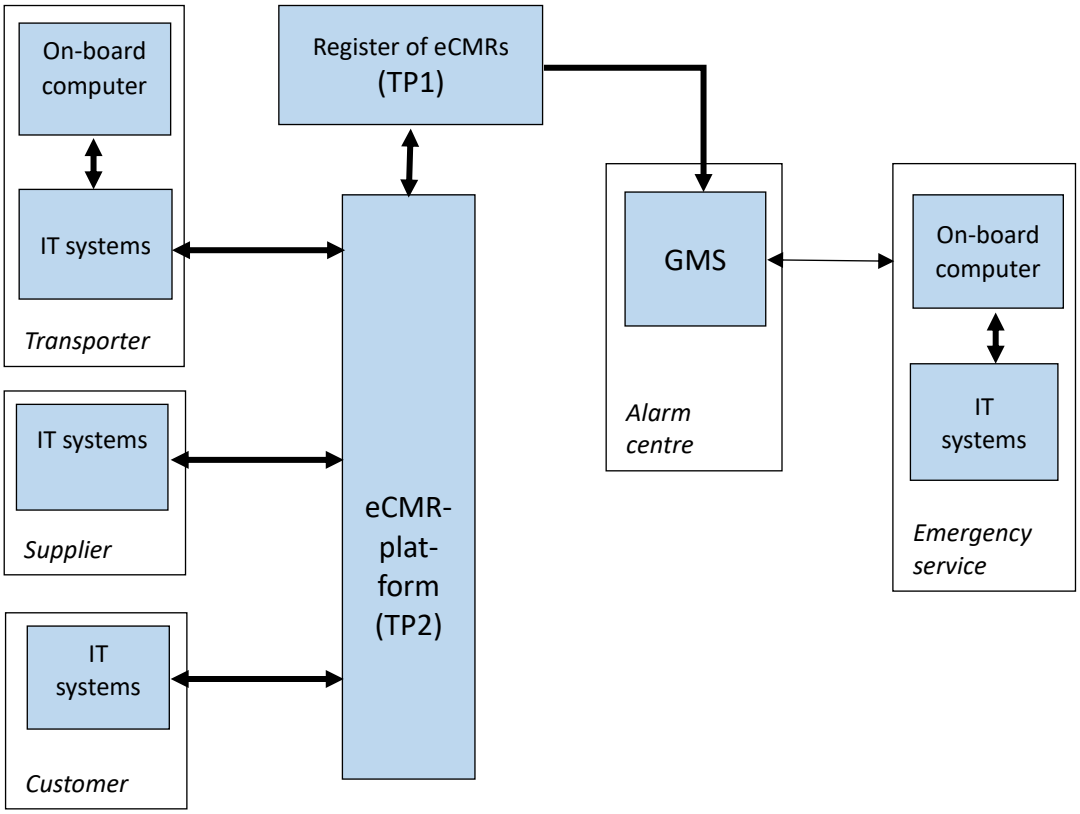
Conclusion

Option 2 aims to ensure that emergency services have information about the dangerous substance and the mode of transport *as reliable as possible*. So, the main 'design criterion' is: reliability of information. A TP1/TP2 system is realized as specified by the guidelines RID/ADR/ADN of the UNECE, by upgrading eCMR-platforms to TP2s and GMS to a TP1.
The needed investments are substantial.

6.3 Improvement option 3: National , dynamic register of eCMRs

Improvement option 3 also tries to optimize the information reliability ('wish' requirement from criterion 3.3.1). It can be seen as an attempt to deal with the eventual aversion of logistics companies to too much government influence in their business (6.2). One national register (a TP1 server) is established instead of extending the existing system GMS. This register may be set up, for instance by the collective of eCMR-platforms – the 'united eCMR-platforms' so to say -, which don't have any interest in the contents of the stored data sets, but only in making money by service logistical companies. Anyway, it is assumed to be *privately owned*. (It might also be a PPP (public private partnership), but that solution is difficult to organize because of the European competition rules.) So, the main distinction between option 3 and option 2 is the private respectively public responsibility for the TP1 function.
Logistics companies can allow the eCMR-platform to upload eCMRs to the register (TP1) upon request (in the case of an incident). In this way the data quality is guaranteed, because the data stored in the eCRM-platforms are reliable and up-to-date. The register should make the bills of lading (eCMRs) accessible to the ILT and the alarm centre (under conditions, i.e. in case of an inspection or an incident). The critical success factor is that the register is up-to-date and reliable at the moment of an incident. It is therefore not necessary that all eCMRs of current transports are

stored in the register; it sufficient if the register can retrieve easily and quickly the needed data from eCMR-platforms in case of an incident. This is the reason the register is called 'dynamic'. See scheme 6.3.



Schema 6.3: National register of eCMRs

Legenda: ⟷ computer-computer communication
⟷ human-computer communication

Necessary investments:

- A collective of public and/or private parties have to establish an trusted party, that will set up and maintain the new national register. This register must become a TP1 server (chapter 5). This will require substantial investments (even more than for adjusting the GSM in option 2).
- All eCMR-platforms will have to admit and to organize conditionally retrieving of data by the register. More precisely, they must become TP2 servers (chapter 5). It depends on the existing implementation of the platform whether the investments are substantial.
- The alarm centre needs an user-friendly facility for retrieving data from the register. This will be relatively simple to implement (but not as simple as option 1).

The advantages of this option are:

- The alarm centre has direct access to reliable information about a transport in the case of an incident, given that the register has been adequately organized and the eCRM-platforms (or the logistics companies) have adapted their systems in the right way.
- The investments in the technology are substantive (see previous option), but seem acceptable, because the logistics companies have a lot to gain if they can get rid of the paper bill of lading.

- Theoretically this option may evolve in the end to virtually one European register having the functions described above, preferred by the logistics sector. But this will only be possible, when all European states adopt the UNECE guidelines fully. This is very unlikely in the short term.

But there are some disadvantages:
- Somebody must initiate the setting up of the register within a competing market. When government takes initiative it might prefer option 2.
- The organisation of the data exchange is rather complex. A new stakeholder (for developing and maintaining the register) arises and has to gain trust of all other parties. It is not certain whether this option can be realized, because each stakeholder might wait for action of the others.

The same holds as for option 2: option 3 is functionally suboptimal, because the centralist has to take some extra actions to retrieve the eCMR, which is automatically provided by option 1.

The mapping of this option to the European TP1/TP2 system is even more straight-forward than of option 2:

'TP1/TP2 system' (Guidelines RID/ADR/ADN)	*Improvement option 3 ('Dynamic' register)*
TP2	eCMR-platform
TP1	National 'dynamic' register

This improvement option is discussed with a transport company (Appendix A). One supplier (NAM) came up itself with this solution (Appendix C). Both think that this option 3 is acceptable and feasible, provided that is guaranteed that the register is only consulted when there is an incident. This can be guaranteed, if the national register meets the requirements of a TP1 server. However, the transport company of course prefers a solution on the European level.
One representative of the fire department also favours a solution like this:

> 'If the information (eCMR) is stored in a general system, they (the fire brigade) can probably select the truck based on where the accident occurred and based on a general description. The eCMR can then be selected from the electronic system.' (Appendix E)

Observation
Notice that options 2 and 3 are identical at a technical level, but they differ from the viewpoint of who initiates the implementation and takes responsibility for the functioning. Both solutions are instances of an complete European TP1/TP2 system in the end. The advantages and disadvantages are comparable. It seems a question of taste which option to choose. If one prefers a leading role for government option 2 will be chosen. If one wishes to trust the market mechanism and seeks stable support of the logistics sector, than option 3 must be considered.
A compromise is also possible. Government could invest in option 2 (i.e. the development of a TP1 as a loosely coupled subsystem of the GMS), privatize the resulting TP1 at a later time (for instance in a private foundation), so that ultimately option 3 is realized .

Conclusion

Option 3 has the same aim as option 2: to ensure that emergency services have information about the dangerous substance and the mode of transport *as reliable as possible*. So, the main 'design criterion' is: reliability of information. A TP1/TP2 system is realized as specified by the guidelines RID/ADR/ADN of the UNECE, by upgrading eCMR-platforms to TP2s and to develop a national register of eCMRs as a TP1.
The needed investments are substantial.

6.4 Improvement option 4: the 'combination' option

The three improvements options so far cause a dilemma. Option 1 is obviously superior when looking to the information position of the emergency services. They get all information they can get at the moment of the notification message to the alarm centre, thus very timely. Moreover, this option is simple to realize, if the stakeholders wish. Options 2 and 3 however offer better information quality in terms of reliability and security; these options are more expensive. Obviously it is attractive to look for a combination, using the same maximizing requirements of both timely and reliable information as in option 1 respectively options 2 and 3.

Before discussing such a combination, notice that options 2 and 3 are identical at a technical level (see the last observation in 6.3). Therefore in the following these two options are seen as one: the 'option of the TP1/TP2 system' or 'improvement option 2/3'.
So, we look for an improvement option which combines advantages of options 1 and option 2/3. A sensible combination appears to be:

- An eCall application that can send an emergency notification which includes the licence plate number (but not necessary with a bill of lading, as in option 1), is installed in the on-board computers of trucks. This application is already in use in personal cars, but rarely in trucks.
- The alarm centre is granted access to the TP1 server (GMS or national register) after having received an automated notification.
- The TP1 server retrieves the needed data from the right TP2 server (eCMR-platform).

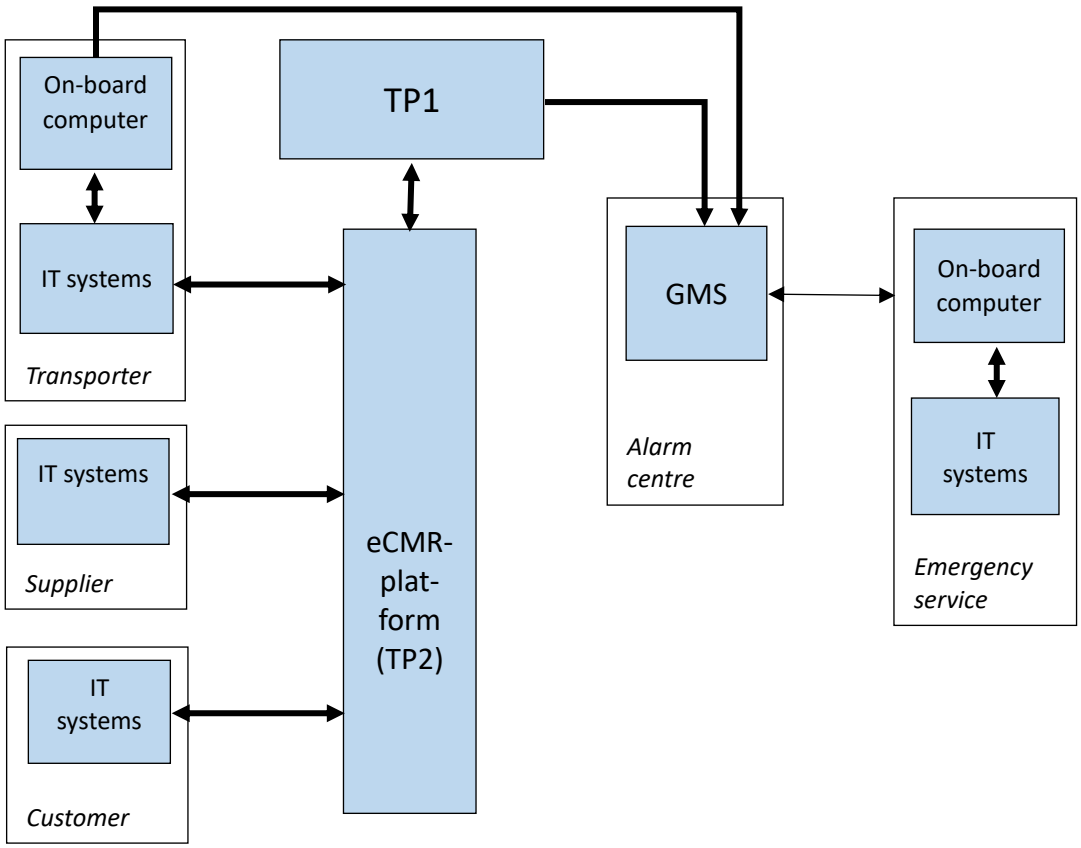
Preferably this process is fully automated from the moment of the notification message. This means some technical requirements for the eCall application. It must use the same coding systems as the TP1/TP2 system (especially the code of the license plate). So, the eCall application should be a bit more advanced than the simple one of option 1. If not, the alarm centre operator has to retrieve the data by manually entering this code GMS. Actually this would violate the maximizing requirement of timely information (from criterion 3.3.2).

Necessary investments:

- For the TP1/TP2 part of this option the same investments are required those for option 2 (6.2) or 3 (6.3).
- The eCall application should not be the simple one that would suffice for option 1. Else no fully automated handling of the notification message by GMS is realized. The investments in the eCall part of option 4 are mainly on the side of the GMS. The necessary investments on the side of the on-board computers of the trucks seem limited, provided that the technical requirements are clear.

Obviously option 4 inherits most of the advantages and disadvantages from options 1 and 2/3. Special attention deserves the following:

- Option 4 is even more expensive than option 2/3. Besides the costs of a TP1/TP2 system also special investments in an eCall application are needed.
- Option 4 offers about the same improvement of the information position of the emergency services as option 1, while maintaining the data reliability and security of option 2/3. If wished even 'false notifications' can be prevented by means of automatic 'call-back identification' of the truck that has sent the notification message.



Schema 6.4: The 'combination option'

Legenda: computer-computer communication
human-computer communication

Of course this combination option complies with the UNECE guidelines, as can be seen from the following mapping:

'TP1/TP2 system' (Guidelines RID/ADR/ADN)	*Improvement option 4 ('Combination')*
TP2	eCMR-platform
TP1	National 'dynamic' register

Observation
A final remark must be made. It is not clear whether this investment will be acceptable for logistics companies. It may require an investment in an advanced eCall application. Logistics companies cannot expect any financial return on investment from this. Government could subsidize the introduction of such an application. A more realistic approach is to initiate and subsidize an open standardization process aiming a set of technical specifications for the desired application. Organized that way, the implementation process would take much time (more than money). We return to this subject later on.

Conclusion

Option 4 tries to combine the advantages of option 1 as well as those of options 2 and 3: to ensure that emergency services have information about the dangerous substance and the mode of transport *as early and reliable as possible*. A TP1/TP2 system is realized as specified by the guidelines RID/ADR/ADN of the UNECE (see options 2 and 3). In addition, it provides an eCall application (see option 1).
The needed investments (especially in time) are substantial.

6.5 Conclusion

Four options for improvement of future data communication between the logistics sector and the emergency services are designed. All improvement options are based on the central position of the alarm centre as 'the spider in the web', and of course all satisfy the constraints mentioned in section 6.0.

The four options differ in terms of the underlying idea.
Option 1 aims to ensure that emergency services have information about the dangerous substance and mode of transport *as early as possible*. It is realized by installing an eCall application into the on-board computer of the truck. This application can automatically send an incident notification to the alarm centre. The needed investments are relatively small. See scheme 6.1.
Option 2 aims to ensure that emergency services have information about the dangerous substance and the mode of transport *as reliable as possible*. A TP1/TP2 system is realized as specified by the guidelines RID/ADR/ADN of the UNECE, by upgrading eCMR-platforms to TP2s and GMS to a TP1. The needed investments are substantial. See scheme 6.2.
Option 3 has the same aim as option 2. But a TP1/TP2 system is realized by upgrading eCMR-platforms to TP2s and to develop a national register of eCMRs as a TP1. The needed investments are substantial. See scheme 6.3.
Option 4 tries to combine the advantages of option 1 as well as those of options 2 and 3. Both a TP1/TP2 system and an eCall application are realized. The needed investments are substantial. See scheme 6.4.

7. Evaluation of the improvement options

7.1 Preliminary remarks

This chapter continues the discussion of the 'Design phase' of the research (2.1). We will evaluate the improvement options that were presented in chapter 6: (a) 'automatic notifying the alarm centre' (option 1); (b) a public or a private instance of 'the TP1/TP2 system' (option 2/3), (c) a 'combination' of the two previous options (option 4).

At first sight option 4 is superior, because this option improves the information position of the fire brigade most. This option scores best in respect of timeliness and is very user-friendly which is important in times of panic. However, options 1 and 2/3 have their own merits. Option 1 scores almost as well as option 4 on the most relevant criteria, and is cheap and easy to realize (within a time period of 3 to 5 years, if one wishes). Option 2/3 provide also reliable data and there are guarantees for data security. They are all less expensive than option 4.

So, the choice is difficult. That's why a more systematic evaluation is indicated. This will be performed in this chapter. The first step (section 7.2) is to evaluate the options per criterion. All options meet the constraints, therefore only the desiderata - introduced in 3.3, 4.3 and 5.3 - must be taken in account. After this the discussion about the weighting of the criteria will be proceeded in section 7.3 (this discussion was already started in 3.3, 4.3 and 5.3). This must lead in section 7.4 to a choice within the scope of this thesis (Introduction): improvement of the information position of the Dutch emergency services in case of incidents with hazardous substances on the road.

7.2 Scoring the options against the evaluation criteria

In this section the three resulting improvement options are evaluated on basis of the criteria of 3.3 and 5.

Criterion 3.3.1:
The information about the incident must be as complete and reliable as possible at the moment of the notification of an incident.

This criterion was leading for the design of options 2/3 and 4. Obviously these options will score best on this criterion, thanks in part to the requirements of the UNECE guidelines. But option 1 doesn't score badly, because the data stored in the on-board computer of the truck must be reliable, also thanks to the (transition) requirements of the UNECE guidelines. Maybe option 1 provides even slightly more reliable information about the truck itself than option 2/3, because the on-board computer is more or less inseparable from the truck.
In a way option 1 is more 'robust' than option 4. The functioning of the technical solution of option 1 depends only on the functioning of the on-board computer of the truck. The functioning of the technical solution of option 4 depends also on the functioning of the TP1/TP2 system. Because of the strict security requirements for the TP1/TP2 system (5.1), this robustness difference is not taken in account.

Criterion 3.3.2:
The information about the hazardous substances and the type of transport must be timely. Ideally this information should be available for the fire brigade at the same time as the notification of the incident itself.

All options mean a real improvement of the timeliness of the information about hazardous substances and the type of transport (compared with the situation today), but options 1 and 4 are superior: one push on the button by the driver immediately guarantees full information for the alarm centre.

Criterion 3.3.3:
The information about the hazardous substances and the type of transport must be accessible in a user-friendly way.

Again options 1 and 4 are superior; see previous point.

Criterion 4.3.2:
The costs (in terms of money and time) on the side of government must be as low as possible.

The costs of option 1 are the lowest in terms of money and time, because the GMS is already able to receive notification messages from the eCall application (6.1). The interviews show that the logistics sector are willing to invest in this option.
Options 2/3 and 4 are much more expensive for government, especially when publicly financed option 2 (adjustment of GMS) is chosen. The logistics companies are willing to invest in option 2/3, if the can expect that it will result in an European TP1/TP2 system, but this is uncertain. So, the government must take into account a time-consuming process. One expects this will take another 10 years (Appendix I). Finally, it is uncertain whether the logistics companies are willing to invest in option 4, because it requires a more advanced eCall application.

Criterion 4.3.5:
Access to sensitive company information must be blocked for unauthorized third parties.

Options 2/3 and 4 score well on information security, because of the strict requirements of the UNECE guidelines (5.1). Option 1 gets about the same score, but for different reasons. A notification message is only sent to the alarm centre, if the truck driver pushes the button or the system notes a serious incident. However, the logistics sector seems to trust options 2/3 and 4 more than option 1 in this respect.

Criterion 4.3.6a:
The financial costs for the logistics companies must be minimal.

Criterion 4.3.6b:
The financial investments for the logistics companies must improve their business process within a reasonable time

See also the considerations under criterion 4.3.2. It is worth a lot to the companies when they no longer have to carry a paper bill of lading. If there is an opportunity to construct a complete TP1/TP2 system, the costs will very probably be acceptable for the logistics sector, because they

are willing to invest in supply chain management. Of course they prefer an European solution. As long as there is no prospect on such a solution, the companies will hesitate to incur considerable costs. The problem is thus that no stakeholder will make decisions alone. Each stakeholder tends to wait for the decisions of the others. The logistics market are waiting for the decisions of 'Europe' or 'the Netherlands', which on their turn are waiting for actions of the market.

- *Criterion 4.3.6a:* The costs of option 1 are relatively small in comparison with the costs of the other options. Option 2 (publicly financed) will obviously score better for the logistics sector than option 3 (privately financed). The 'combination' option 4 is more expensive for logistics companies than option 2/3.
- *Criterion 4.3.6b:* Option 1 doesn't contribute positively to the logistics process. The other options do have the desired side effect of improving the supply chain management systems of the logistics sector. Option 2 (publicly financed) has the best prospect to be realized in the medium term, because the public initiative of building a TP1 server will increase the trust that an European solution is in reach in the medium term. The 'waiting problem' (mentioned above) is then solved partly. For option 3 (privately financed) the 'waiting problem' remains, and this option scores therefore slightly worse (because it takes more time to implement it). The 'combination' option 4 has the same problem even more. It requires investments in an more advanced eCall application, which entails costs in terms of money and especially time.

Criterion 5:
The more an improvement option realizes the vision set out in the guidelines of the UNECE, the better.

Options 2/3 and 4 are clearly superior, but option 1 does not score badly, because it can be seen as a transition phase. If the other options cannot be optimally implemented due to the slow European decision-making, option 1 is a no-regret option in this respect; see 5.2 and 6.1.

7.3 The weights of the evaluation criteria

Table 7.3 summarizes the results of the previous section. The order of the criteria has been slightly modified to reflect their respective character.
The first part of the table shows the functional criteria (3.3.1 – 3.3.3), which are directly related to the objective of this thesis: improvement of the information position of the emergency services.
The second part (criteria 4.3.5 – 4.3.6b) takes the viewpoint of the logistics companies. Their cooperation is required for the successful implementation of the ultimately chosen solution.
The final part (criteria 4.3.2 and 4.3.6a) concerns relatively circumstantial criteria, like the costs (in money and time) for the stakeholders. If Dutch government really wants to, it can remove most obstacles that arise from these criteria, but not all. Government is not able to speed up the process if some parties don't want to cooperate. Remember that legislation is excluded as enforcing instrument (criterion 4.3.3).

Of course it is not justified to choose an improvement option by adding and subtracting the scores. Uncertainties about the weighting of the criteria were mentioned at various places in this thesis. They make it difficult to make a definite choice between the different options. In the next subsections some weighting aspects will be discussed.

Table 7.3: Evaluation of the improvement options

	Option 1: On-board computer (truck)	Option 2/3: TP1/TP2 system	Option 4: combination
Criterion 3.3.1:			
a) Complete, reliable information about hazardous substances	+	++	++
b) Complete, reliable information about the type of transport	++	+	++
Criterion 3.3.2:			
Timely information	++	+	++
Criterion 3.3.3:			
User-friendly access to information	+	-	+
Criterion 4.3.5:			
Information security (logistics companies)	+	+	+
Criterion 5:			
Fit with UNECE vision	=	+	+
Criterion 4.3.6b:			
Improvement of the logistics process	=	+	+
Criterion 4.3.2:			
Minimal costs for government	+	-	-
Criterion 4.3.6a:			
Minimal costs for logistics companies	+	=	-

+ : relatively positive
= : about indifferent
- : relatively negative
NB: Indications like +, = and - don't have the same meaning per row. Therefore no definite conclusions can be drawn by adding and subtracting.

The scope of this research

The scope of this research is determined by its objective. This objective (see Introduction) is to improve the information position of the Dutch emergency services in case of incidents with hazardous substances on the road. This means: a national context; focus on the emergency services; transport on the Dutch roads; innovations which are underway. There was only secondary

attention for: the interests of the logistics sector; transnational transport in various modes (train, boat, truck); and the long term. So within the scope of this research the first set of criteria are the most important. Furthermore, criterion 3.3.2 must get the highest weight, because timely information is most desired by the emergency services (Intermediate conclusion 3.1.4).

It is clearly unrealistic to strictly adhere to the limits of the scope. Results can only be reached by cooperation. Under these circumstances it is not sensible to neglect the interests of the logistics sector. Besides, in politics decisions are rarely made on isolated topics and with unambiguous goals. For instance, a proposal is more likely to be accepted by politics, if it not only serves safety on public roads but also reduces the administrative burden for logistics companies. In general, the importance of the second set of criteria increases as the scope of the study is broadened. There are several obvious ways to broaden the scope.

Transport by train and/or boat

The thesis research is restricted to transport by truck. Option 1 wouldn't even be considered for transportation by boat and train. And option 2/3 – a pure implementation of a TP1/TP2 system - might score better than the 'combination' option 4, because it scores equal in the second part of the table and a bit better in the third part. This is an important observation, because many logistics companies have hazardous substances partially transported by trucks, trains and/or boats. The services of an eCMR-platform are particularly interesting for those combined transports.
Remember that only about 2% of the hazardous substances are transported by truck (1.2).
This observation illustrates again how the demarcation of the research influences the weight of the evaluation criteria.

Duration of the European decision-making process

The research of this thesis was limited to a period of 5 years, but how long will it take to establish a complete European TP1/TP2 system as specified in the UNECE guidelines? The representatives of both the logistics companies and the ILT are not very optimistic about this, to say the least. Which nation will move first? Is the international transport sector able to look beyond direct competition? Is the collective of admitted European eCMR-platforms (the future TP2s) willing to invest in one common TP1 or at least in a cohesive system of national TP1s?

Probably the logistics sector would be willing to take part in the investments in one European TP1, *if* they have the prospect that many European states will do their part (minimally specifying and realizing the machine-machine connection between the TP1 server and the relevant IT systems of their emergency services). But actually the UNECE doesn't propose this idea; on the contrary, it proposes a cohesive system consisting of more than one TP1 (5.1). Logistics companies will be less willing to invest heavily in national TP1s.
For this thesis it is assumed that a privately sponsored TP1/TP2 system will not arise soon without substantial financial support of the European Union. So, on the short term the initiative can only come from a national (i.e. the Dutch) government. It could show some willingness to upgrade the GMS to a TP1 server (option 2).
At this point the last group of criteria become more relevant. If one assumes that decision-making at European level will take more than five years, then only options 1, 2 and 4 (based on option 2) are really eligible. The implementation time for these options could be limited. Option 1, because no European decision-making is needed; option 2 (or 4), because the Netherlands takes the initiative itself.

A second political aim: reduction of administrative burden

Given the limited social impact of incidents with hazardous substances on the road, safety reasons will not be a decisive argument to choose option 2 or 4. But if the Dutch government is willing to upgrade the GMS to a TP1 server (option 2), all things change. In that case the advantages of especially option 2 may come within the planning horizon of the logistics sector. The Dutch government might consider this, not because of the safety gains, but in order to reduce the administrative burden for the logistics sector. This political objective is outside the scope of this thesis. Nevertheless all things considered, options 2/3 and 4 cannot be excluded due to the expected duration of the European decision-making process.

Conclusion about the weighting

The weights of the evaluation criteria depend heavily on the scope of the research. Given the scope of the research the first group of criteria is the most important. In particular criterion 3.3.2 must be given great weight (interim conclusion 3.1.4).
The second group of criteria represents the interests of the logistics companies, and can therefore not be ignored. Their support is indispensable.
The third group of criteria seems at first sight to be less important, provided that implementation of the chosen option is possible within reasonable time. However, the latter condition is not always met. Because of the uncertainties at the European level there is reasonable doubt whether options 3 and 4 are even feasible in the medium term (this observation is not clearly visible in the scoring in table 7.3!).

7.4 The ‘best’ choice

The conclusion of the previous section must be that it is not a trivial task to choose the ‘best’ option. The process of selecting the optimal option is therefore structured in three rounds.

Round 1: The best option in terms of functionality for the emergency services

From the perspective of the emergency services option 4 should be preferred. It has the best scores on all criteria of the first part of table 7.3. *Option 4 is anyway functionally and technically the best option*, because it scores highest on all functional and technical criteria. But this is not enough to conclude that option 4 should be implemented under the current circumstances. In the next rounds some implementation issues are taken in account.

Round 2: The best option from the perspective of the logistics sector

The second round is concerned with the logistics sector, whose support is indispensable to realize any option. The logistics sector is only interested in a safe handling of incidents as far as their image is on stake (bluntly expressed). So it is not very interested in the scores on the criteria of the first part of the table. Particularly the second part of table 7.3 is important. So, from the perspective of the logistics sector *option 2 - potentially ending in option 3 - should be preferred*. Option 4 scores equally well on the criteria of the second part of the table, but at higher costs. This would be acceptable, if government is willing to subsidize the advanced eCall application. Option 1

seems – according to the interviews - to be acceptable because of its low costs, which could be compensated by the enhancement of the image of the sector.

Round 3: The 'best' option from the perspective of the Dutch government

The Dutch government must decide whether it wants to take the initiative for implementing an option, in order to solve the 'waiting problem', mentioned in 7.2. There are two lines of thinking along which it can reason, corresponding with two political objectives. The first line is that the government is ready to invest in the safety of incident handling. The second line is that the Dutch government is ready to reduce the administrative burden for the logistics sector; if this leads to a safer handling of incidents by the emergency services, so much the better (these two lines of thinking will return in section 8.5: see scheme 8).
The former line of thinking is assumed in this thesis, but because of the small impact of incidents with hazardous substances on the road, the latter line of thinking might have been more fruitful in hindsight. That is the reason that the choice of the 'best' option is so difficult in this case.

Given the scope of this research (i.e. the first line of thinking above), government should select the cheap, feasible 'no-regret' option 1 as the option to be implemented first, allthough option 4 is functionally the best one. Option 1 scores second on the most relevant evaluation criteria in the context of this research: reliability, timeliness and user friendliness (first part of table 7.3). But this option doesn't have to wait for decision-making at the European level (included in criterion 4.3.2). Admittedly, option 4 scores better on most criteria, but there are serious doubts whether option 4 can be implemented within a reasonable time period (say 5 years). The most obvious weak point of option 1 – the fit with the UNECE vision – can be put into the perspective of a transition period, which is consistent with the UNECE guidelines. In other words, the developments don't have to stop after implementing option 1. The 'ideal' option 4 remains within the long term range.

So, given the scope of the research and after consideration of both functional and practical criteria, *option 1 should be selected for implementation, at least for the start*. Choosing this option does not block other options for the future.

Some concluding remarks

So, given the scope of this research, the cheap no-regret option 1 should be chosen: automatic notifying by an eCall-like application in the on-board computer of the truck. It is not the best one in respect of functionality, but it is the 'best' one because it is feasible on the short-term and doesn't block future developments.

However, when broadening the scope the choice could be different. Especially when taking in account the possibility of combined transport of hazardous substances, option 2/3 would be more attractive, especially option 2, because this option could be implemented faster than option 3. Option 4 might anyway serve as the 'ideal' situation to pursue in the long term. The biggest problem of options 3 and 4 is the uncertainty about the decision-making at the European level.

This leads to a somewhat speculative observation. If the Dutch government (wanting to improve the safety during the handling of incidents on the road) decides to implement option 1, than this option could evolve to option 4 in the long term. If the Dutch government (wanting to reduce the administrative burden of the logistics sector) unilaterally decides to implement option 2, then option 4 will never be realized, because of the limited added value. For the UNECE guidelines don't

require that an eCMR is stored in the on-board computer of the truck, if a TP1/TP2 system is implemented fully. Because this transition requirement holds only in the transition phase (5.2). So if the Dutch government is prepared to invest in option 2, it should preferably make *in advance* agreements with the logistics sector about realizing option 4 later on. This observation is relevant for some recommendations that will be discussed in section 8.5.

7.5 A qualitative cost-benefit analysis

Will the investment in the preferred improvement option 1 give return on investment? A (quantitative) cost-benefit analysis (CBA) should give an answer. But in this case one can doubt whether such an analysis is useful, for two reasons.

Firstly, when safety for society is at stake the decision to invest is mainly a political one. When for instance a serious accident occurs in the near future, one can expect a 'spontaneous' willingness to invest with all parties. The costs are in that situation not anymore of decisive importance. Government will pursue 'safety above all', and the logistics sector will want to strengthen its image of safe transport, certainly when the costs are limited in comparison with the total business.

> 'CBA is often taught in a way that is completely divorced from political reality. We wish to avoid this mistake. CBA is a normative tool, not a description of how political and bureaucratic decision makers actually make decisions. (…) In practice, correct CBA is no more than a voice for rational decision making.' (Boardman et al., 2013)

Secondly, the costs of the respective improvement options may be estimated, when sufficient information is available about number of trucks, the number of on-board computer types and so on, but the estimation of benefits will be very tricky indeed, even if reliable information were available about numbers of incidents and the caused damage. Potential time gains for the fire brigade may be assessed, but the effect in terms of human lives and wounded remains uncertain; see also chapter 9. Moreover, what is the price of a human life? One will have to calculate with shadow prices, which may provoke much discussion.

This thesis is not in the first place concerned with the costs and benefits of IT investments. Its goal was to indicate potential improvements in the information position of the fire brigade, given the IT innovations within the logistics sector. Nevertheless it makes sense to present the costs and benefits for the involved parties in an qualitative way, for the following reason. In the previous section was argued that option 1 is the 'best' one, given the objective of the research. But one could ask whether even this option should be realized. In other words, maybe the null-option of 'doing nothing' is to be preferred, because of the limited relevance of the problem (< 20 incidents per year). Table 7.5.1 summarizes this qualitative analysis.
The analysis suggests that the investments in realizing improvement option 1 is justified. The benefits are small, but so are the costs. Here is an additional, psychological argument: by investing in option 1 the safety subject remains on the political agenda at little cost. Option 1 is also intuitively the most attractive, because it exploits the presence of the on-board computer, which is the only IT device that is always available at the moment of an incident. However, it is uncertain whether the benefit 'more safety' is achieved (see the final chapter). So, ultimately the decision remains a political one.

Table 7.5.1: Qualitative cost-benefit analysis of improvement option 1

	Benefits	*Costs*
Fire brigade	Reliable and timely information about hazardous substances and type of transport	Minimal training of the personnel
Alarm centre	Faster and more complete call-up of emergency services	Minimal adjustment of GMS
Logistics company	Efficiency because of eCMR (some reduction of administrative burden)	Installation of eCall application, eCMR included
ILT	None	None
Society	More safety	Maybe some regulations

Given the conclusion that option 4 might serve as an ideal to pursue (see concluding remarks in section 7.4), it is useful to make also a qualitative cost-benefits analysis of option 4, because this option combines all advantages, save for the costs. See table 7.5.2.
The investments needed to realize this option, are quite large. The potential benefits lie both in the sphere of social safety and in the reduction of the administrative burden for logistics companies.

Table 7.5.2: Qualitative cost-benefit analysis of improvement option 4

	Benefits	*Costs*
Fire brigade	Reliable information about hazardous substances and type of transport	Minimal training of the personnel
Alarm centre	More complete call-up of emergency services	Substantial adjustment of GMS (=> TP1)
Logistics company	Efficiency because of eCMR (reduction of administrative burden)	Installation of advanced eCall application
eCMR-platforms	New services to alarm centres and logistics companies	Substantial adjustment of the technical system (=>TP2)
ILT	Easy access to eCMR	Investment in access to GMS or national register (TP1)
Society	More safety	(besides cost mentioned already above)

7.6 Conclusion

Comparing advantages and disadvantages of the improvement options, that were designed in chapter 6, one should give preference to the cheap, feasible no-regret option 1: automatic notifying by an eCall-like application in the on-board computer of the truck. It scores second on the most relevant evaluation criteria in the context of this research: reliability, timeliness and user friendliness (first part of table 7.3). Moreover, a choice for option 1 doesn't block the realization of option 4 later on. Option 4 isn't selected immediately as the 'best' one, because there are serious doubts whether it can be implemented within a reasonable time period (say 5 years).

However, when broadening the scope of the research the choice could be different. Especially when taking in account the possibility of combined transport of hazardous substances, option 2/3 would be more attractive on the medium term, especially option 2, because this option could be implemented faster than option 3. The biggest problem of options 2/3 and 4 is the uncertainty about decision-making at the European level. This problem would be less prohibitive, if Dutch government would decide to implement option 2, in order to reduce the administrative burden of the logistics sector.

8. Conclusions and recommendations

8.1 Preliminary remarks

Before the conclusions of this thesis research are summarized, some preliminary remarks are made about the limitations of the research.

- The objective of this thesis was to improve the information position of the emergency services. To that end the information (data) exchange is researched between the logistics sector and the emergency services, when confronted with an incident with hazardous substances on the road (detection and response). The research was focused on the IT used by these sectors. The goals and the primary processes of the involved organizations are considered as given.
- In the course of the research the scope is restricted step by step. First the choice is made to restrict the research to the decisions and actions of the fire brigade and the alarm centre during the detection and response phase of the incident management. Secondly, only the IT developments of logistics companies are studied which have to comply with the ADR regulations. It is argued why both restrictions probably do not harm the validity of the research results.
- The research results are mainly based on interviews, with all its advantages and disadvantages. The main disadvantage is that there isn't any certainty that the opinions of the interviewees are representative for their sectors (Fortunately, most facts were confirmed in literature, i.e. national and European regulations). The main advantage is that the interviewees all reason from their own viewpoint and interests. In this research the opinions of the logistics sector and the emergency services appeared to be very much in line. So, there is also a good chance that stakeholders can agree on eventual future steps.
- The demarcation of the research entails risks for the validity of the research, especially when choosing the optimal improvement option. For this reason a sort of sensitivity analysis has been made. Indeed the choice of the 'best' option appears to depend strongly on the scope.

8.2 Research questions and answers

At the base of this thesis lies the observation that logistics companies and emergency services both are using IT to support their primary processes (administration, planning etc.). But the IT infrastructures of the emergency services and the logistics sector are evolving independently. The objective of this research is to determine how this IT evolution will affect the safety during an incident with hazardous substances. In particular the chances for improvement of the information position of the emergency services were investigated. The research was limited to the detection and the response phase of the incident. Consequently the main research question became:

> *How should present and future IT, used by logistics companies and emergency services, improve the detection of and the response to an incident with hazardous substances on the road?*

This main research question was elaborated into six sub-questions, which were answered in chapters 3 to 7.

Research question 1 (RQ1):
How are the main actors operating just before (detection) and during (response) an incident on the road with hazardous substances?

This question is answered in section 3.1. Many actors are involved in the process of handling an incident. Some of them belong to the emergency services, others to the logistics sector. An incident is dealt with by the emergency services, and in particular the fire brigade. This brigade comes into action after a witness - usually the truck driver – has reported the incident to the alarm centre. So, initially the communication takes place via the alarm centre. Once the fire brigade has arrived at the scene of the incident, there can be direct communication between the fire brigade and the driver. Usually, only at that time the fire brigade receives information about the nature of the hazardous substances (the bill of lading). For an overall picture, see scheme 3.1.
The analysis of the handling (detection and response) of an incident indicates that the effectiveness of this process could improve, if the fire brigade would have *earlier* complete and reliable information about the involved hazardous substances (Intermediate conclusion 3.1.4). All interviews do confirm this conclusion.

Research question 2 (RQ2):
What information do the emergency services use just before and during an incident on the road with hazardous substances?

This question is answered in section 3.2. The emergency services (the fire brigade) are using four categories of information:
1. Information about the hazardous substance;
2. Information about the type of transport and the vehicle;
3. Information about the situation at the spot;
4. Information about the environment and about the weather.

Only information about the hazardous substance and the type of transport (categories 1 and 2) is available from the trucker or the carrier. This information is recorded in the bill of lading, that always has to be carried by the trucker, according the ADR regulations.

Research question 3 (RQ3):
Which IT infrastructures are used by respectively the emergency services and the logistics sector?

This question is answered in chapter 4. All logistics companies have their own information systems, but two IT innovations within the logistics sector are especially relevant when looking for opportunities to improve the information position of the fire brigade: (a) the increasing use of eCMR-platforms by logistics companies, and (b) the probable future use of eCall-like systems.
The eCMR-platforms offer the opportunity to make business more efficient. The partners in the supply chain (carriers, suppliers and customers) have access to the platform of their choice and can follow the transport from step to step.
An eCall-application communicates directly with alarm centres in the case of an incident. At this moment eCall is scarcely installed on the on-board computers (which are present in most trucks), but this could change quickly (5.2).
The most relevant IT system for the emergency services is the GMS (in Dutch: ‘Geïntegreerd Meldkamer Systeem’) that is used by the alarm centre.

Nowadays there is no structurally organized data communication between the logistics sector and the emergency services. See scheme 4.2.

> Research question 4 (RQ4):
> *Which European IT developments are relevant for the future of the IT infrastructures of respectively the emergency services and the logistics sector?*

This question is answered in chapter 5. For the logistics companies are operating internationally and they prefer European solutions. For instance, at the moment the use of a paper bill of lading is mandatory for most carriers of hazardous substances. The logistics sector wants to get rid of this paper bill, for reasons of efficiency. The recently published *Guidelines for the use of RID/ADR/ADN 5.4.0.2* (UNECE, 2020b) may offer an opportunity to reach this. These guidelines have no legal force, but they make the European vision more explicit than before. The advocated system architecture has two types of 'trusted parties', TP1 and TP2 (see scheme 5). This 'TP1/TP2 system' has to connect IT systems of respectively the logistics sector and emergency services in a very secure way.
The guidelines do specify a transition phase too. The national regulator, the ILT, enforces the ADR regulations more or less on the basis of these specifications.

> Research question 5 (RQ5):
> *How can the data exchange between the IT systems (used by the emergency services and the logistics sector) be improved in order to make the detection of and response to an incident more effective?*

This question is answered in chapter 6. Four options for improvement are discussed. All improvement options are based on the central position of the alarm centre as 'the spider in the web', and of course all satisfy the constraints mentioned in section 6.0.

Option 1: automatic notifying
Option 1 aims to ensure that emergency services have information about the dangerous substance and the mode of transport *as early as possible*. So, the main 'design criterion' is: timeliness of information. The option is realized by installing an eCall application into the on-board computer of the truck. This application can automatically send an incident notification to the alarm centre, which also contain the information wished for. The necessary investments are relatively small. See scheme 6.1.

Option 2: Alarm centre access to the eCMR-platform
Option 2 aims to ensure that emergency services have information about the dangerous substance and the mode of transport *as reliable as possible*. So, the main 'design criterion' is: reliability of information. A TP1/TP2 system is realized as specified by the guidelines RID/ADR/ADN of the UNECE, by upgrading eCMR-platforms to TP2s and GMS to a TP1. The needed investments are substantial. See scheme 6.2.

Option 3: National, dynamic register of eCMRs
Option 3 has the same aim as option 2: to ensure that emergency services have information about the dangerous substance and the mode of transport *as reliable as possible*. So, the main 'design criterion' is: reliability of information. A TP1/TP2 system is realized as specified by the guidelines RID/ADR/ADN of the UNECE, by upgrading eCMR-platforms to TP2s and to develop a national register of eCMRs as a TP1. The needed investments are substantial. See scheme 6.3.

Option 4: The 'combination' option
Option 4 tries to combine the advantages of option 1 as well as those of options 2 and 3: to ensure that emergency services have information about the dangerous substance and the mode of transport *as early and reliable as possible*. A TP1/TP2 system is realized as specified by the guidelines RID/ADR/ADN of the UNECE (see options 2 and 3). In addition, it provides an eCall application (see option 1). The needed investments are substantial. See scheme 6.4.

Considering the scope of this research, one should give preference to the cheap, feasible no-regret option 1: automatic notifying by an eCall-like application in the on-board computer of the truck. It scores second on the most relevant evaluation criteria in the context of this research: reliability, timeliness and user friendliness. Option 4 scores even better on these criteria, but there are serious doubts whether it can be implemented within a reasonable time period (say 5 years). The same holds for options 2 and 3. Option 1 is a 'no-regret' option, because it doesn't block the future realization of option 4 (the 'ideal' situation).

> Research question 6 (RQ6):
> *Which IT related measures should the emergency services, the logistics sector and government take in order to maximize the safety during an incident on the road with hazardous substances?*

This question is answered in chapter 6 too. The description of the four options also includes a description of the technical measures and the needed investments. However, below (section 8.4) some attention will be paid to related organizational and administrative measures without which investments in the development of IT will not pay off.

8.3 Main conclusions of the research

The research led to the following conclusions:

1) The analysis of the handling (detection and response) of an incident indicates that the effectiveness of this process could improve, if the fire brigade would have *earlier* complete and reliable information about the involved hazardous substances (Intermediate conclusion 3.1.4).

2) Both the transport company and the fire brigade use information about the transported hazardous substances and about the type of transport for their respective decisions (Intermediate conclusion 3.2.1). For the fire brigade timely information is the most important success factor (Intermediate conclusion 3.2.2). The relevance of the financial costs is essentially a political issue, but because of the relatively limited impact of incidents with hazardous substances on the road no economic justification for large investments exists (4.3). The logistics sector values the criterion of information security highly; transport companies will not allow unauthorized third parties access to their data (4.3). They are ready to invest if return on investment can be expected. For them the benefits of the use of eCMR (instead of a paper bill of lading) are substantial (3.1 and 4.3).

3) In addition to the information about the transported hazardous substances and about the type of transport, the fire brigade information uses information about the situation on the site and

about the environment. The fire brigade thinks that complete and timely information about an incident is an illusion. Professional experience is anyway needed to interpret the available information (Intermediate conclusion 3.2.3).

4) Two IT innovations within the logistics sector are especially relevant when looking for opportunities to improve the information position of the fire brigade: (a) the increasing use of eCMR-platforms by logistics companies, and (b) the probable future use of eCall-like systems. The eCMR-platforms offer the opportunity to make business more efficient. At this moment eCall is scarcely installed on the on-board computers (which are present in most trucks), but this could change quickly (5.2).

5) Nowadays there is no structurally organized data communication between the logistics sector and the emergency services. Establishing data communication between the logistics sector and the emergency services offers opportunities to improve the information position of the emergency services.

6) Although the scope is limited to the Dutch emergency services, it is necessary to look at the European context. For the logistics companies are operating internationally and they prefer European solutions. Recently the *Guidelines for the use of RID/ADR/ADN 5.4.0.2* were published (UNECE, 2020b). The advocated system architecture has two types of 'trusted parties', TP1 and TP2. This ‘TP1/TP2 system’ has to connect IT systems of respectively the logistics sector and emergency services in a very secure way. Obviously options to improve the information position of the emergency services should preferably be compatible to this TP1/TP2 system. The existing eCMR-platforms may be upgraded to TP2s, but TP1s are not yet nominated in Europe.

7) Four options for improvement of future data communication between the logistics sector and the emergency services are discussed. All improvement options are based on the central position of the alarm centre as ‘the spider in the web’.
   Improvement option 1 discusses the possibility of data communication between the on-board computer of the truck and the GMS of the alarm centre. This option is superior in terms of timeliness of information.
   Improvement option 2 discusses data communication between eCMR-platforms and the GMS, which should be upgraded to a TP1 server. The (public) investments would be substantial, and the logistical companies probably prefer one European TP1.
   Improvement option 3 investigates the possibility of a new privately financed, national register (with the functionality of a TP1) in which current digital bills of lading (eCMRs) could be stored dynamically. This option finds support of the logistics sector and ILT, but it requires a lot of investment from this sector. Moreover, a new stakeholder enters the game.
   In the perspective of the UNECE guidelines options 2 and 3 are identical in the in the sense that they realize (the Dutch part of) the TP1/TP2 system. They differ only because of the way they are financed and managed: publicly or privately.
   Finally a ‘combination’ option 4 is designed, which combines features of option 1 and option 2/3. It is functionally superior, but there are serious doubts about the feasibility on the short term.

8) Option 4 is functionally the best one, but it will take a (too) long time to realize. Therefore, option 1 should be selected for implementation, at least for the start. It is second best, given the scope of the research and – importantly - it does not block realization of option 4 for the future.

9) improvement option 1 must be preferred, because (1) it is cheap and relatively easy to implement and (2) scores well on the criteria of timeliness and user-friendliness (7.4). These criteria are assumed to be critical success factors from the viewpoint of the emergency services. A global qualitative cost-benefit analysis suggests that investments in realizing (for instance) option 1 is justified. Option 1 is a 'no-regret' option because it doesn't block any other option.
   However, this result appears to be 'scope sensitive'. When (a) broadening the scope to the European level, (b) considering other modes of transport (train or boat) and (c) taking in account the political goal to reduce the administrative burden of companies, option 2 might be chosen (7.4).

8.4 Assessing the validity of the conclusions

Most of the empirical data for this research came from interviews. Some of these data were easily verified in reality or literature. It is for instance a fact that logistics companies invest much in supply chain management, in particular in using eCMR-platforms. Also the existence of eCall-like systems is a matter of fact. Other empirical findings were less easy to verify, in particular opinions about future innovations and about the acceptability of proposed improvement options. Nevertheless these opinions probably can be trusted, because the respective representatives of the emergency and the logistics sectors have remarkedly univocal opinions. They all agree about the benefits of earlier complete and reliable information for the fire brigade. Also no truly contradictive opinions arose about the merits of the different proposed solutions. This broad unity of opinions can be explained by assuming that there are no evident conflicts of interest. Apparently the decision about investing in the information position of the fire brigade is not a 'wicked problem'.

The publication of the UNECE guidelines about this subject brought a strong confirmation of the information acquired by means of the interviews. Though nobody referred explicitly to these guidelines before the publication, many interviewees must have had some knowledge about the presumable contents.

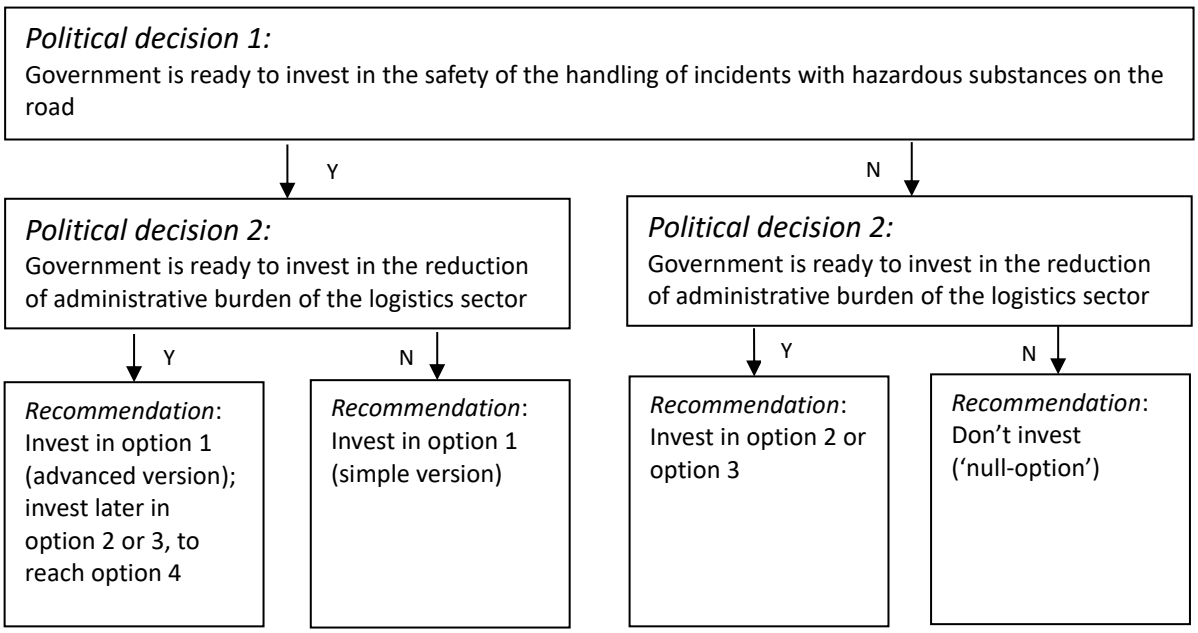
More uncertain is whether investing in the information position of the fire brigade would give positive return of investment (7.4). The conclusion may be politically tenable, but economical substantiation is missing. It is not attempted to make a (quantitative) cost-benefit analysis, because especially the benefits are difficult to assess.

8.5 Recommendations

This section is meant to complete the answer of research question 6. Chapter 6 did answer already the question which 'pure' IT measures (investments and so on) should be taken by whom in order to realize the respective improvement options. However it is common knowledge that IT itself

performs nothing. This chapter will pay some attention to related organizational and administrative measures without which investments in the development of IT will not pay off.

In 7.4 option 1 is chosen, but options 2, 3 or 4 could be preferable for other reasons than only the improvement of the information position of the emergency services. For instance the minister of Economic Affairs may find it attractive if the minister of Justice and Safety invests in upgrading the GMS to a TP1 server (option 2), because it reduces the administrative burden for the logistics sector. This example illustrates that the context in which decisions are made may be relevant. For that reason scheme 8 might be helpful. The scheme orders the main decisions from the perspective of the Dutch government. Of course the two mentioned political decisions can be taken in any order, but in the context of this research the depicted order is the most logical one. As can been seen in the scheme any of the options of chapter 6 might be the outcome of the decision process. This is in line with the observations in sections 7.3 and 7.4 that the outcome of the evaluation strongly depends on the chosen perspective. In the following is assumed that the first political decision is answered positively. So, only the left side of the scheme is covered below, and only insofar as it relates to option 1 (the two boxes at the bottom left).



Scheme 8: Investment decisions from the perspective of the Dutch government

Recommendations to the political level of Dutch government

Assumed is that the minister of Justice and Safety in principle is willing to invest in option 1 (6.1), i.e. data communication between the on-board computer of the truck and the GMS of the alarm centre when an incident is happening. The first question to be answered is whether he has to invest in the cheap simple version or a more expensive advanced version of an eCall application. His choice ought to depend on the minister of Economic Affairs (and Climate).

Recommendation to the minister of Economic Affairs :
Consult with the minister of Justice and Safety about the possibility of upgrading the GMS to a TP1 server in the sense of the UNECE guidelines. If the result is positive, start consultation with the logistics sector and the 'united eCMR-platforms' about their contribution.

The further elaboration of this recommendation falls outside the scope of this study, but obviously the result will influence decision-making on option 1. If there is an immediate prospect that option 4 will be realized in the end (via option 2), it doesn't make sense to invest now in the most simple application of an eCall application within option 1. Government should agree with the logistics sector that a more advanced eCall application has to be implemented in the coming years. In that case the implementation process becomes more complex, but it will lead in the end to the realization of the 'ideal' option 4.

For simplicity this chapter focuses on option 1, the simple as well as a more advanced version. Besides, most recommendations remain valid – with some minor adaptions -, when another option is chosen. For they all have the same goal, namely to coordinate the evolution of the IT infrastructures of the logistics sector and the emergency services as far as needed. The coordination ought to be minimal, because it otherwise hampers innovation. The coordination can be minimal, because there are hardly any conflicts of interests.

The emergency services and the alarm centres

To implement option 1 the emergency sector has to invest. Or rather, the minister of Justice and Safety must do so on behalf of this sector, because of his/her political responsibility for the functioning of the emergency services. Some minor adjustments to the GMS have to be made: this system must be able to receive notification messages from the trucks and pass them to the right fire departments. Because all twenty alarm centres use the same GMS, it makes no sense to implement the adjustment centre for centre. So all operators of the alarm centres must be trained at about the same time, especially the ones who are placed there from the fire department. However, one of the advantages of option 1 is that training of operators and fire-fighters is hardly necessary. Actually, improvement option 1 doesn't affect the working processes of the alarm centres nor the fire departments very much.
Of course must the minister inform the logistics sector about his/her plans. If a more advanced eCall application is considered, prior consultation with the sector on the precise specifications is necessary (see 6.4; final remark). In that case the minister should start and subsidize an open standardization process with the goal of technical specifications for the desired application. The great advantage of this approach is that option 4 stays within reach in the long term.

Recommendation to the minister of Justice and Safety:
- Make resources available (a) to adjust the GMS according to improvement option 1, (b) to inform the logistics sector (while consulting with the ILT) and (c) to inform the operators of the alarm centres.
- Consider to facilitate the development of a more advanced eCall application.

The logistics sector

Logistics companies are willing to invest in IT, if return on investment is to be expected. For this reason many of them do invest already in supply chain management systems, which support efficient allocation of trucks and so on. Because the most advanced of them also have to comply

with the ADR regulations, a positive spin-off of these systems for them could be the replacement of the paper bill of lading by a digital one (eCMR). So probably innovative logistics companies will in the future have (a) stored data about transported hazardous substances in their IT systems and in one of more eCMR-platforms, and (b) on-board computers in their trucks (perhaps in the future they even cannot buy trucks without them anymore). Maybe transport companies don't feel a strong incentive to install an eCall-like application in the on-board computer, but they will not object either. Option 1 is cheap and the risk that third parties get unauthorized access to sensitive information is limited, because the truck driver decides (if he is able to) when he releases a notification message in case of an incident.

In summary, the logistics sector doesn't need much incentive to innovate. However they have to know in which direction the emergency sector moves. The ILT could promote this awareness (see below). So, no special recommendations for the logistics sector are formulated. Government should first take the initiative.

The national regulator ILT

The ILT is an independent and neutral party, and it has the task and the power to enforce the law independently. One of the purposes of this task is to facilitate the work of the emergency services (Appendix G).
Its legal powers give the ILT an important position in relation to the logistical sector. This position enables the ILT to influence innovation processes within this sector. For instance, the ILT may or may not allow the eCMR replacing the paper bill of lading. Until now its position about the eCMR is indifferent, provided that the ILT and the emergency services get the same information in the same format digitally as formerly on paper. The ILT will certainly study the new UNECE guidelines (chapter 5) and decide which additional requirements for the transition phase will be adopted and which not (UNECE, 2020b: Annex A, Section 4 and 5). Of course The ILT will inform the logistics sector about its choices.
If the minister of Justice and Safety plans to implement improvement option 1 (6.1), the ILT could adjust its message somewhat, when negotiating with logistics companies about best practices and when inspecting their trucks - of course within the limits of its legal powers. After all, one of the ILT tasks is to explain applicable laws and regulations to the logistics sector. The ILT can explain how the use of eCall in combination with eCMR by the logistics sector can be an effective way to send notification messages to alarm centre if confronted with an incident. This promotion should not be restricted to transports which have to comply with the ADR regulations.

From research viewpoint it is a pity that the ILT doesn't register details about incidents with hazardous substances on the road, but this is understandable because of the relatively small impact of these incidents on society (1.2). Therefore registration will not be recommended below. The recommendations regard only the possible ILT role as a catalyst for a harmonized development of the IT infrastructures of the logistics sector and the emergency services.

Recommendations to the ILT (after the decision to implement option 1):

- Give positive feedback when inspecting trucks if provided with an eCall-application that satisfies the requirements of the chosen option. Explain the advantages of such an application, when inspecting other trucks.
- Promote implementation of the chosen option when negotiating with the logistics sector, for instance about best practices.

The ILT is asked to comment these recommendations. It does not see much benefit in the first one, because the truck driver would not be able to influence the decisions of an transport company in any way (Appendix G). But: if it doesn't help, it doesn't hurt either.

The Institute for Safety IFV (Dutch: 'Instituut Fysieke Veiligheid')

The mission statement of the IFV is (IFV, 2020):

> 'The IFV contributes to a safer society by strengthening the safety regions and their partners in terms of professionalising their tasks. The IFV develops and shares relevant knowledge, has expertise in acquiring and managing communal equipment and supports authorities and management councils in question – in line with its 'spot and connect' device.'

The Fire Service Academy (Dutch: 'Brandweeracademie') is a department of the IFV. It 'takes care of the permanent professional competence of fire service employees and people employed in the field of crisis management and disaster relief' (IFV, 2020). In section 9.2 some further research is suggested. In particular suggestions 2 and 3 may be of interest for the IFV or the Fire Service Academy.

Recommendation to the IFV:
Consider to initiate research as suggested in section 9.3.

The process of implementing improvement option 1

Assumed that the minister of Justice and Safety decides to implement option 1 and to make the necessary financial resources available, a smooth process is recommended. There is no point in rushing this process, because there is no urgent need for the results. But it is important that there is steady progress.

Step 1: Technical specification of the eCall application
The first step is specifying the eCall application and the corresponding functions of the GMS in the alarm centre. The specifications must guarantee that the GMS will be able to receive, process and send incident data, for instance: (a) the eCMR and/or the Kemler code of the transport, (b) some data about the truck, and (c) the GPS position of the incident. The simplest way to achieve this is that the eCall application attaches the eCMR as a PDF file; the new version of GMS must only be able to receive those extended messages and to send them unchanged to the right emergency service (mostly the fire department).

If a more advanced eCall application is wished for, prior consultation with the sector on the precise specifications is necessary. An open standardization process should be initiated, as recommended above. An advanced facility must realize machine-machine communication on the basis of code systems (at least the licence plate number, but maybe also machine-readable coded eCMRs or Kemler codes; see 4.1). This complicates the design and construction, but also offers opportunities. The new version of the GMS could for instance search in data bases for additional information about how to handle the transported hazardous substance, and add this information into its message for the fire brigade. Moreover, this investment facilitates the move to option 4 in the long term.

The standardization process requires the involvement of the logistics sector. A central organization

like the Dutch association for Transport and logistics TLN ('Transport en Logistiek Nederland') may be willing to take some responsibility for the process (Appendices A and E). On the site of this organization one can read (TLN, 2020):

> 'Over the years, TLN has been very successful on many fronts. This includes the expansion of road networks and the improvement of collective labour agreements (CLAs) in the transport sector. TLN has also helped to make the Dutch transport sector into one of the *safest* and cleanest in the world. An effective marketing campaign has also helped to significantly *improve the sector's image*.
> No matter what the future may bring, TLN is ready to meet all challenges head-on. It aims to do this by generating new developments in transport and logistics, in areas such as mobility, *road safety*, sustainability and effective entrepreneurship. It also wants to support and advise transport companies, and continue to expand horizons through active involvement. Transport is engrained into our daily existence – we simply cannot cope without it. And TLN is there to support everyone who plays a role in this essential sector' *(italics by the author).*

Step 2: Building and installing the specified software
The second step is implementing the specified functions the respective systems. The adjustment of the GMS is the responsibility of the minister of Justice and Safety. At the same time the transport companies should be invited to implement the specified eCall application in the on-board computers of their trucks. It would be even better when the suppliers of trucks are persuaded to install this application in the on-board computers. However this will probably be difficult, because the supplier market is international. Action at the European level would be more effective.

Step 3: Introducing the new function within the respective organizations
As soon as the new version of the GMS is available, all organizations concerned must be prepared. But, if the new function is well-designed, the alarm centre doesn't even notice it: it functions fully automatic. Preferably the fire brigade must have some knowledge about the new function, but it may also use the information very well without further preparation. This is actually a key success factor (evaluation criterion 3.3.3), because of the small number of incidents. Lessons from a training will be forgotten, before the first incident happens. It is recommendable to introduce the function within real-life exercises of the fire brigade.
Finally, the truck drivers must be instructed on how to use the 'panic button'.

Because there is no real urgency (only 20 incidents per year and no casualties) it makes no sense to try to control the implementation process strictly in time. However it is sensible to monitor the progress, again because no urgency is felt by most stakeholders.

9. Discussion

9.1 Back to the main research question

The main research question of this thesis was:

> *How should present and future IT, used by logistics companies and emergency services, improve the detection of and the response to an incident with hazardous substances on the road?*

Indeed the IT innovations in the logistics do offer opportunities to improve the information position of the fire brigade. Four options for improvement were described. But the answer is 'qualified', because an objective quantitative cost-benefits analysis is lacking (7.5). Though the investments (needed for option 1) are low, the benefits are scientifically unknown. Remember that incidents with hazardous substances on the road are rare. If one could assess the benefits per incident of a better information position, the benefits (in terms of euros) would appear to be limited. It is even not certain whether the improvement of the information position of the fire brigade will lead to any more effective dealing with an incident with hazardous substances on the road. This will be explained below.

The information position of the fire brigade can be described in terms of the four categories of information the fire brigade needs (3.2):

1. Information about the hazardous substance (GEVI-number etc.);
2. Information about the type of transport (bulk or general cargo) and the vehicle;
3. Information about the situation at the spot (leakage, fire, the position of the vehicle, victims, traffic jam);
4. Information about the environment (urban, undeveloped, water supply for fire extinguishing) and about the weather (wind direction for instance).

Supposed that improvement option 1 is realized and the fire-fighters have complete information of the two first categories in an early stage. This doesn't suffice for them to determine a scenario about the most probable course of events at the site of the incident (3.2). For instance, while the fire-fighter has been informed that petrol is in the container of the truck thanks to the eCMR, he yet doesn't know whether the container leaks. Thus on arrival he will do at first some investigations at the spot itself to gather additional information (categories 3 and 4). Maybe he will decide to be on the safe side and will measure everything anyway. In that case there will be no time gains. So it is uncertain whether a better information position will cause a more timely response of the fire-fighter.

The complete answer of the main research question about the dealing of an incident with hazardous substances on the road is therefore: it is possible to improve the information position of the emergency services, but this will not cause with certainty a more effective handling of the incident. Nevertheless, in the opinion of the author the investment in the preferred improvement option is useful: it is relatively cheap to achieve and easy to use. If it doesn't help, it doesn't hurt either.

9.2 Suggestions for further research

Suggestion 1

To really benefit from better and faster information of category 1 and 2, the emergency services must make sure that they get earlier information of category 3 and 4 too. If the interviewee of the fire department (Appendix D) is right, a professional fire-fighter must be present at the site of the incident to collect these data. Some organizational measures might contribute to earlier and more complete information about an incident. (Absolute completeness will be impossible, because the situation can change rapidly.) The fire department could for instance send an exploring unit (by motorcycle?) ahead to do this. This would mean an adjustment of the primary process of the dealing with an incident with hazardous substances on the road (scheme 3.1).
Before reorganizations like this are considered, the consequences should be studied carefully. After all, the low number of incidents doesn't justify high investments. A reorganization like this might be complex, because the fire brigade is a very special organization, employing professionals and well-trained volunteers.

Suggestion 2

As said above one cannot predict to what extent an improved information position of the fire brigade leads to a more effective dealing with the incident. It could be interesting to follow the impact of a rather small technical innovation like improvement option 1. The objective of this research would be to learn more about how organizations like the fire brigade accept technical innovations that are not directly related to their primary tasks (fighting fires). The main research question of such a study could be:

> *How does an organization (with professionals and volunteers) like the fire brigade respond to the introduction of an technical IT innovation.*

Because there are 20 emergency regions ('veiligheidsregio's'), several introducing strategies can be tried in a number of different regions. One can assess and compare the situation before and after the implementation of the innovation. Possible implementation strategies are:

- Introduction without any verbal or written information about the innovation: just see what happens (how the new information is used), when an incident occurs;
- Introduction without any verbal or written information about the innovation, but the fire department does exercise with it implicitly: just see what happens during the exercises;
- In addition: introduction with verbal or written information about the innovation for only the professionals;
- In addition: introduction with verbal or written information about the innovation for all professional and volunteer staff.

A study like this could learn us about the culture and the adaptive power of the fire brigade, that is a very special organization with professionals and volunteers. A working hypothesis could be that the fire brigade will respond very adequately to new fire-fighting technology, but more slowly to IT innovations which they don't use frequently, regardless of the way of introducing these innovations. A disadvantage of this approach is that it will take a long time to get enough empirical observations, because of the limited number of incidents per year.

Suggestion 3

In section 3.2 the decision process of translating incident information via a specific incident scenario to decisions about actions of the fire brigade is described. The fire brigade needs four categories of information to determine a specific scenario. This leads to a research suggestion: *can the translation of this information to a plausible specific incident scenario be supported by Artificial Intelligence (AI)?* Bril et al (2016) suggests that extensive experience with this translation process exists and has been documented. This set of experiences could be used to train an AI application. The usability of the result could be tested in training situations of the fire brigade.

Suggestion 4

Another suggestion for further research can be derived from the discussion about the research objective in section 7.3. It was suggested that the Dutch government might consider the upgrade of the GMS to a TP1 server in order to reduce the administrative burden for the logistics sector; the time gains for the fire brigade would be only a desirable side effect. It seems to be possible to quantify most of the costs and benefits for the logistics sector in the case option 2 or 3 is chosen. In other words, in the light of this alternative objective a costs/benefits analysis seems to be possible and useful, contrary to what was established for the current research objective (7.4). The result might be interesting for the Dutch association for Transport and logistics TLN ('Transport en Logistiek Nederland').

9.3 Reflection

Finally some reflections. All research has unexpected sides that the researcher have to deal with. The first surprise of this research was the lack of empirical data. The document which induces this research (see Introduction) showed some discomfort with the IT developments in the logistics sector. It suggested that these could weaken the information position of the emergency services. The presence of the national regulator ILT is a reassurance: it will not let the information position of the emergency services deteriorate. But the subject doesn't have a very high priority. Therefore the ILT doesn't collect systematically data. Neither does any other organization, that was consulted. For this reason the only possibility was to listen to the stories of experts. Fortunately, all the interviewees were most helpful. Some of them did spontaneously some additional investigations within their organizations to check or enhance the quality of their statements. It was a great pleasure to speak with them. The author is indebted to them. Without their contributions this thesis couldn't be completed.

A second surprise was the position of the national regulator ILT. The ILT was identified as a stakeholder early in the research, but its role was initially underestimated because of its independent and neutral position (no interview was planned with a representative of the ILT). In retrospect this was a mistake. In 1.3 the thesis subject is presented as a coordination problem: the logistics sector and the emergency services must not choose incompatible IT solutions. Obviously the ILT can have an catalytic function in this coordination process, because of its tasks and powers. This is nothing new: each regulator has the job to bring supervised organizations to desired behaviour. But for the researcher it was an important lesson: don't underestimate the position of stakeholders who seem to have no own interests in the matter; their role in improving things may be crucial.

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Appendix A: Interview met transportbedrijf Den Hartogh

Gesprek met: Erik Groen, Project Manager Den Hartogh Liquid Logistics B.V.
Datum: 15 november 2019
Plaats: Rotterdam

Inleiding

Ik heb interviews gehad met de brandweer en de NAM. Intussen weet ik (ook dankzij een informeel gesprek met een van uw chauffeurs) tamelijk goed hoe gevaarlijke stoffen worden vervoerd en hoe incidenten worden afgehandeld. Ik zal u daarover dus weinig vragen stellen. Ik wil met u vooral hebben over (1) de informatie, die u gebruikt bij het plannen en doen uitvoeren van transporten van gevaarlijke stoffen; (2) de manieren waarop die informatie is vastgelegd in ICT-systemen; (3) de communicatie van de relevante ICT-systemen met de buitenwereld (opdrachtgevers, afnemers, overheden, meldkamer, hulpdiensten).
Als u bepaalde vragen niet wilt beantwoorden, dan is dat natuurlijk uw goed recht!

Algemene vragen

Hoeveel transporten realiseert Den Hartogh ongeveer per jaar? Hoeveel incidenten op de weg (dus niet bij de 'handling') zijn er ongeveer, die leiden tot een melding?

Ongeveer 100.000 transporten per jaar, zowel nationaal als internationaal. Er hebben de laatste jaren geen incidenten op de weg plaatsgevonden. Maar stel dat er een tankwagen vast komt te zitten in een tunnel en deze staat in brand, dan kunnen de hulpdiensten slecht bij de vracht. In zo'n geval zou het erg nuttig zijn, als zij konden beschikken over digitale informatie over de vracht buiten de chauffeur om. De handhavers moeten nu waarschijnlijk zoeken in vijftien portalen en dus zijn ze veel te laat. De oplossing zou zijn één centrale portal voor Europa, waar alle losse transporteurs hun informatie naar toe sturen. Den Hartogh zou daar voor zijn, maar zo'n internationaal systeem is er nog niet.

Loopt Den Hartogh binnen de logistieke sector voorop met ICT-innovatie? Is er samenwerking met andere transporteurs op dit vlak?

Den Hartogh maakt gebruik van LoadIt en TransFollow (een concurrent van LoadIt). Den Hartogh probeert binnen de logistieke sector te innoveren met ICT en ook samen te werken met andere concurrenten. Voornamelijk om de supply chain 'visible' te maken. Een supply chain is meestal een keten van verschillende transporteurs. Samenwerking met andere transporteurs betekent dat ze gecoördineerd kunnen opereren over de hele keten en dus de klant beter kunnen bedienen.

Den Hartogh kan samenwerken met concurrenten: aan supply chain visibility, zodat de klant zijn product kan volgen: tussen het laden en het lossen in: waar hangt het product van de klant uit. Dit moet je het ruim nemen: ook voor onderaannemers van Den Hartogh. En als een container op een trein staat naar Italië, kunnen ze ook zien waar die trein zich bevindt. Supply chain visibility is voor Den Hartogh belangrijk: het creëert transparantie naar je klanten toe.

Dit gaat dus over multimodal transport. Het is een collectieve onderneming om samen zover te komen. Een andere partij is bijvoorbeeld Logenios:

https://www.eurotracs.com/en/econnect_logenios_logistics/econnect_app/
https://optimiselogistics.com/home/
https://logenios.com/

Kosten/baten van het project LZP

De digitale vrachtbrief is een belangrijk onderwerp voor mijn thesis.
Welke baten verwacht Den Hartogh van volledige digitalisering van de vrachtbrief? Moet Den Hartogh hiervoor grote kosten maken?

De baten en de kosten zijn moeilijk in te schatten. De baten zijn erg groot: efficiëntie wordt hoger, maar de kosten zijn ook hoog; dit zal elkaar dus een zo'n beetje uitbalanceren.

Het belangrijkste is dat onze klant een vraag of behoefte heeft. Als die graag willen digitaliseren, dan gaan wij met ze meekijken. Het moet natuurlijk wel kosteneffectief voor ons zijn. Als de rekening eenzijdig bij Den Hartogh terecht dreigt te komen, stellen we de vraag: hoe gaan we dat met elkaar oplossen? Dit was in dit geval niet nodig, want we zien echt wel de mogelijkheid van verbetering van de efficiëntie, vooral door afname van het papierwerk: de digitale vrachtbrief is dertien euro goedkoper dan de papieren vrachtbrief, dus TLN en logistieke verenigingen in Nederland zijn echt geïnteresseerd. Het levert bovendien een goede relatie op met de klant. Verder moeten we een vrachtbrief 7 jaar lang bewaren. Er is een pakhuis voor nodig om ze allemaal op te slaan. Maar het belangrijkste is toch waarschijnlijk dat een digitale vrachtbrief meer en sneller inzicht geeft. Zo is voor iedereen duidelijk, wanneer een order kan worden afgesloten. Den Hartogh zelf heeft ongeveer 100.000 transporten per jaar, waarvan er intussen 30.000 digitaal worden gevolgd. Het moeilijke is dat Den Hartogh te maken heeft met de hele keten: vooral onze klant moet het willen, en de klant van de klant ook; dat ligt gevoelig. Bij afvalstoffen is dat gemakkelijker, omdat de NAM wel wil, en zowel leverancier als afnemer is. De NAM heeft 200 locaties met papieren vrachtbrief.

Zijn er praktische belemmeringen om de papieren vrachtbrief volledig te vervangen door de digitale versie? Zo ja, welke zijn dan die belemmeringen (technisch, organisatorisch, juridisch)?
Zijn er nog belemmeringen om de digitale vrachtbrief volledig door te voeren?
Misschien kunt u in uw antwoord aandacht besteden aan de communicatie met de landelijke overheid (ILT, RDW) en de meldkamer en/of de hulpdiensten.

Voornamelijk de ILT heeft praktische kritiek. Deze zijn vooral organisatorisch. De ILT wil dat de papieren en digitale vrachtbrief identiek zijn; dit is nu nog niet het geval. We gaan 5 december a.s. met hen bespreken hoe we dat kunnen doen. Zij zijn de toezichthouders, dus zij moeten weten wat wij doen. Voor de rest is er binnen Nederland geen reden om niet verder uit te rollen. Voor Europa is dit moeilijker omdat niet iedereen mee gaat met verdere digitalisering. Verder internationaal is de digitalisering nog moeilijker.
ILT heeft twee verschillende handhaversportalen. Voor ritten die we doen met producten (met een vrachtbrief) moeten we TransFollow hebben. Voor de ritten met afvalstoffen (met een begeleidingsbrief) hebben we LZP, ook een handhaversportaal. ILT moet dus kijken op twee portals.
Eigenlijk moet er vanuit het Europese parlement worden gezegd dat er één Europees portaal moet komen, dat een ILT bijvoorbeeld kijkt op vrachtbrief.com met behulp van de kentekens van de trucks. De EU-trajecten lopen meestal meerdere jaren. Dat houdt ontwikkelingen wel tegen. Op dit moment heeft bijvoorbeeld Duitsland nog niet de overeenkomst geratificeerd om vrachtbrieven in

te zien. Je mag wel door Duitsland heen rijden met een digitale vrachtbrief, van Nederland naar Polen, maar van Duitsland naar Nederland mag niet.
Het zou dus mooi zijn als er één Europees portal zou komen. Dan zijn we als transporteurs niet meer afhankelijk van vijftien aanbieders binnen NL en waarschijnlijk net zoveel in ieder ander land in Europa! Dan zouden ook de hulpdiensten kunnen aankoppelen.

De layout van de vrachtbrief en begeleidingsbrief zijn niet identiek, maar dat is voor Den Hartogh niet relevant. Maar de ILT viel er wel over, omdat ze vrezen niet te weten waar te kijken als er een calamiteit is. ILT heeft gevraagd of zij op de boordcomputer van de chauffeur moeten kijken of dat zij dat online kunnen bekijken. We hebben met elkaar hiervoor nog geen oplossing voor kunnen vinden, behalve een aanpassing maken van de app, waardoor een overheidsinstantie met een druk op de knop de digitale vrachtbrief kan zien. Dat zou eigenlijk niet moeten hoeven, want we hebben een pilot gedaan met TransFollow en goedkeuring gekregen voor de manier waarop we het doen: de chauffeur krijgt een transactienummer en kan daarmee laten zien wat hij vervoert. Verder zou een handhaver op basis van het kenteken van de oplegger of het trekkende voertuig kunnen zien wat er aan CMR's openstaat. Dus een handhaver heeft twee mogelijkheden: in een portal kijken of aan de chauffeur vragen wat is de transactiecode van de vrachtbrief.

Zou u er bewaar tegen hebben om <u>vooraf</u> informatie over het transport (de digitale vrachtbrief) te 'uploaden', zodat deze toegankelijk is voor ILT en hulpdiensten?

Nee, daar heeft Den Hartogh geen probleem mee, maar niet alle informatie moet altijd beschikbaar zijn. Als het gaat om incidenten mag iedereen weten wat daar bij zit natuurlijk. Maar Den Hartogh wil niet dat de ILT bij wijze van spreken permanent alle kentekens van Den Hartogh kan volgen. De ICT-systemen moeten zo specifiek ingesteld worden, dat enkel bij een incident de brandweer er bij mag.

Het is voor Den Hartogh dus geen probleem, als er nationale of liefst internationale standaarden voor de communicatie van vrachtgegevens komen, als er ook maar goede afspraken komen wanneer de ILT (en hulpdiensten) erbij kunnen. Maar de handhavers weten het op dit moment niet: moet het TransFollow worden of LZP? Of moet er toch een handgeschreven vrachtbrief in de auto zitten? Bij voorkeur wordt dit vanuit de EU geregeld; anders moet bij grensoverschrijdend transport het NL-systeem worden gekoppeld aan dat van andere aanbieders. Het liefst een Europees portal dus of iets wat daarop lijkt.
Communicatie met ILT en hulpdiensten via de boordcomputer is minder goed. Op de boordcomputer kan de chauffeur zien waarmee hij bezig is: de opdracht en de vrachtbrief. De vrachtbrieven worden na afronding van de opdracht gewist door de chauffeur, of anders na 120 uur. Als de handhaver op de boordcomputer mee kan kijken, komt hij misschien bij de verkeerde informatie uit, namelijk van een vorige order.

Als er een calamiteit is, dan zou er een paniek-button moeten zijn. Een calamiteit komt niet vaak voor en daarom is de investering niet de moeite waard. Als we allemaal gaan digitaliseren, moet dit wel gebeuren. Personenauto's kunnen al automatisch 112 bellen; dat is op een vrij éénvoudige manier geregeld. Het zou logisch zijn dat dit ook bij vrachtwagens gaat gebeuren.

Kan de informatie in de vrachtbrief ook door een hulpdienst gebruikt worden?

Ja, dat kan in principe. Deze functie is 'out of scope' gehouden in het vorige project. Er was wel een project, waarbij de handhavers op basis van een kenteken kunnen kijken naar wat er vervoerd

wordt. Dat is productinformatie, maar het was de vraag of dat voor de hulpverleners wel toereikend was. Die vraag is bij het begin van het project (TransFollow) dus buiten beeld gehouden. Ik krijg wel gespreksverslagen van een ander project toegestuurd, met een handhaver uit Zaanstad. Deze veiligheidsregio heeft weinig kennis van het ladingdragende materiaal, dus van de tankwagen. We zien daar een kans om hulpverleners beter bekend te maken met de materie. Er is uitgekomen dat het veel moeite kost om alle hulpverleners toegang te verschaffen tot de vrachtbrieven. Nu concentreren we ons op het gesprek met de ILT. Het is wel interessant of aan een traject met de hulpdiensten nog een vervolg wordt gegeven.

> *Erik zal een en ander intern navragen. Het resultaat staat in een email van 18 november met de volgende inhoud:*
> Ja, we zijn in contact met hulpverleningsinstanties met betrekking tot dit onderwerp. In de praktijk blijkt dat de hulpverlening geen gebruik maakt van de vrachtbrief bij calamiteiten. Zij gebruiken met name de op de vrachtwagen aangebrachte symbolen en leggen (telefonisch) contact met de vervoerder voor het verkrijgen van informatie. Ze staan wat dat betreft neutraal ten opzichte van het gebruik van een digitale vrachtbrief versus de papieren.
>
> Wel zien de hulpverleners toegevoegde waarde van een digitale vrachtbrief voor verbetering van hun informatievoorziening (dus dat ze de informatie over de lading in de digitale vrachtbrief wel gaan gebruiken). Dit door het integreren van (delen van) de digitale vrachtbrief informatie set in hun digitale informatievoorziening.
>
> Hierbij moet je denken aan bijvoorbeeld integratie in e-Call, waardoor bij het signaleren van een ongeluk niet alleen informatie over de locatie en het voertuig maar ook over de lading aan de meldkamer kan worden doorgegeven. Dit is iets waarover TransFollow in contact staat met de hulpverlening. Wij juichen deze mogelijke ontwikkeling ook toe en willen hier waar mogelijk graag proactief stappen in zetten. Echter, wij zien dat dit vanuit de hulpverlening verder weinig prioriteit krijgt. Hierdoor verwacht ik dat op korte termijn nog geen daadwerkelijke integraties zullen worden gerealiseerd.
>
> Een concrete klant casus kan natuurlijk wel altijd helpen om de ontwikkelingen te versnellen. Dus indien nodig ondersteunen we je hierin graag!
>
> Ik hoop je hiermee wat meer achtergrond te hebben gegeven?
>
> Met vriendelijke groet,
>
> Jörgen Hensgens

LoadIT

Ik heb van de NAM begrepen dat LoadIt een centraal systeem bij het vervoer van gevaarlijke stoffen. Het verbindt digitaal de aanbieder, de vervoerder en de afnemer van gevaarlijke stoffen. Is dit een goede manier om de functie van LoadIt te omschrijven?

Wie gebruiken LoadIt (opdrachtgever, aanbieder, vervoerder, afnemer), en waarvoor gebruiken zij het?

Den Hartogh gebruikt enkel LoadIt om de digitale vrachtbrief en begeleidingsbrief te monitoren, de rest van LoadIt wordt door de NAM gebruikt.

Gebruikt Den Hartogh LoadIt voor de logistieke planning of zijn er daarvoor andere ICT-systemen?

Als LoadIt slechts een selectie bevat van alle logistieke gegevens, namelijk dat deel dat nodig is voor de communicatie met andere partijen, is er dan een automatische koppeling met de echte logistieke systemen van Den Hartogh? Bestaat er een plaatje van hoe LoadIt past in de ICT-structuur van Den Hartogh?

Welke informatie wordt er ongeveer in LoadIt opgeslagen, en verwerkt? Zijn alle gegevenselementen van de digitale vrachtbrief daarbij? Wordt er ook informatie over de vervoerende truck opgeslagen in LoadIt of zit die alleen in andere ICT-systemen van Den Hartogh?

Enkel de digitale vrachtbrief en begeleidingsbrief wordt gebruikt. Veel zit ook in de ICT sytemen van Den Hartogh.

Welke betrouwbaarheidseisen worden aan de gegevens in LoadIt en aan de vrachtbrief gesteld? Wie is er verantwoordelijk voor de correctheid van de gegevens? Wordt daarvoor getekend (digitale handtekening binnen het systeem), door wie (ontdoener, vervoerder, afnemer) en op welke momenten?

De gegevens in de vrachtbrief moeten volledig zijn. De verantwoordelijkheid voor de correctheid van de gegevens ligt bij de NAM die deze goed moet aanleveren. De chauffeur/transporteur moet ze dan goed invoeren.

Kunt u garanderen dat de gegevens in de digitale vrachtbrief overeenstemmen met die van de papieren vrachtbrief en met de werkelijke lading van de trucks?

Het transport management systeem van Den Hartogh communiceert met dat van de NAM. Dit is ‘in house’ ontwikkeld; daarmee plannen wij het vervoer van A naar B. Op basis van die informatie versturen wij afvalbegeleidingsbrief mee. Met het systeem doen wij ook de facturering; die moet natuurlijk betrouwbaar zijn.
In de digitale vrachtbrief kan je niet altijd alles invullen. Soms gaat er een combinatie van afvalstoffen in een tank; die gaat dan in één stroom van A naar B. Die ene afvalstroom heeft dan één afvalstroomidentificatie. Als de digitale vrachtbrief en de papieren vrachtbrief inhoudelijk niet identiek zijn, is Den Hartogh strafbaar.

Werkt u met het systeem Transfollow of een vergelijkbaar systeem (voor andere klanten dan de NAM)? Zo ja, is dat niet hinderlijk, en kunt u iets zeggen over de verschillen tussen deze systemen?

Het systeem TransFollow en LoadIT zijn twee verschillende systemen. Dat is zeker hinderlijk, het doel is om één gezamenlijk Europees systeem te bouwen.

Kunt u iets zeggen over de respectieve marktaandelen van LoadIT, Transfollow en eventuele andere vergelijkbare systemen?

Transfollow wordt door iets van 80% van Den Hartoghs klanten en LoadIT door iets van 20% van zijn klanten.

Wat zou u ervan vinden, als er door een overheid standaarden voor dergelijke systemen zouden worden vastgesteld (m.n. de technische interfaces)?

Dat is prima, dit moet vanuit het Europees Parlement geregeld worden, want het gaat vaak over

internationaal transport.

De boordcomputer

Den Hartogh heeft zijn trucks uitgerust met boordcomputers. Daarin is onder andere de digitale vrachtbrief opgeslagen (althans alle informatie daarvan).
Doet de chauffeur gedurende het transport iets met de boordcomputer (raadplegen, invoeren van gegevens)?

Nee, de chauffeur kan de boordcomputer niet gebruiken tijdens het rijden, wel op de parkeerplaats. Hij hoeft ook alleen maar goederen in en uit te schrijven.

De boordcomputer staat permanent in verbinding met centrale computers van Den Hartogh. Welke informatie wordt er uitgewisseld?

Heeft de boordcomputer ook functies, vergelijkbaar met eCall (dat bij incidenten automatisch informatie doorgeeft aan de 112-meldkamer over locatie e.d.)? Zo ja, worden dan ook gegevens uit de vrachtbrief en over de truck met de melding mee verzonden? Als de techniek nog niet zover is, ligt het probleem dan bij de boordcomputer of bij de meldkamer/hulpdiensten?

De eerste vraag is eigenlijk in hoeverre LZP is gekoppeld aan systemen van Den Hartogh. Als een chauffeur 30 ton product heeft geladen, wordt dat gegeven onderdeel van de digitale vrachtbrief. Dit gebeurt via een ‘third party interface’, in dit geval een interface tussen LZP en Den Hartogh's systeem. Datzelfde gebeurt met klanten. Dat is erg belangrijk, anders is digitalisering niet efficiënt.

Toekomst

Welke informatische of ICT-ontwikkelingen verwacht u in de nabije toekomst (5 jaar)?

Er gebeurt veel aan digitalisering bij Den Hartogh. Vrachtverkeer controleert op een bepaalde rijstrook bijvoorbeeld de bandenspanning en als die afwijkt wordt daar een melding van gemaakt. Het resultaat is minder klapbanden en daardoor minder calamiteiten.

Tenslotte

Met wie kan ik verder praten over i.h.b. de vragen die niet helemaal zijn beantwoord?

Het is best lastig inzicht te krijgen hoe ICT-systemen van Den Hartogh werken. De IT-er bij Den Hartogh is er in de bijeenkomst op 5 december. Het kan verder nuttig zijn TransFollow te vragen naar de plannen met digitale vrachtbrief en hulpverleners. Al deze vragen kan je stellen op de bijeenkomst van LZP op 5 december.

Appendix B: Interview met meldkamer regio Haaglanden

Gesprek met: Arno Sormani, MKB Ondersteuning, Veiligheidsregio Haaglanden
Datum: Maandag 25 november 2019
Plaats: Den Haag

Sfeertekening

Op 25 november heb ik gesproken met Arno Sormani bij de meldkamer voor alle drie de hulpdiensten. Het gebouw van de meldkamer was vrij nieuw en vooral erg groot. Ik heb dan ook niet alles gezien. Ik heb wel gezien één meldkamer voor zowel brandweer, politie en ambulance. Er mochten geen foto's gemaakt worden van deze ruimtes. Hier zitten politieagenten, ambulance-personeel en brandweer achter tafels naar vier computerschermen per persoon te kijken. Iedereen heeft een eigen bordje met zijn/haar taak, bijvoorbeeld "intake", wat betekent dat de persoon de telefoon aanneemt als er een omroep bij 112 binnen komt. Ook is er een groot scherm die door verbonden is met camerasystemen, gericht op straat en waarop ook staat hoeveel meldingen er zijn verwerkt en nog verwerkt moeten worden. Hier kunnen de 50 mensen in de zaal naar kijken.

Het gesprek begon met een introductie van mijn afstuderen en welke vragen ik beantwoord zou willen hebben. Als een melding bij 112 wordt gedaan, dan komt dit binnen bij een centrale instantie/punt in Driebergen. Er is in de loop van de tijd best veel geschoven met het aantal meldkamers (deze aantallen zijn over de tijd verandert). Bij de invoering van de wet op de veiligheidsregio's waren er nog 25 meldkamers voor alle drie de hulpdiensten dus eigenlijk 75 meldkamers. Uiteindelijk moeten dit 10 meldkamers worden. Ook is er dus een geïntegreerd meldkamersysteem (GMS), wat onder andere betekent dat een meldkamer uit Groningen meldingen kan verwerken die eigenlijk voor de meldkamer uit veiligheidsregio Haaglanden bedoeld zijn.

Inleiding

Het doel van mijn thesis is na te gaan wat de invloed is van het gebruik van ICT (i.h.b. de digitale vrachtbrief) door logistieke bedrijven op de effectiviteit van het functioneren van de hulpdiensten bij incidenten op de weg met gevaarlijke stoffen. De meldkamer komt daarin naar voren als een 'spin in het web': de verbinding tussen de melder en de hulpdiensten.
Er zijn al veel interviews geweest, i.h.b. met de brandweer en met een vervoerder. Over de afhandeling van een incident is daardoor al het nodige bekend. De vragen daarover zijn vooral controlevragen. Het gaat in dit interview vooral over welke rol ICT speelt bij die afhandeling en hoe de ICT-infrastructuur in staat is optimaal aan te sluiten bij toekomstige ontwikkelingen in de logistieke sector.

De afhandeling van meldingen in het algemeen

Hoe gaat de meldkamer om met meldingen van incidenten met gevaarlijke stoffen?

- *Welke vragen worden gesteld aan de melder? (gegevens en foto's van het incident? Locatie, brand, lekkages, gewonden? Vrachtbrief? Kemlerborden? Kenteken?...)*

Bij een melding worden protocollen gebruikt. Hierin staan onder andere vragen naar de locatie van het incident en wat er gebeurt is. Daar moet duidelijk uit worden wat de kern van het probleem is. Hierop volgt dan weer een specifiek ander protocol met vervolgvragen. Uiteindelijk komt hier een

meldingsclassificatie uit voort.

- *Welke hulpmiddelen (protocollen) worden gebruikt om de juiste hulpdiensten te alarmeren?*

Met name protocollen worden gebruikt om de juiste hulpdiensten te alarmeren. Verder zijn er geen andere specifieke hulpmiddelen bij de melding.

- *Welke informatie geeft de meldkamer door aan de geselecteerde hulpdiensten en hoe wordt die informatie verstrekt?*

De informatie die de meldkamer doorgeeft aan de geselecteerde hulpdiensten hangt erg sterk af van de meldingsclassificatie. Deze informatie wordt verstrekt door de centralist en hangt erg sterk af van het oordeel van de centralist. De meldingsclassificatie is hierbij een hulpmiddel bij.

- *Hoe blijft de meldkamer in contact met de hulpdiensten tijdens de afhandeling?*

De meldkamer blijft niet in contact met de hulpdiensten tijdens de afhandeling.

- *Wat legt de meldkamer vast na de melding van 'brand meester', en wat wordt met die gegevens gedaan en door wie?*

Alle informatie wordt voor een bepaalde termijn bewaard. Deze informatie blijft op de meldkamer. Informatie die naar buiten gaat, wordt ontdaan van de informatie waaruit de identiteit van de centralist kan worden opgemaakt.

De afhandeling van automatische meldingen

Hoe anders verloopt de afhandeling van incidenten, als de melding automatisch binnen komt (via eCall)?

- *Komen dergelijke meldingen per telefoon binnen? In tekstvorm? Welke gegevens (kunnen) worden meegestuurd (Type auto? Kenteken? …) Foto's? locatie-informatie van GPS?*

Meldingen van eCall gaan naar Driebergen. Ecall verstuurt relatief weinig gegevens. Enkel het type auto + het kenteken van deze auto.

- *Wordt er meteen telefonisch contact gezocht met melder, bestuurder*

Er wordt wel telefonisch contact gezocht met de melder/bestuurder, maar het kan zijn dat deze niet meer aanspreekbaar is. Dat is ook meteen het nadeel van eCall, er worden helemaal niet zoveel gegevens verstuurd, dus de hulpdiensten weten alsnog niet precies wat er gebeurt is.

- *En als dat niet lukt, Bevat de automatische melding doorgaans voldoende informatie om de juiste hulpdiensten te alarmeren? Stuurt u die informatie ook door?*

Dit valt dus tegen, maar dan gaan ze met onvolledige informatie naar het incident toe. Bij een bedrijfsongeval is er meestal meer informatie, maar bedrijfsongevallen komen wel minder vaak voor.
Rijkswaterstaat heeft misschien wel informatie op basis van kenteken wat een tankwagen zou vervoeren aan gevaarlijke stoffen, maar dit is meer informatie uit de "wandelgangen". Tankwagens zijn meestal gecompartimenteerd. Tankwagens kunnen ook rond rijden zonder logo of naam; dan is het onduidelijk onder welke verantwoordelijkheid de tankwagen valt.

(We hebben nog even doorgepraat over hoe moeilijk het was om een universeel transport-ICT-syteem op te zetten dat een verbindende schakel tussen verschillende vervoerders vormt. Dit is volgens Arno erg lastig. Ook is er besproken of realtimetraffic managementsystemen (zoals

zichtbaar in de meldkamer op het grote scherm) nuttig zijn of dat de focus beter de vrachtbrief en gps kan zijn, zoals binnen mijn afstudeer thesis.)

De ICT van de meldkamer: het Geïntegreerd Meldkamer Systeem (GMS)

Wat is de rol van het GMS?
De GMS zou eigenlijk het gemeenschappelijk meldkamer systeem moeten heten, aangezien alle drie hulpdiensten er gebruik van maken en dat dus het beste omschrijft wat het is en doet.

- *Welke ondersteuning biedt het GMS aan de meldkamer medewerker?*

Het GMS geeft inzetvoorstellen. Dus het systeem geeft aan welke middelen ingezet zouden kunnen worden, maar de centralist beslist hier uiteindelijk over. Ook is er onderlinge communicatie mogelijk tussen meldkamers.

- *Is er een permanente verbinding met de hulpdiensten, of moeten zij per incident worden geselecteerd en opgeroepen? Ondersteunt GMS de selectie van de hulpdiensten?*

Zij moeten per incidenten worden geselecteerd en worden opgeroepen. De GMS ondersteunt wel de selectie van de hulpdiensten door een inzetvoorstel te doen. Hiermee heeft de centralist een idee welke hulpdienst (voertuigen en mensen) ingezet zouden kunnen worden.

- *Zijn er directe koppelingen met bijvoorbeeld RDW (kentekens), Kadaster (kaarten), RWS (drukte op wegen), KNMI (weer), ILT?*

Nee er zijn geen directe koppelingen, hiervoor wordt gewoon het internet gebruikt, bijvoorbeeld voor het weer de buienradar. Kentekens via de RDW kan als burger en kan de brandweer dus ook met bijvoorbeeld een ipad in de auto.

- *Is er toegang tot kennisbestanden, bijvoorbeeld over gevaarlijke stoffen?*

Ja er is een database met informatie over gevaarlijke stoffen (bijv. de implosie- en explosieboven- en ondergrens. Het is ook mogelijk om een P2000 safety data sheet te raadplegen, hoewel je deze ook buiten het GMS kan opvragen.

- *Heeft de meldkamer verbinding met de (boordcomputers van de) hulpdiensten tijdens de afhandeling van een incident?*

Ja, de GMS (en centralist) stuurt meestal incidentinformatie naar de ipad. De boordcomputer bevat meestal de informatie over het brandweervoertuig zelf (en GPS).

- *Welke typen communicatie worden door het GMS ondersteund: telefoon, sms, GPS, Whatsapp, mail, online toegang tot registraties? Kunnen kanalen parallel worden benut (telefoon, mail, directe koppelingen)? Bijvoorbeeld: als er een kenteken wordt gemeld, worden er dan automatisch voertuiggevens opgevraagd bij de RDW?*

Niet alle typen communicatie worden door GMS ondersteund, telefoon wel, maar gps, sms, whatsapp en mail niet. SMS, whatsapp en email kunnen wel via de mobiele telefoon van de centralist worden gebruikt. Het GMS geeft het telefoonnummer van de melder wel weer. Kanalen worden dus niet per se parallel benut, maar de centralist zou kunnen en appen en bellen tegelijk, hoewel dit niet echt goed werkt.

- *Zijn er voorbeelden van automatische koppelingen van het GMS met private ICT-systemen (zoals TransFollow)?*

Nee, er kan bijvoorbeeld geen informatie automatisch bij STEDIN worden opgevraagd.

De ICT van de meldkamer: overige ICT

Gaat alle meldkamercommunicatie (in en uit) via het GMS? Of zijn er alternatieven (noodvoorziening)?
Niet alle meldkamercommunicatie gaat via het GMS. De centralist heeft eigen telefoon en eventueel andere informatiebronnen. Er zijn wel koppelingen, zoals met MennoMasters, maar daar doet de GMS soms niets mee.

Is er andere ICT-ondersteuning op de meldkamer?
Er is bijvoorbeeld voice-login.

Het beheer van het GMS

Hoe is het beheer van GMS georganiseerd?
GMS is in principe landelijk en is geschreven in een programmeer taal. De centrale computer draait waarschijnlijk op Linux.

- *Wie besluit er over uitbreidingen en veranderingen van het GMS?*

Niet gevraagd.

- *Hoe vaak komen er nieuwe releases van het GMS?*

Software updates zijn meestal één keer per jaar.

- *Welke privacyregels gelden er? Worden de handelingen van de centralist 'gelogd'? Onder welke omstandigheden (bij de aanwezigheid van welke gegevens) zou het meldkamerproces geautomatiseerd kunnen verlopen?*

Alle handelingen worden gelogd, maar als deze gegevens naar buiten worden gecommuniceerd, worden de (identiteits)gegevens over de centralist niet mee gestuurd.
Elke veiligheidsregio heeft in principe zijn eigen problematiek, hoewel de meldkamers in principe identiek zijn, heeft de centralist specifieke kennis, die moeilijk te automatiseren valt.
Ook specifieke brandweereénheden hebben ook weer specifieke kennis, waar de meldkamer niets van weet. Dit creëert dus verschillen over veiligheidsregio's heen. De brandweer in Rotterdam heeft waarschijnlijk meer kennis van gevaarlijke stoffen bijvoorbeeld.

Is er een compacte beschrijving (of een plaatje) van de ICT binnen een meldkamer?
Nee, er is geen plaatje van de ICT publiek beschikbaar. Enkel de beheerder heeft en krijgt hier toegang toe.

Appendix C: Interview met de NAM

Gesprek met: Henk Eleveld Waste coordinator NAM
Datum: 17 oktober 2019
Plaats: Rotterdam

Inleiding

Ik heb al enkele interviews gehouden met de brandweer en weet dus voorlopig genoeg van de gang van zaken bij de afhandeling van een incident. Ik wil met u vooral hebben over (1) de informatie, die u gebruikt bij het plannen en doen uitvoeren van transporten van gevaarlijke stoffen; (2) de manieren waarop die informatie is vastgelegd in ICT-systemen; (3) de communicatiemogelijkheden van de relevante ICT-systemen met de buitenwereld (in de eerste plaats: Den Hartogh en eventueel overheden; in de tweede plaats bij incidenten: met meldkamer en hulpdiensten).
Als u bepaalde vragen niet *kunt* beantwoorden, dan kunt u me misschien verder helpen om alsnog het antwoord te vinden.
Als u bepaalde vragen niet *wilt* beantwoorden, dan is dat natuurlijk uw goed recht!

Opmerking vooraf
Henk is voor de NAM 'ontdoener' van afvalstoffen. Deze stoffen zijn zeker niet minder gevaarlijk dan 'zuivere' gevaarlijke stoffen, vooral omdat de samenstelling wisselt. Het gaat om WACO: 'water-aardgascondensaat'.
Kosten/baten van de digitale vrachtbrief
Het uitwisselen van vrachtbriefgegevens via de computer is wettelijk toegestaan, mits die uitwisseling van gegevens van de nodige waarborgen is voorzien.

Welke baten verwacht u voor de NAM van volledige digitalisering van de vrachtbrief? Moet de NAM hiervoor grote kosten maken? Met wie overlegt u over deze digitalisering?

Logistiek zonder papieren is efficiënt, transparant, milieubewust én kostenbesparend. Men heeft direct inzicht in afval-, grond- en materiaalstromen. Het zou volledig papierloos moeten gaan en tegelijk op maat van de gebruiker. De baten zijn dus vooral een beter overzicht. Er zijn twee honderd locaties en al deze locaties hebben nu ook nog papieren vrachtbrieven. Dit is erg inefficiënt. De investering van de NAM in dit project is niet groot in vergelijking met die in olie- en gasprojecten, zoals Offshore gasvelden en de reguliere operaties van Shell.
Binnen dit project wordt weinig gedaan aan incident management (hulpdiensten kunnen niet bij de digitale logistieke informatie). Het doel is namelijk vooral het optimaliseren van de transporten. Het project 'Logistiek zonder papieren' (LZP) is geen eigendom van de NAM. De NAM huurt één etage in het gebouw van SHELL. Het raffinaderijproces van SHELL in de Rotterdamse haven is enorm en zal dat komende generatie ook blijven. NAM wordt komende jaren veel kleiner, aangezien de gasvelden in Groningen dicht gaan. Hierdoor blijft enkel SHELL over.

Zijn er praktische belemmeringen om de papieren vrachtbrief volledig te vervangen door de digitale versie? Zo ja, welke zijn dan die belemmeringen (technisch, organisatorisch, juridisch)? Misschien kunt u in uw antwoord aandacht besteden aan de communicatie met Den Hartogh, de landelijke overheid en de meldkamer en/of de hulpdiensten.
NB: Neemt u a.u.b. de tijd om deze vraag te beantwoorden!

De primaire actor die een bezwaar heeft tegen de volledige vervanging van de vrachtbrief is de ILT. Zij zijn verantwoordelijk voor de handhaving. Zij willen met één druk op de knop bij de boordcomputer de normale vrachtbrief kunnen zien, zodat ze precies dezelfde informatie krijgen als ze daarvoor krijgen. Andere hulpdiensten zijn niet betrokken en hebben vermoedelijk geen bezwaar om de papieren vrachtbrief te vervangen. Er is ook geen centrale portal waar de handhaver de informatie vandaag kan halen. Den Hartogh heeft wel een boordcomputer op hun vrachtwagens, maar is alleen verantwoordelijk voor het transport.
De meldkamer en hulpdiensten zijn dus niet betrokken bij LZP gezien het doel van het project (optimaliseren van goederenstromen). Op zich ligt hier een kans op een extra opbrengst van LZP. Het is misschien nuttig om een centrale portal te maken of een betere versie van de vrachtbrief in de boordcomputer te stoppen. De ILT is echter de belangrijkste actor op dit moment *(NB: Henk is bereid mij met de ILT in contact te brengen).*

De vrachtbrief inhoudelijk
De regelgeving eist minimaal de volgende inhoud:
a. de naam en het adres van de afzender;
b. de naam en het adres van de vervoerder;
c. de naam en het adres van de geadresseerde;
d. de gebruikelijke aanduiding van de aard van de goederen;
e. het brutogewicht of de op andere wijze aangegeven hoeveelheid van de goederen.

Heeft de digitale vrachtbrief deze gegevenselementen of wellicht nog meer?
Zijn deze gegevenselementen (internationaal / Europees / nationaal) gestandaardiseerd? Zo ja, welke norm?
Ja, zie de officiële vrachtbrief (begeleidingsbrief of eCMR) om deze informatie te krijgen. LOAD IT (het systeem dat de NAM gebruikt om overzicht te houden op alle vervoersstromen) is wel anders opgemaakt dan de vrachtbrief, maar heeft wel de belangrijkste gegevenselementen. De CMR en begeleidingsbrief zijn gestandaardiseerd (naar de normen van de ADR), maar de boordcomputers zijn niet gestandaardiseerd, en dat is dan ook direct het probleem: de ILT wil dit niet op deze manier.

Welke betrouwbaarheidseisen worden aan de gegevens in de vrachtbrief gesteld? Kunt u bij uw werk vertrouwen op de gegevens van anderen of controleert u altijd zelf nog eens?
Er wordt gekeken of er geen gegevens missen. Het systeem laat dit in principe ook zien. Niet alle velden in de vrachtbrief zijn verplicht (in dat geval zijn ze wit en niet grijs). Het is vooral dus het ontbreken van informatie dat een vrachtbrief onbetrouwbaar kan maken. Gegevens worden gecontroleerd voor zover dat mogelijk is. Er kan op papier een handtekening worden gezet (Henk Eleveld in zijn functie van 'ontdoener') en ook bij de digitale versie (hoewel dat minder gebeurt).

De vrachtbrief ICT-technisch
Zijn er (internationaal / Europees / nationaal) standaarden voor de wijze waarop (de gegevenselementen van) de vrachtbrief digitaal moeten worden opgeslagen?
Zo ja, welke?

Zo nee, is het mogelijk kennis te nemen van de intern bij de NAM gebruikte standaard (het liefst heb ik een technische beschrijving van het 'datarecord' in de computer)?
Nee, maar het is wel mogelijk om kennis te nemen van de intern gebruikte standaard, zie het LOAD-IT systeem of bronbestand. Bedrijven hebben verder allemaal andere systemen (een concurrent van het LOAD-IT systeem is bijvoorbeeld Transfollow).

Gebruikt NAM deze standaarden in haar communicatie met Den Hartogh en anderen?
De NAM gebruikt deze standaarden in haar communicatie met de boordcomputer in de tankwagen van Den Hartogh. De vrachtwagenchauffeur communiceert weer met het planningscentrum in Assen en dergelijke, maar dit verloopt niet per sé volgens die standaarden.

Verstrekt u of Den Hartogh vóór het vertrek van de vrachtauto elektronisch (vrachtbrief)gegevens aan de overheid over de lading? Zo nee, zou u daar bezwaar tegen hebben?
Nee, dat doen wij en zij niet. Bij een controle zou er via het kenteken informatie opgevraagd moeten kunnen worden door het ILT. De boordcomputer zelf geeft nog niet de informatie op juiste manier en met dezelfde layout als de papieren vrachtbrief.

Verstrekt u of Den Hartogh bij de melding van een incident met een vrachtauto elektronisch (vrachtbrief)gegevens aan de regionale meldkamer of aan de regionale brandweer? Zo nee, zou u daar bezwaar tegen hebben?
Nee, dat gebeurt niet, en Den Hartogh zou dat moeten doen en zij zouden er ook bezwaar tegen kunnen hebben.

De ICT-ondersteuning van de planning en de opdrachtverlening aan Den Hartogh
Ik heb graag een indruk in hoeverre uw plannings- en opdrachtproces wordt ondersteund door geautomatiseerde informatiesystemen.

Welke interne NAM-systemen ondersteunen de planning en de opdrachtverlening t.a.v. het transport van gevaarlijke stoffen? Welke vrachtbriefgegevens komen uit die NAM-systemen en welke vrachtbriefgegevens voegt u zelf toe?
Het Load-IT systeem en het bronbestand (een excel sheet). De vrachtbrief wordt volledig gevuld met informatie tijdens het laden en lossen. Deze systemen zijn enkel om een globaal overzicht te hebben, vanuit een centraal systeem.

Aangenomen dat Den Hartogh de definitieve vrachtbrief samenstelt, welke vrachtbriefgegevens stuurt u digitaal naar de opdrachtnemer? Kunt u iets zeggen over de techniek waarmee dat wordt gedaan?

Is completering van de vrachtbrief de verantwoordelijkheid van Den Hartogh? Ontvangt u die definitieve vrachtbrief? Slaat u die op in een ICT-systeem? Wat doet u er verder mee? Hoe lang bewaart die informatie?
Completering is de verantwoordelijkheid van de vrachtwagenchauffeur (van Den Hartogh). De definitieve vrachtbrief niet, maar wel de belangrijkste informatie (via Load-IT). Deze informatie wordt in dat systeem opgeslagen. Het is onduidelijk hoe lang de informatie wordt bewaard.

De volgende vragen moet ik wellicht stellen aan Den Hartogh:
Heeft Den Hartogh de digitale vrachtbrieven opgeslagen in een centraal systeem?
Ja.

Is de digitale vrachtbrief opgeslagen in de boordcomputer (of een tablet) van de vrachtauto of staat de boordcomputer continu in verbinding met de centrale computer?
Boordcomputer staat vrijwel continu in verbinding met een (centrale) computer. De digitale vrachtbrief is niet letterlijk opgeslagen in de boordcomputer, vandaar de papieren vrachtbriefversie.

Heeft de boordcomputer ook een functie als de 'zwarte doos' in geval van incidenten? Kan de computer automatisch een digitale melding naar de meldkamer zenden, zoals de coördinaten van de plaats van het incident?
Boordcomputer werkt nog onvoldoende als een 'zwarte doos'. Nee dat doet de boordcomputer niet.

Weet u of Den Hartogh de digitale vrachtbrief 'uploadt' naar een of ander landelijk register?
Het centrale portal (die nog niet goed werkt) gaat op basis van kenteken. Hier kan dus nu nog niet de juiste informatie uit worden gehaald.

Toekomst

Welke informatische of ICT-ontwikkelingen verwacht u in de nabije toekomst (5 jaar)?
–

Hoever bent u met realtime traffic management?
Daarover is nog niet in deze setting nagedacht.

Tenslotte

Is er documentatie over de plannen van de NAM met digitale vrachtbrief of andere relevante innovatieve ontwikkelingen?

Is er documentatie over de informatie-infrastructuur bij de NAM en het technische datacommunicatiebeleid van de NAM met toeleveranciers en opdrachtnemers?

Na het gesprek waren er nog enkele onduidelijkheden. Er zijn nog enkele vragen gesteld (via email) na het gesprek met Henk Eleveld. Hierop zijn de volgende antwoorden opgekomen (mail van 29 oktober 2019).

Bij een informatieanalyse zijn de functionele eisen, zoals de betrouwbaarheidseisen relevant. Deze eisen zijn afhankelijk van het doel en het gebruik van de informatie. Vandaar nog de volgende vragen over de (digitale) vrachtbrief.

De 'ontdoener' zet, als ik het goed heb begrepen, ook een handtekening op de vrachtbrief. Voor de correctheid van welke informatie-elementen tekent hij?
De ontdoener is verantwoordelijk voor alle gegevens op de vrachtbrief. Van locatie van herkomst tot bestemming. Belangrijkste zijn de (afval)stofgegevens. En de classificering. Dat moet overeenkomen met de stof die geladen wordt. De chauffeur is verantwoordelijk voor het feit dat hij zeker stelt dat hij gaat laden conform zijn vrachtbrief.

Komt tijdens een concreet transport de digitale vrachtbrief inhoudelijk volledig overeen met de uiteindelijke papieren vrachtbrief?

Het IL&T stelt dat als eis. Alle gegevens moeten inzichtelijk zijn in de boardcomputer of telefoon. De lay out is niet verplicht alleen de info.

Uit het gesprek kreeg ik de indruk dat de (digitale) vrachtbrief alleen wordt gemaakt, omdat dit Europees-wettelijk is vereist. Welk nut heeft de vrachtbrief voor de NAM zelf?
NAM geeft afvalstoffen bij derden in transport. Gedurende dit proces worden er verschillende

handtekeningen gezet. In het laatste vak tekent de ontvanger van de afvalstof. Daarmee verklaard de ontvanger dat hij de (afval)stof accepteert.
Dit is weer van belang voorde afvalstoffen registratie van NAM zelf en de meldingen die de verwerkers moeten doen bij het Landelijk Meldpunt Afvalstoffen (LMA)

De NAM bewaart de (digitale) vrachtbrieven nog een onbepaalde tijd. Voor welk doel (na het transport) doet zij dat? Is het een juridische verplichting? Dient de opgeslagen wellicht een verantwoordingsdoel?
Het is een wettelijke verplichting om de documenten 7 jaar te bewaren. NAM heeft dit contractueel gedelegeerd aan de transporteurs

Appendix D: Interview met brandweer regio Haaglanden

Gesprek met: Mario de Slegte, (afdeling operationele voorbereiding)
Datum: 10 september 2019
Plaats: Den Haag

NB: Door tijdgebrek zijn niet alle vragen aan de orde geweest.

Ter inleiding

5. Voorstellen aan elkaar.
6. Vragen hoeveel tijd er is.
7. Vragen of het gesprek mag worden opgenomen.
8. Het doel van mijn thesis is na te gaan wat de invloed is van het gebruik van ICT (i.h.b. de digitale vrachtbrief) door logistieke bedrijven op de effectiviteit van het functioneren van de hulpdiensten bij incidenten op de weg met gevaarlijke stoffen (IBGS = Incident Bestrijding Gevaarlijke Stoffen). Ik houd mij dus niet bezig met preventie en nazorg, alleen met detectie en response. Ik probeer ook aanbevelingen op te stellen voor zowel logistieke bedrijven als hulpdiensten.
9. NB: Ik ga uit van bonafide logistieke bedrijven. Van criminele transporteurs is überhaupt geen betrouwbare informatie te verwachten.

Algemene vragen

Toelichting:
Eerst enkele algemene vragen en vragen over de rol van de brandweer en andere hulpdiensten bij incidenten op de weg met gevaarlijke stoffen.

Waar gebeuren de meeste ongelukken op de weg met gevaarlijke stoffen?

- *Op de autobanen?*
- *Op op- en afritten?*
- *Op provinciale wegen?*
- *Elders?*

Beeld van de brandweer is dat de risico's niet zozeer optreden tijdens het vervoer als wel bij de 'handling' (het verpompen en verladen). Op een LPG-tankwagen zitten veiligheidsmechanismes; de LPG zelf zit in een stalen container, die wordt gekeurd; dat gaat allemaal prima. Maar als de tankwagen wordt aangesloten op het tankstation, dan kan het mis gaan. Heeft de chauffeur de goede veiligheidsmaatregelen genomen, zit de koppeling goed, is die geaard? Menselijk handelen veroorzaakt in het algemeen de meeste risico's, en dat is vooral aan de orde bij het verpompen en verladen. Dan begint de koppeling soms te lekken en te sputteren, zelfs bij een veilig bedrijf als DSM. Maar er zijn erg veel chemiebedrijven en het gaat er dus ergens wel een keer iets mis. Verder kan je analyseren dat inderdaad de risico's het laagst zijn als een tankwagen rechtdoor rijdt over een snelweg. Tenzij de chauffeur een slaapaanval krijgt. Je kan op zich groepsrisico en plaatsgebonden risico berekenen. We hebben nauwelijks voorbeelden van tankwagens die op de weg gekanteld zijn, bij die weinige voorbeelden is de tankwagen met een wiel door het gras is gereden. Dat heeft weinig met de integriteit van het transport te maken.

Welke van de hulpdiensten heeft de leiding bij de afhandeling van een IBGS?
Dat is in de wet geregeld in de wet op de veiligheidsregio's (vroeger brandweerwet). Daar staat in: operationele leiding is bij de brandweer. Brandweer heeft taken bij rampbestrijding, ze hebben de operationele leiding bij het incident, maar kunnen andere diensten niet gedetailleerd aansturen. Ik kan niet tegen de politie zeggen: jij moet de weg afzetten met vier auto's en twee leidinggevenden, maar ik kan wel tegen de politie zeggen, de weg moet afgezet worden op die en die punten, op vierhonderd meter afstand. Brandweer kan ook zeggen: jullie moeten zorgen voor opvang. Hij kan niet zeggen: deze mensen moeten worden opgevangen in het gemeentehuis en ze krijgen koffie met suiker. De inhoud van het proces daar kan de brandweer niets over zeggen, maar wel wat er moet gebeuren. Dat is in de wet zo geregeld.

Ongeplande tussenvraag: Is dat het geval bij alle incidenten?
Bij een schietpartij heeft de politie de leiding. Maar het commandoteam stemt onderling af. Is er brand in een winkelstraat en het gevolg is dat er mensen beginnen te plunderen: dan heeft de brandweer de operationele leiding. Het kan ook zijn: er zijn plunderingen gevolgd door enkele brandstichtingen en dan zou volgens de regels de brandweer ook de leiding hebben; alleen dan zeggen we: het is wel erg handig als de politie even vertelt wat we gaan doen, want het zijn plunderingen met geweld en hier en daar een brandje. Dan zeggen we: pakken jullie het voortouw. Dat is collegiale afstemming. Dat gaat heel goed.

Beschikt de brandweer (en andere hulpdiensten) over protocollen over hoe te handelen bij een igs? Kan ik die inzien?
Niet aan de orde geweest.

Hoe houden logistieke bedrijven zich aan de geldende regelgeving? (bijvoorbeeld 'kemler-borden')
Tankwagens worden altijd gekeurd en ze hebben een vrachtbrief. Ze gebruiken inderdaad kemler-borden, behalve criminelen. Dat staat allemaal in de ADR ('Accord européen relatif au transport international des marchandises Dangereuses par Route'). Je moet de ADR ook goed kunnen lezen: als je bijvoorbeeld 10.000 liter terpentine in een container hebt, dan moeten daar kemler-borden op, maar als je 10.000 flesjes terpentine van een liter vervoerd (denk aan de bevoorrading van de GAMMA met wasbenzine en terpentine). Dat valt dan niet onder de regelgeving. Die regelgeving onder het ADR garandeert dus niet altijd dat de brandweer te weten komt, wat hij wil weten. En dan wordt een vrachtbrief interessant.

Welke type gevaarlijke stoffen worden onderscheiden?

c) Explosief
d) Brandbaar
e) Giftig
f) Corrosief
g) *…*

Je kan ze onderverdelen in 9 typen gevaarlijke stoffen, maar bij transport is dat eigenlijk niet eens zó belangrijk. Belangrijker is wat er kan gebeuren. Denk aan het eerdere voorbeeld: het maakt verschil of er één container is of 10.000 literflessen. ADR garandeert niet dat de brandweer kan beschikken over de informatie waarnaar hij op zoek is. Vervoerders hebben het ook over chemicaliën, en wij noemen het gevaarlijke stoffen en eigenlijk ook pas, als er iets gaat lekken of branden of zo. Focus liever niet op bepaalde type gevaarlijke stoffen. Er zit ook een psychologische kant aan. Het is zeker fysiek, rationeel en ook emotioneel gevaarlijk, als er dertigduizend liter benzine is uitgestroomd. Maar als de brandweer er schuim over heen gooit, dan zegt iedereen, ja goh benzine, dat tanken we dagelijks. Maar als er één klein doosje met een stickertje 'radioactief'

erop wordt gevonden, dan haal je misschien CNN, maar de brandweerman gaat er in zijn zwembroek naast staan, bij wijze van spreken.
Concentreer je liever op het ontsluiten van informatie voor de brandweer. Stel je voor: vrachtwagen ligt op zijn kant; chauffeur is onwel geworden, dus niet aanspreekbaar; vrachtbrief ligt in zijn dashboard kasje, en het is gevaarlijk om die daaruit te halen. Dan wordt dus de digitale kant interessant. We willen bijvoorbeeld op basis van kenteken snel bij ILT kunnen achterhalen wat die chauffeur vandaag vervoert. Hoe vind je die informatie snel en betrouwbaar, want ze willen binnen een paar seconden weten wat het is. De stof zelf is minder relevant, omdat de brandweer vooral uitgaat van scenario's. Als de stof lekt, moet er afgedekt of afgedicht worden. Of de stof stinkt is dan niet per se relevant. Het is wel interessant wat de stof met je doet, omdat je daarop ook je beschermende kleding kiest. Sommige stoffen vereisen bepaalde kleding. Een standaard blusoverall is vooral bestand tegen hitte. Daar kunnen we brandende plant/locatie mee in gaan, want die beschermt de drager. We hebben geleerd, hoever je daarmee kan gaan en wanneer je terug moet. De blusoverall beschermt ook tegen chemicaliën; er zit kevlar in. Als daar spetters zoutzuur op komen, dan vreet dat het materiaal aan, maar de pakdrager gaat niet meteen omvallen. We hebben ook andere pakken die de inwerking van chemicaliën beter kan hebben. Vandaar er altijd druk op de ketel bij de brandweer staat. De psychologische factor is ook belangrijk. We moeten vooral kijken naar scenario's. Alle gevaarlijke stoffen typen komen voor, en nieuwe typen leiden soms tot andere scenario's, bijvoorbeeld wel of geen BLEVE.

In het vervolg beperken we ons tot explosieve, brandbare en/of giftige stoffen!

Vragen over het proces van melding tot afhandeling igs

Toelichting:
Deze reeks vragen dient om een beeld te krijgen van de gang van zaken bij igs. Uiteindelijk wil ik een procesbeschrijving of -model van de afhandeling van een igs door de hulpdiensten. *We kunnen aan de hand van een concrete casus spreken of van een gemiddelde (ideaaltypische) igs, zoals u daar een beeld van heeft. Ik laat u de keuze. Als we uitgaan van een concrete casus (hetgeen mijn voorkeur heeft, zeker als daarover verdere literatuur is!), dan graag ook vermelden in welke opzichten de gang van zaken destijds afweek van de normale gang van zaken.*

Mijn voorlopige procesbeschrijving (script) is als volgt: (1) een igs wordt gemeld bij de meldkamer (112), (2) de meldkamer geeft de melding door aan één of meer hulpdiensten, (3) de gealarmeerde hulpdiensten bereiden zich voor, (4) de hulpdiensten rukken uit, (5) de hulpdiensten doen ter plaatse van het igs wat ze moeten doen, (6) de hulpdiensten voorzien in nazorg en verrichten allerlei administratieve werkzaamheden (processen-verbaal e.d.).
(Misschien een tekening van het proces meenemen en voorleggen)

In hoeverre klopt dit script? Kunt u het aanvullen?
Dit script klopt, maar bij stap 1 is er al een probleem voor de brandweer: er wordt een incident gemeld, maar het is onduidelijk in hoeverre iets een incident is waarvoor moet worden uitgerukt. De melding beschrijft slechts een beleving van degene die belt: het stinkt hier en er ligt iets heel gevaarlijks op straat, maar er komt eigenlijk water uit de dakgoot. Sommige dingen lijken heel gevaarlijk, maar dat zijn dat in werkelijkheid niet. Andere dingen lijken ongevaarlijk, maar zijn wel gevaarlijk. De brandweer moet rekening houden met die persoonlijke/emotionele belevingsfactor. Ook moeten ze meestal handelen op basis van zeer onvolledige informatie. De melding geeft vaak niet meer dan een indicatie, en moet met professionele ogen worden gelezen. Aan de hand van de melding maakt de centralist op de alarmcentrale een inschatting gemaakt van het incident. Op

basis daarvan stuurt die de melding naar de waarschijnlijk benodigde éénheden ter plaatse. Ter plaatse kan overigens altijd blijken dat er nog een bepaalde dienst of specialist nodig is.
Meestal weten we pas achteraf precies hoe het zat en wat we nodig hadden gehad.
Een centralist kan je desgewenst laten zien hoe dit allemaal digitaal werkt. Je kan een melding aanmaken en de computer doet een voorstel welke éénheden moeten gaan rijden. Ook als er nadere informatie uit het veld komt, tikt de centralist die in en stelt de computer eventueel voor om andere eenheden te sturen.

Is de voorbereiding van de brandweer (stap (3)) afhankelijk van het type gevaarlijke stof bij het igs? Weet de brandweer doorgaans tijdig om welke gevaarlijke stoffen het gaat en wat de locatie is van het igs? Wat doet de brandweer, als zij het niet weet?
De voorbereiding is afhankelijk van het type gevaarlijke stof of beter gezegd van het scenario waar het type toe leidt. De brandweer weet niet altijd om welke gevaarlijke stof het gaat; op locatie weten ze het meestal wel. Als het onduidelijk is welke gevaarlijke stof aanwezig is, dan gaat de brandweer er toch naar toe, met onvolledige informatie dus.

Is de respons van de brandweer ter plaatse (stap (5)) afhankelijk van het type gevaarlijke stof bij het igs? Weet de brandweer doorgaans tijdig om welke gevaarlijke stoffen het gaat? Wat doet de brandweer, als zij het niet weet?
De respons is afhankelijk van het type gevaarlijke stof, met name voor de keuze van de kleding/pakken.

Vragen over de informatie die het logistieke bedrijf verstrekt of zou kunnen verstrekken aan de hulpdiensten

Toelichting:
Deze reeks vragen dient om inzicht te krijgen in de informatie die het logistieke bedrijf heeft en die tevens relevant is voor de hulpdiensten bij een igs. Van belang is vooral ook op welk moment het logistieke bedrijf die informatie verstrekt en hoe het dat doet. In een latere reeks vragen komt aan de orde welke ICT er precies wordt gebruikt en hoe dat kan veranderen in de nabije toekomst (komende 5 jaar). Ook hier kunnen we spreken aan de hand van een concrete casus spreken of van een gemiddelde (ideaaltypische) igs, zoals u daar een beeld van heeft.

Welke informatie zou de brandweer willen hebben voor de voorbereiding van het uitrukken (stap (3)), die een logistiek bedrijf standaard heeft (bijvoorbeeld in de vrachtbrief, GPS)?
- *De vervoerde gevaarlijke stoffen*
- *De hoeveelheden*
- *Locatie van het incident*

Dat is de zoektocht die we doen op de afdeling operationele voorbereiding. In feite bestaat ideale informatie niet. Als die bestond, kon zij alleen geleverd worden door een passerende brandweerman (dat is trouwens wel eens gebeurd). We zijn al blij met relevante en betrouwbare informatie, als die er maar snel is. Betrouwbare bronnen zijn digitale vrachtbrieven en informatie van het ILT. Één van de moeilijkste dingen is de actualiteit van de informatie: klopt het nog steeds? Nogmaals, we zijn al blij met 80% ‘rake’ informatie. ‘Optimaal’ is hier een beter woord dan ‘ideaal’.

Is de papieren vrachtbrief nu nog verplicht?
De vraag is niet gesteld, omdat het antwoord intussen bekend was: de papieren vrachtbrief is nu nog verplicht volgens de ADR.

Hoe komt de brandweer aan deze informatie?

- *De trucker heeft alle informatie al doorgegeven aan de meldkamer (percentage?)*
- *De trucker heeft telefonisch contact met de brandweer (percentage?)*
- *Het logistieke bedrijf (eventueel de trucker) verstrekt de informatie digitaal (percentage?)*
- *Anders (namelijk? Percentage?)*

De vrachtwagenchauffeurs hebben geleerd om relevante informatie aan de hulpdiensten te leveren. Zij komen met de vrachtbrief op de plek van het incident. Van te voren geven ze alle informatie door aan de meldkamer die wordt gevraagd. In de moderne nieuwe vrachtauto's zit een boordcomputer, maar niet alle vrachtauto's zijn modern. De trucker heeft geen telefonisch contact met de brandweer. Ik weet niet precies van wie de brandweer meestal informatie krijgt, maar deze wordt direct naar de boordcomputer van de brandweer gestuurd. In een brandweerauto zit een MDT 'mobiele data terminal'; dat is een soort tomtom, met een zoekfunctie.

Welke informatie zou de brandweer willen hebben voor de response ter plaatse (stap (5)), die een logistiek bedrijf standaard heeft (bijvoorbeeld in de vrachtbrief)?
De brandweer wil weten: de vervoerde gevaarlijke stoffen, de hoeveelheden, de locatie van het incident. En dat allemaal snel en betrouwbaar.

Hoe komt de brandweer aan deze informatie?

- *De brandweer heeft de informatie al bij de voorbereiding gehad (percentage?)*
- *De trucker vertelt het ter plaatse (percentage?)*
- *De trucker verstrekt ter plaatse de vrachtbrief (papier) (percentage?)*
- *De trucker verstrekt ter plaatse de vrachtbrief (digitaal) (percentage?)*
- *Het logistieke bedrijf verstrekt de informatie digitaal (percentage?)*
- *Anders (namelijk? Percentage?)*

De brandweer krijgt een gedeelte van deze informatie bij de voorbereiding, via de vrachtbrief, ter plaatse en in de toekomst misschien ook via de digitale vrachtbrief. Naar percentages is niet gevraagd.

Vragen over de ICT, tegenwoordig gebruikt door de logistieke bedrijven en de hulpdiensten

Toelichting:
Deze reeks vragen dient om inzicht te krijgen in het huidige ICT-gebruik van direct betrokkenen en de eventuele problemen daarmee, in het bijzonder tijdens een igs (in de fases van detectie en respons). De vragen gaan vooral ook over de communicatie tussen de apparaten van de trucker en de brandweerlieden. Laten we bij deze vragen ons niet beperken tot één concrete casus.

Truckers

Welk percentage van de vervoerders van gevaarlijke stoffen beschikt tegenwoordig over boordcomputers (laptops, tablets), waarop onder andere de digitale vrachtbrief staan?
Niet aan de orde geweest.

Beschikken truckers bij een igs (waarbij zij hun truck moeten verlaten) over de al dan niet digitale vrachtbrief, zodat zij die kunnen overleggen aan de hulpdiensten?
De truckers beschikken meestal over een digitale vrachtbrief, maar het is onduidelijk hoe die kan worden ingezet.

Weten truckers met en zonder boordcomputers evenveel van de aard van hun lading?
Niet aan de orde geweest.

Hulpdiensten

Beschikken de uitrukkende hulpdiensten (uitgesplitst naar politie, brandweer, ambulance) tegenwoordig over boordcomputers (laptops, tablets)? Zijn de mensen 'op de auto's' goed geïnstrueerd? Welke rol spelen mobiele telefoons?
De uitrukkende hulpdiensten beschikken over boordcomputers (in ieder geval de brandweer), en soms ook over een tablet. Dit kan afhankelijkheid van deze technologie creëren.

In hoeverre worden de computers gebruikt om te bepalen wat er ter plaatse moet worden gedaan? Kunt u dit specificeren?
Niet aan de orde geweest.

Communicatie tussen de computers van truckers en die van meldkamer en hulpdiensten

Kunnen de computers van de truckers communiceren met die van:
- *De meldkamer?*
- *De vaste locaties van de hulpdiensten (de 'kazernes')?*
- *(de auto's van) het personeel van de hulpdiensten?*

Niet aan de orde geweest.

Zo nee, wat zijn de redenen daarvan?
Niet aan de orde geweest.

Zouden de hulpdiensten een probleem hebben bij de afhandeling van een igs, als alle benodigde informatie alleen *digitaal beschikbaar zou zijn? Komt dat al voor in de praktijk?*
Niet aan de orde geweest.

Vragen over de ICT, in de nabije toekomst gebruikt door de logistieke bedrijven en de hulpdiensten

Toelichting:
Deze reeks vragen dient om inzicht te krijgen in het toekomstig ICT-gebruik van direct betrokkenen en de eventuele problemen die daarmee zijn, in het bijzonder tijdens een igs (in de fases van detectie en respons). De vragen gaan vooral ook over de communicatie tussen de apparaten van de trucker (of het logistieke bedrijf) en de brandweerlieden.

Truckers

Is te verwachten dat de papieren vrachtbrief verdwijnt binnen 5 jaar? Welke wettelijke maatregelen moeten daarvoor worden genomen, onder andere om de betrouwbaarheid en de beveiliging van de informatie te garanderen? Wat betekent dat alles voor de opleiding van truckchauffeurs (in Europees verband)?
Niet aan de orde geweest.

Welke ICT zullen logistieke bedrijven de komende jaren introduceren om hun primaire processen te stroomlijnen, die potentiële gevolgen heeft voor de afhandeling van een igs? Wat zijn bijvoorbeeld

de gevolgen van 'realtime traffic management' bij de logistieke bedrijven?
Niet aan de orde geweest.

Communicatie tussen de computers van truckers en die van meldkamer en hulpdiensten

Welke maatregelen zouden de hulpdiensten (uitgesplitst naar politie, brandweer, ambulance) moeten nemen om te kunnen profiteren van de ICT-ontwikkelingen in de logistieke sector?
Niet aan de orde geweest.

In hoeverre is er in het ICT-beleid van de hulpdiensten hiermee al rekening gehouden?
Niet aan de orde geweest.

Filosoferen over het ICT-beleid van de hulpdiensten

Toelichting:
Deze discussie wordt alleen gestart, als daar tijd voor is. *Zij gaat over scenario's om de communicatie tussen logistieke bedrijven (met hun truckers) en de hulpdiensten (met hun personeel op de auto's) in de toekomst te structureren. (Deze scenario's kunnen ook tijdens de bespreking van de vorige reeks vragen aan de orde komen, als denkmodellen.) Vooralsnog zie ik de volgende scenario's:*

- *De informatie ten behoeve van de afhandeling van een igs verloopt via de ICT van de logistieke bedrijven (via die van de centrale meldkamer) naar die van de ingeschakelde hulpdiensten. Dit is het meest centrale scenario, waarbij individuele truckers en medewerkers van de hulpdiensten minimale zorg hebben over de beschikbaarheid van informatie, want het wordt allemaal buiten hen om geregeld.*
- *De informatie ten behoeve van de afhandeling van een igs verloopt via de ICT van de logistieke bedrijven naar die van de medewerkers van de hulpdiensten. Zij krijgen na de melding door de trucker toegang tot bepaalde systemen van de logistieke bedrijven. Dit scenario ontlast de trucker.*
- *De informatie ten behoeve van de afhandeling van een igs verloopt via de ICT (boordcomputers) van trucks op initiatief van de truckers (via de ICT van de centrale meldkamer) naar die van de ingeschakelde hulpdiensten. Dit scenario ontlast de medewerkers van de hulpdiensten.*
- *De informatie ten behoeve van de afhandeling van een igs verloopt direct van de boordcomputers van de trucks naar de boordcomputers van de hulpdiensten. Dit is het meest decentrale scenario.*

In schema:

	Concentratie logistieke ICT	Deconcentratie logistieke ICT
Concentratie ICT hulpdiensten	Informatie van ICT logistieke bedrijven via ICT meldkamer en ICT kazernes naar ICT personeel hulpdiensten	Informatie van ICT trucks via ICT meldkamer en ICT kazernes naar ICT personeel hulpdiensten
Deconcentratie ICT hulpdiensten	Informatie van ICT logistieke bedrijven direct naar ICT personeel hulpdiensten	Informatie van ICT trucks direct naar ICT personeel hulpdiensten

Discussiepunten:

- Welke van deze scenario's (gesteld dat zij te realiseren zijn) heeft de voorkeur, bezien vanuit de praktijk van de afhandeling van een igs? Waarom?
- Welke bezwaren zouden er tegen deze scenario's kunnen zijn vanuit de optiek van logistieke bedrijven? (Technische haalbaarheid, wettelijke belemmeringen, belangen)
- Welke bezwaren zouden er tegen deze scenario's kunnen zijn vanuit de optiek van hulpdiensten? (Technische haalbaarheid, wettelijke belemmeringen, belangen)

Deze discussie is wegens tijdgebrek niet gevoerd.

Gespreksevaluatie en vervolg

Toelichting:
Deze reeks vragen dient om te constateren welke vragen onbeantwoord zijn gebleven en wat er kan worden gedaan om die antwoorden alsnog te krijgen. In de praktijk zullen de volgende vragen al beantwoord zijn op het moment dat de gesprekspartners eerdere vragen niet konden beantwoorden.

Zijn er stukken beschikbaar, waaruit de onbeantwoorde informatie is te halen?
Niet aan de orde geweest.

Welke organisaties zouden met prioriteit moeten worden geïnterviewd:

1. *Logistieke bedrijven (welke? petrochemische bedrijven?)*
2. *Politie (welke regio? Koepel?)*
3. *Ambulancesector (welke regio? Koepel?)*
4. *Instituut Fysieke Veiligheid*
5. *Centrale meldkamer (waar?)*
6. *Beleidsdirecties op ministeries (welke?)*
7. *Rijksinspecties (I Leefomgeving & Transport, I Justitie &Veiligheid, I Politie & Crisisbeheersing?)*

Mario suggereert vooral de meldkamer.

Appendix E: Interview (telefonisch) met brandweer regio Haaglanden

Gesprek met: Mark Knaapen, Hoofd Officier van Dienst/ Hoofd Sectie Brandweer at Veiligheidsregio Haaglanden)
Datum: 17 september 2019
Plaats: Rotterdam

Ter inleiding

h) Voorstellen aan elkaar. Vragen hoeveel tijd er is. Vragen of het gesprek mag worden opgenomen.
i) Het doel van mijn thesis is na te gaan wat de invloed is van het gebruik van ICT (i.h.b. de digitale vrachtbrief) door logistieke bedrijven op de effectiviteit van het functioneren van de hulpdiensten bij incidenten op de weg met gevaarlijke stoffen (igs). Ik houd mij dus niet bezig met preventie en nazorg, alleen met detectie en response. Ik probeer ook aanbevelingen op te stellen voor zowel logistieke bedrijven als hulpdiensten.
j) In eerder interview met Mario de Slegte is al veel aan de orde geweest, met name over de gang van zaken vóór en tijdens een igs. Hoewel niet al mijn vragen zijn beantwoord, ga ik die vragen niet nu herhalen. Mijn verslag van dat gesprek zal ik aan Mario opsturen om te controleren of ik alles goed heb begrepen; misschien kan hij onbeantwoorde vragen alsnog beantwoorden. Ik concentreer me in dit gesprek op de huidige en toekomstige ICT bij de brandweer. Als er tijd over is, dan kom ik graag terug op eerder onbeantwoord gebleven vragen.

Er was genoeg tijd, we hebben uiteindelijk ruim een uur gepraat. Het gesprek mag worden opgenomen, maar dat is niet gelukt, ik heb het merendeel met de hand bijgeschreven. Ik heb aan het begin het doel van mijn thesis vertelt wat eerder aan de orde is gekomen en met name over de gang van zaken voor en tijdens een igs.

Vragen over de communicatie bij de *detectie* door de brandweer

Toelichting:
Met Mario de Slegte is gesproken over de gang van zaken bij een igs. Ik wil mij nu concentreren op de communicatie met ICT op twee momenten:

10. *Detectie: focus op periode van melding tot uitrukken, dus op de informatie die nodig/gewenst is om de beslissing te nemen uit te rukken en met welk materieel.*
11. *Response: focus op de periode van aankomst bij het igs tot vrijgeven van die plaats, dus op de informatie die nodig/gewenst is om beslissingen te nemen ter plaatse.*

Eerst dus de detectie. Uit het gesprek met Mario bleek dat wellicht het meeste te winnen is bij de melding van het incident. De bij de melding beschikbare informatie is dermate onbetrouwbaar dat de brandweer vaak met te zwaar materieel of zelfs onnodig uitrukt. In deze fase is betrouwbare informatie niet alleen belangrijk voor de effectiviteit van het uitrukken, maar ook voor de efficiëntie.

Vragen:

De huidige situatie bij een melding van een igs:

Klopt het dat de brandweer vaak uitrukt op basis van onbetrouwbare en onvolledige informatie?

Ja, dat klopt de brandweer rukt vaak uit op basis van onbetrouwbare en onvolledige informatie. Daar kunnen de hulpdiensten niet zoveel aan doen, de personen die het incident melden kunnen deze informatie gewoon niet op een goede manier overdragen aan de meldkamer en de brandweer. De informatie van de meldkamer bekijken heeft dus niet zoveel zin, aangezien de informatieoverdracht al mislukt bij de getuige van het incident. De focus van jouw onderzoek zou dus echt moeten liggen bij het eerder verkrijgen van de informatie uit de digitale vrachtbrief, zo snel mogelijk na een incident. Hiervoor moeten ICT-systemen aan elkaar worden gekoppeld, en informatie worden gedeeld met de systemen van de brandweer. De focus moet niet liggen op de communicatie tussen de brandweer, politie, ambulance en meldkamer, want die gaat meestal wel goed.

Welke informatie ontvangt de brandweer bij of kort na de melding? Van wie komt die informatie (meldkamer of trucker of logistiek bedrijf)? Wat kunt u zeggen over de betrouwbaarheid en volledigheid?

De informatie komt voornamelijk van mensen die het ongeluk zien gebeuren: getuigen of van de vrachtwagenchauffeur die belt. De informatie is incompleet en onbetrouwbaar, omdat het iemand is die psychologisch er niet op is ingesteld om de juiste informatie te verschaffen (de persoon is immers net betrokken geweest bij een stressvol incident). De informatie die de brandweer krijgt bij of kort na de melding is dus vaak onbetrouwbaar en onvolledig. Het verbeteren van die informatie is niet makkelijk, maar de vrachtbrief zou een nieuwe informatiebron kunnen zijn voor de brandweer. Ze zouden dan alvast in het algemeen kunnen weten wat voor soort gevaarlijke stoffen in de truck zit en misschien hoeveel er in zit. Dit zou een grote verbetering zijn. Als de informatie (vrachtbrief) in een algemeen systeem zit, kunnen ze waarschijnlijk de vrachtwagen selecteren op basis van waar het ongeluk heeft plaatsgevonden en op basis van een algemene omschrijving. De vrachtbrief kan dan geselecteerd worden uit het elektronisch systeem.

Welke informatie ontvangt de brandweer bij of kort na de melding?

De brandweer ontvangt dus enkel algemene informatie via de meldkamer. De meldkamer heeft een aantal protocollen en vragen aan diegene die het incident meldt, maar diegene die het meldt kan meestal geen volledige informatie geven.

Specifiek: is de informatie uit de (papieren of digitale) vrachtbrief beschikbaar bij de brandweer bij het beslissen over het uitrukken?

Nee, de informatie uit de papier of digitale vrachtbrief is vrijwel nooit beschikbaar bij de brandweer als ze uitrukken bij het incident. Deze informatie is nu meestal analoog en daardoor enkel beschikbaar in de vrachtwagen, de chauffeur is meestal niet aanspreekbaar bij het incident met gevaarlijke stoffen.

Welke ICT-systemen spelen hierbij een rol (bij de trucks, de meldkamer, de brandweerkazerne of de brandweerauto)? In hoeverre kunnen deze systemen met elkaar communiceren? Wat verhindert optimale communicatie?

Dit zijn meestal systemen van de landelijke organisatie waar de brandweer op is aangesloten. Iedereen heeft dan ook zijn eigen ICT-regiosysteem dat door marktwerking steeds iets verschillend is. De logistiek heeft geen landelijk systeem voor gevaarlijke stoffen (dit bestaat wel voor de trein en voor bedrijven, maar niet voor transport over de weg). Hier ligt dus ook dus een kans om te kijken hoe het ICT-registratie systeem bij de trein en bij bedrijven is. Bij de Rotterdamse haven moet er een bedrijfsbrandweer zijn bijvoorbeeld. Ook is er een kans, omdat dus wel bewezen is dat het mogelijk is om zo'n systeem te maken (voor de trein bestaat het al).

Ongeplande vraag: Is er eigenlijk sprake van een non-probleem, omdat Mario de Slegte had gezegd dat het grootste probleem bij de 'handling' van gevaarlijke stoffen optrad en niet zozeer op de openbare weg?

In de veiligheidsregio Haaglanden kwamen incidenten met gevaarlijke stoffen inderdaad eigenlijk niet zo vaak voor.

> *Eigen aantekening*
> Ik weet dat het merendeel van de gevaarlijke stoffen in Zuid en Noord-Holland wordt vervoerd in de omgeving van de Rotterdamse haven en de haven van Amsterdam. Het is wel van belang om te kwantificeren hoe groot het probleem is dat ik onderzoek. Als het om een non-probleem gaat, heeft het niet veel zin om in de oplossing ervan te investeren. Het zou kunnen dat de logistieke bedrijven hier meer zicht op hebben dan de hulpdiensten. Verder zijn er misschien statistieken bij het IFV of het CBS.

<u>De verwachte en de gewenste situatie bij een melding van een igs:</u>

Is het wenselijk dat de brandweer bij de melding tegelijk de digitale vrachtbrief van de betrokken truck ontvangt? Is de organisatie binnen de brandweer erop ingericht deze informatie zo te verwerken dat de beslissingen rond het uitrukken kunnen worden geoptimaliseerd?

Is het praktisch haalbaar dat de brandweer bij de melding tegelijk de digitale vrachtbrief van de betrokken truck ontvangt? Ziet u belemmeringen, zoals:

- *Gebrek aan standaardisatie bij de brandweer?*
  Nee, er is op zich geen gebrek aan standaardisatie, niet alles is daar gestandaardiseerd, elke regio heeft zijn eigen ICT-systeem dat door marktwerking is ontstaan, maar dit is op zich geen probleem.
- *Onwil om informatie te verstrekken bij logistieke bedrijven?*
  Nee, TLN wil dat wel degelijk, anders zijn ze enkel snelwegen aan het ontruimen en ontstaat er te veel vertraging. Ze hebben er belang bij dat er zo min mogelijk ongelukken gebeuren. Individuele logistieke bedrijven hebben wel een belang om hun eigen gegevens af te schermen, die zullen minder graag gegevens delen. Het zou dus misschien toch via wetgeving moeten worden geregeld. De TLN koepelorganisatie zou hier vermoedelijk wel over na willen denken.
- *Een grote diversiteit aan technische ontwikkelingen bij logistieke bedrijven?*
  Er zijn heel veel transportbedrijven en dat maak het moeilijk om al die bedrijven op één systeem aan te sluiten. Er zijn (minimaal) 2 open standaarden en de veiligheidsregio's kunnen daarop aansluiten. Het zou mooi zijn als er een verplicht landelijk systeem zou zijn, waarin alle logistieke bedrijven de relevante informatie zou vastleggen en waaruit de brandweer informatie kan verkrijgen. Praktische haalbaarheid hiervan wordt dus vooral beperkt, doordat er heel veel transportbedrijven zijn.

Zijn er (komende 5 jaar) andere ICT-ontwikkelingen te verwachten in de logistieke sector, die van

belang zouden kunnen zijn bij de communicatie tussen logistieke bedrijven en de brandweer in verband met de detectie in de brandweerkazerne in geval van een igs?

Er zijn erg veel ICT-ontwikkelingen geweest, bijvoorbeeld 4G en 5G technologie. Een nuttige ICT-ontwikkeling is bijvoorbeeld het veiligheidssysteem eCall, dat in een auto bij een incident automatisch een melding geeft naar de 112-centrale met de gps-positie en het aantal inzittenden.

Bestaat er overleg tussen (koepels van) brandweer en logistieke bedrijven over dit soort zaken? Welke rol spelen de betrokken ministeries en rijksinspecties?

Primaire antwoord: landelijke gevaarlijke stoffen coördinator (email gekregen). En er is dus een koepel van de brandweer, Brandweer Nederland, waar het IFV een onderdeel van is; dat is bijna hetzelfde. Bij de logistieke bedrijven bestaat er alleen TLN. Het is onduidelijk in hoeverre deze twee koepel organisaties overleggen, waarschijnlijk wel.

Vragen over de communicatie bij de *response* van de brandweer

Toelichting:
Zoals aangekondigd nu een aantal vragen over de communicatie ter plaatse van het igs. Bij deze vragen wordt ervan uit gegaan dat de informatie bij de detectie (zie boven) niet voldoende betrouwbaar en volledig was voor een effectieve respons, zodat er ter plaatse nog informatie moet worden verzameld of verkregen. Het gaat vooral om informatie, waarover de trucker (of het logistieke bedrijf) beschikt en de brandweer nog niet.

Vragen:

De huidige situatie op de plaats van een igs:

Moet de brandweer ter plaatse van een igs nog veel specifieke informatie verzamelen om tot de juiste response te komen (bijvoorbeeld aard en hoeveelheid van de aanwezige gevaarlijke stoffen)? Welke van deze informatie is beschikbaar bij de trucker (en specifiek de vrachtbrief)?

Er is een melding en daar ga je op af. Ter plaatste is er samenwerking met een vrachtwagenchauffeur of constateert de brandweer zelf wat het probleem is. Dat kost veel tijd. De belangrijkste informatie is beschikbaar bij de vrachtwagen (vrachtbrief), maar daar kan je niet altijd bij.

Zijn er problemen bij de overdracht van informatie door de trucker (of het logistieke bedrijf) aan de brandweer ter plaatse? Zijn die problemen van technische aard? Zijn truckers en brandweerlieden voldoende opgeleid om optimaal gebruik te kunnen maken van hun ICT?

Trucker weet meestal genoeg van de gevaarlijke stof en van zijn truck van wat er van belang is, maar hij is niet altijd aanspreekbaar op het moment van het incident. Zowel truckers als brandweermensen zijn op zich voldoende opgeleid over het type gevaarlijke stof en wat er geladen is en ze kunnen redelijk goed met elkaar communiceren, hoewel de indeling van gevaarlijke stoffen bij transport over de weg en die van de chemische industrie wel iets van elkaar verschillen. De digitale vrachtbrief moet antwoord op kunnen geven op het type gevaarlijke stof en de hoeveelheid. Er zijn nu oranje identificatieborden; daarmee is echter niet duidelijk hoeveel er in zit. Met de vrachtbrief weet je dat wel. Ook kan het zijn dat de tankwagen gereinigd is, maar niet

gelost is, of vica versa. Er is nog winst te halen in de snelheid en betere informatie bij een incident met gevaarlijke stoffen.

Welke rol spelen ICT-systemen bij de trucks, de meldkamer, de brandweerkazerne en de brandweerauto?

Incident gevaarlijke stoffen is slechts een onderdeel van het brandweerwerk. De brandweer heeft zijn eigen ICT-systemen en iedere brandweerauto heeft een boordcomputer. Voor personenauto's kan het type auto worden achterhaald door het kenteken uit te lezen. Het is niet per sé nuttig om te kijken naar de ICT systemen van de meldkamer, aangezien daar het probleem niet zit. Er zijn erg veel transportbedrijven, het is niet gezegd dat die allemaal hetzelfde ICT-systeem gebruiken.

De verwachte en de gewenste situatie op de plaats van een igs:

Is de verwachting dat zonder verdere actie de digitale vrachtbrief de informatiepositie van de brandweer ter plaatse van het igs verbetert of verslechtert?

Ja, de informatiepositie van de brandweer bij het incident verbetert dan. Informatie wordt betrouwbaarder en wordt sneller beschikbaar. *(Ik werp tegen dat de informatie ook zou kunnen verslechteren, maar dat leek hem niet zo.)* Informatie van de chauffeur kan vervangen worden door de informatie uit de digitale vrachtbrief. Deze informatie is betrouwbaarder en wordt sneller beschikbaar, bij analoge vrachtbrief gaat er heel veel tijd om heen om de vrachtwagen uit de vrachtwagen te halen en te halen.

Welke maatregelen zijn nodig om te bereiken dat de brandweer ter plaatse kan beschikken over de informatie in de digitale vrachtbrief? Zowel van de zijde van de brandweer als van de logistieke bedrijven?

Er moet een landelijk systeem en een plicht en/of wens om daarop aangesloten zijn. Het liefst moet dat een soort intrinsieke wens van betrokkenen zijn, maar zo nodig kan het door de wet worden afgedwongen.

> *Eigen aantekening:*
> Ik moet nog eens goed nadenken of zo'n centraal, landelijk systeem wel een haalbaar en goed alternatief is, en zo ja, hoe dat dan het beste kan worden vormgeven. Decentrale oplossingen met een beperkte standaard-interface hebben vaak meer draagvlak. Brandweer en transportbedrijven moeten eventuele oplossing wel willen gebruiken.

Zijn er (komende 5 jaar) andere ICT-ontwikkelingen te verwachten in de logistieke sector, die van belang zouden kunnen zijn bij de communicatie tussen logistieke bedrijven en de brandweer in verband met de respons ter plaatse van een igs?

De ICT-ontwikkelen voor response en detectie zijn redelijk vergelijkbaar. De ICT-ontwikkelingen (4G/5G) zijn erg hard gegaan en zijn voldoende om zo'n soort systeem op te zetten. Ook zou ik dus naar het eCall, software systeem kunnen kijken voor auto's.

Vragen naar (openbare) documenten over de gang van zaken bij een igs

Welke wetgeving is van belang voor dit onderwerp? (Ik noemde zelf: ADR, REACH, Basisnet)

ADR is daarbij de belangrijkste voor mijn onderzoek. Verder wist Mark ook geen andere wetgeving.

Beschikt de brandweer over protocollen over hoe te handelen in geval van een igs? Is er ander instructiemateriaal? Kan ik deze documenten inzien?

Ja er zijn protocollen, maar hij dacht niet dat deze nuttig waren voor mij. Dan zou je echt brandweerman moeten willen worden. Dit gaat over inzet procedures, basisinzet, handelingsperspectief, maatwerkadvies en dingen zoals windrichting. Er worden heel veel perspectieven beschreven en is eigenlijk basislesstof.

Is er verder nog relevante literatuur?
Nee, niet zover hij weet.

Gespreksevaluatie en vervolg

Toelichting:
Deze reeks vragen dient om te constateren welke vragen onbeantwoord zijn gebleven en wat er kan worden gedaan om die antwoorden alsnog te krijgen. In de praktijk zullen de volgende vragen al beantwoord zijn op het moment dat de gesprekspartners eerdere vragen niet konden beantwoorden.

Welke organisaties zouden met prioriteit moeten worden geïnterviewd:
- *Logistieke bedrijven (welke? petrochemische bedrijven?)*
  Dat is nuttig. Je zou met vervoerders het verloop van een concreet igs kunnen nagaan. Of vragen naar de ervaringen en plannen met de vrachtbrieven. Het is ook interessant te weten hoe vervoerders staan tegenover verdere informatieplichten.
- *Politie (welke regio? Koepel?)*
  De vraag is of je daar relevante informatie krijgt. Men zal vertellen over handhaving en controles, wetgeving. Dat is bijvoorbeeld zinvol, als je vragen wilt stellen over normen voor de belading van de vrachtwagen. Hij ziet niet veel relatie met de onderzoeksvraag.
- *Ambulancesector (welke regio? Koepel?)*
  Hiervoor geldt hetzelfde als voor de politie. Het kan helpen, als je wilt weten welke gevaren er zijn voor de mens bij de verschillende chemische stoffen.
- *Instituut Fysieke Veiligheid*
- *Centrale meldkamer (waar?)*
  Een interview bij de meldkamer gaat niet het verschil maken.
- *Beleidsdirecties op ministeries (welke?)*
  Nee, hij ziet geen relatie met de onderzoeksvraag.
- *Rijksinspecties (I Leefomgeving & Transport, I Justitie &Veiligheid, I Politie & Crisisbeheersing?)*
  De belangrijkste rijksinspectie voor dit onderzoek gaat over milieuwetgeving, namelijk ILT.

Appendix F: Interview met een vrachtwagenchauffeur Den Hartogh

Gesprek met: Ronald
Datum: 7 oktober 2019
Plaats: Rotterdam

Achtergrond
Het doel van dit interview was niet zozeer informatie verzamelen, die direct bruikbaar zou zijn voor mijn thesis, maar om gevoel te krijgen van de context waarbinnen het vervoer van gevaarlijke stoffen in de praktijk speelt. Inderdaad ben ik op de site geweest en heb het hele proces van een verlading gezien. Juist bij de verlading ontstaat wel eens een incident. Op de locatie van verlading zijn dan ook speciale veiligheidsmaatregelen genomen.
De gesprekspartner was min of meer toeval; ik kwam hem tegen op site, en ik had eigenlijk met een andere vrachtwagenchauffeur een gesprek gepland, maar die bleek niet beschikbaar. Het gesprek is niet opgenomen, aangezien het niet was toegestaan elektronica mee nemen de site op. Dit verslag is gebaseerd op enkele notities. Gezien de doelstelling zijn incidenten maar beperkt aan de orde geweest. De chauffeur keek vaak mee, als ik wat opschreef.
Daarnaast heb ik kort gesproken met de plantoperator: Hans Talboom.

Gesprek met de chauffeur

Hoe is een chauffeur van gevaarlijke stoffen opgeleid?
De vrachtwagenchauffeur heeft natuurlijk zijn reguliere vrachtwagenrijexamen. Daarnaast heeft hij een speciale opleiding gehad: WaCo (water-aardgascondensaat). Hij is dus gespecialiseerd in deze vracht. Er zijn meer transportbedrijven, maar deze rijden meestal tussen verschillende locaties. Voor de NAM is Den Hartogh wel de primaire leverancier. Het vrachtvervoer met gevaarlijke stoffen is dus best geliberaliseerd; er zijn verschillende commerciële partijen. De overheid controleert enkel.

Hoe verloopt de administratie? Gaat die schriftelijk of via de computer?
De administratie verloopt vooral schriftelijk (vrachtbrief). De boordcomputer heeft informatie uit het planningscentrum. Deze informatie is niet per sé up-to-date, en ook niet altijd betrouwbaar. Het is bijvoorbeeld mogelijk om twee gevaarlijke stoffen in één tankauto te laden en dat wordt dan niet altijd goed ingevoerd in de computer.
De chauffeur voert zelf niets in op de boordcomputer; alle informatie komt van het planningscentrum. De boordcomputer communiceert met 3G, maar er wordt niets mee verstuurd. Dus ook niet naar de meldkamer of de brandweer.
De vrachtbrief is opgeslagen in de boordcomputer. De gegevens zijn onderdeel van het CRM (Customer relationship management systeem) of E-CMR. Dat is uitsluitend bedoeld om het transport efficiënt te maken. Het heeft geen functie bij incidenten.

Kunt u het verladingsproces beschrijven?
Verladen duurt ongeveer een uur. Schoonmaken hoeft niet altijd te gebeuren. Je kan meerdere malen dezelfde stof laden zonder de tankwagen schoon te maken. Het is belangrijk dat het gas inert is in de tankwagen en dat er geen zuurstof bij de gevaarlijke stof komt. Inert maken kan door er stikstof bij te voegen. Bij het laden wordt er eerst geaard (als beveiliging tegen elektrische schokken). Er zijn 2 slangen die naar de tankwagen gaan, waardoor er een circulair systeem is; reststoffen gaan weer de NAM-tank in. Bij het laden kan de chauffeur ‘Kemler’-borden op de

tankwagen plaatsen. De tankwagen heeft een drukmeter en een volumemeter. De vrachtwagenchauffeur moet bepalen hoeveel er in de tankwagen gaat. Dit mag niet te veel zijn, want dan is de druk te hoog of de lading te zwaar.
Bij het verladen is er een risico dat de installatie niet stopt, waardoor de wagen te vol wordt. Ook komen er wel eens menselijke fouten voor. Zo is er eens een slang tussen de tankwagen en de installatie blijven zitten. De tankwagen reed weg en, omdat de twee slangen een omtrek van tien centimeter hebben, was er best schade aan de installatie.
De tankwagen heeft veiligheidsmechanismes: een claxon en een knipperlicht, waardoor de chauffeur weet als er iets fout gaat.
Ook de rit die de chauffeur nu ging maken, was trouwens niet helemaal normaal. Omdat de compressor op de site stuk was, moest het water-aardgascondensaat naar Delftzijl.

Er zijn op de site zones met een verschillend beveiligingsniveau: zone 0, 1 en 2. Zone 0 is het gevaarlijkst en zone 2 het minst gevaarlijk. Er zijn rekken op de grond bevestigd ter bescherming tegen gevaarlijke stoffen. De gevaarlijke stoffen lopen direct de rekken in naar een veilige plek, zodat ze niet de grond verontreinigen.

Eigen indruk:
De vrachtwagenchauffeur leek er niet direct van overtuigd dat het nuttig was om bij een incident de informatie met de brandweer te delen. Hij ging er volgens mij vanuit dat hij nooit een ongeluk met gevaarlijke stoffen te maken zou krijgen. Als het zou gebeuren, dan was dat gewoon een risico van het vak. Ik had niet het gevoel dat hij dacht dat de digitale vrachtbrief daar verschil in kon maken.

Kort gesprek met de plantoperator Hans Talboom

Hans Talboom is plantoperator, en bedient ook een computer waarmee hij het proces op de site bestuurt: de compressor, het affakkelen, de warmtewisselaar en dergelijke. Hij heeft vanuit die positie geen invloed op de verlading; alle verladingshandelingen worden zuiver mechanisch ondersteund. Alleen metingen aan de inhoud van de tank zit, zijn te zien op de computer.

Appendix G: Interview met Inspectie Leefomgeving & Transport

Emailwisseling met: Andre Schenkel
Datum: 8 januari 2019

Hieronder een aantal vragen die ik aan de orde zou willen stellen.

Over de omvang van het probleem

Tot nu toe heb ik weinig gegevens kunnen vinden over de omvang van het probleem. Ik had gedacht aan bijvoorbeeld:

- *Aantal incidenten met gevaarlijke stoffen op de weg met indicatie van de gevolgen (schade, aantal gewonden en doden; afgelopen 5 jaar; misschien zelfs nog uitgesplitst naar veiligheids-regio)?*
  ILT is niet geïnteresseerd in de schade en doden dan wel gewonden, puur te wijten aan incidenten met het transport van gevaarlijke stoffen, zijn er al jaren niet. Als er al gewonden waren is dit te wijten aan andere zaken zoals botsingen en handelingen tijdens het laden dan wel lossen. Deze laatste worden dan door de ISZW onderzocht.
- *Aantal van dergelijke incidenten met trucks die onder de ADR-regelgeving vallen (idem)?*
  Wij krijgen jaarlijks een paar honderd meldingen van incidenten met gevaarlijke stoffen. De meeste incidenten vinden echter plaats tijdens het laden dan wel lossen van de wagens en gezien jouw richting van onderzoek ben jij op zoek naar incidenten waarbij de hulpdiensten over de gegevens van de inhoud van de wagens zouden moeten kunnen beschikken, zouden dat de incidenten onderweg betreffen. Wij splitsen dergelijke meldingen echter niet zodat ik niet zo 123 die gegevens beschikbaar heb. Dit zijn er mbt het wegtransport echter hooguit 20 per jaar.

Ik heb in uw meerjarenplan 2019-2023 gelezen:

De ILT-brede risicoanalyse
De ILT zet haar schaarse capaciteit selectief in op de terreinen waar de maatschappelijke risico's het grootst zijn en waar het handelen van de ILT het meeste effect kan sorteren. Een belangrijke pijler voor deze afweging is de ILT-brede risicoanalyse (IBRA) omdat ze de basis vormt voor het kiezen van de onderwerpen waarop de inzet van de ILT wordt vergroot of verkleind. Deze methode helpt de ILT om ordelijk te kiezen op basis van maatschappelijke schade.
Bron: Meerjarenplan ILT 2019-2023, p. 7

Op grond hiervan heb ik de hoop dat u beschikt over bovengenoemde gegevens of dat u op een andere manier het risico heeft weten te kwantificeren. Mijn vraag is dus: Hoe kwantificeert de ILT het risico van incidenten met gevaarlijke stoffen op de weg, en hoe groot is dat risico?
Voor deze risico's heeft de ILT een Inspectie brede risicoanalyse (IBRA) uitgevoerd over al haar taken en gebieden waar toezicht op gehouden moet worden. Er zijn 33 gebieden gedefinieerd waarbij incidenten tijdens het transport van gevaarlijke stoffen op plaats 23 staat. IBRA gaat uit van geld en (internationale afspraken) oftewel wat kost het de BV Nederland als er een dergelijk ongeval gebeurt en wat hebben wij internationaal voor verplichtingen. Incidenten met wegvervoer zijn nagenoeg allemaal verzekeringskwesties, dus geld scoort niet hoog; internationaal zijn er geen verplichtingen over aantallen inspecties, dus dat scoort ook niet hoog. Daarbuiten gebeurt er gewoon op dit gebied niet zoveel zodat de maatschappelijke onrust ook niet groot is en of dit nu onze verdienste is (goed toezicht) of dat de branche zich van nature goed gedraagt laat ik maar in

het midden... Kortom het antwoord op jouw vraag is: niet zo'n groot risico. Het toezicht op het transport van gevaarlijke stoffen blijft aanwezig maar heeft geen hoge prio met alle gevolgen van dien mbt mensen, middelen etc.

Over de taken en bevoegdheden van de ILT op dit terrein
De ILT heeft een handhavingstaak in verband met de REACH-regelgeving. Impliceert dat tegelijk een handhavingstaak in verband met de ADR-regelgeving, die voor de logistieke sector zo belangrijk is?
Deze vraag begrijp ik niet. REACH staat los van de gevaarlijke stoffen wetgevingen. ILT heeft beiden in haar pakket echter zijn 2 verschillende taken met verschillende teams die zich daarmee bezig houden. Natuurlijk werken deze wel samen als het nodig is want ze zitten wel in 1 afdeling.

Welke bevoegdheden heeft de ILT ten opzicht van transportbedrijven in het algemeen en individuele truckchauffeurs in het bijzonder, wanneer het gaat om transporten die onder ADR vallen? Mag de ILT bijvoorbeeld trucks onverwacht staande houden voor een inspectie?
Wij (en de Douane) zijn toezichthouder wat betekent dat wij in de gevaarlijke-stoffenketen op alles, iedereen en overal controles kunnen uitvoeren. Anders dan bv de politie die alleen opsporing heeft, wat betekent dat zij alleen op kunnen treden als er een overtreding is geconstateerd.

Welke bevoegdheden heeft de ILT ten opzicht van transportbedrijven in het algemeen en individuele truckchauffeurs in het bijzonder, wanneer het gaat om transporten die niet onder ADR vallen? Mag de ILT bijvoorbeeld trucks onverwacht staande houden voor een inspectie?
Behalve voor gevaarlijke stoffen zijn wij ook toezichthouder voor een aantal andere vervoerswetgevingen (WWG, Atbv, EVOA etc.) dus ja, ook dat mogen we. Voor een aantal van deze genoemde wetgevingen is de politie ook toezichthouder, wat betekent dat zij ook zomaar voertuigen kunnen staande houden.

Over het overleg van 5 december jl.
Het standpunt van de ILT over de digitale vrachtbrief was zeer helder. Het maakt de ILT niets uit hoe een en ander wordt geïmplementeerd, als de ILT maar simpel alle informatie krijgt die zij nodig heeft voor haar taakuitoefening. Mijn vraag:

Zou de ILT een iets meer richting gevend standpunt mogen en willen innemen, als dat de informatiepositie van de hulpdiensten zou kunnen versterken? Zo ja, hoever kan de ILT hierin gaan?
De ILT geeft uitleg en interpretatie over wet en regelgeving. Verder voeren wij onze controles uit om ervoor te zorgen dat bv met het vervoersdocument het voor de hulpverleners duidelijk is waar en hoe de informatie bij een incident naar boven gehaald kan worden (binnen de wettelijke verplichtingen natuurlijk). Daar waar jij in het standpunt zegt "ILT" moet je dus eigenlijk lezen "de hulpverlening". Als wij inspecties doen is nl altijd de chauffeur aanwezig, dus kan hij de informatie in zijn tablet oid naar boven halen. De controle of wij er zonder de chauffeur bij kunnen is een check op het voor de hulpdiensten kunnen beschikken over de informatie bij een incident als de chauffeur niet meer aanspreekbaar is.

Appendix H: Informatie over eCMR platforms

Information about paperless transport (with the use of the digital bill of lading)
Bakker, Ferdi den. *Digitale vrachtbrief: wie biedt wat?*, 23 oktober 2018 (https://www.logistiek.nl/supply-chain/artikel/2018/10/wie-biedt-wat-voor-digitale-vrachtbrief-101165602?vakmedianet-approve-cookies=1&_ga=2.65015086.1228610182.1574236591-495148325.1574236591)

In dit Nederlandse artikel komen enkele Nederlandse aanbieders van platforms aan het woord, die e-CMR ondersteunen, o.a.: TransFollow en Transporeon. In Nederland zijn er vier erkende aanbieders, in België zes, over heel Europa elf. Om erkenning te krijgen voor eCMR van de Nationale en Internationale Wegvervoer Organisatie (NIWO) dienden leveranciers vóór 1 september 2018 een aanvraag in te dienen.

Weerd, Peter de. *Papierloos transport in Benelux is een feit*, 7 maart 2018 (https://www.logistiek.nl/distributie/nieuws/2018/03/papierloos-transport-benelux-een-feit-101162540)
In dit Nederlandse artikel wordt het gebruik van eCMR (digitale vrachtbrief) rond maart 2018 beschreven in de Benelux en ook kort in Frankrijk en Spanje.

TransFollow, an instance of an independent eCMR platform

(the following information has been retrieved from https://transfollow.org/ and https://www.transportportal.com/en/)
TransFollow is the independent eCMR platform that works together with the transport and logistics sector. Developed for and by the market, the eCMR platform promotes cooperation between senders, carriers and recipients. Many (logistics) software suppliers are already connected to TransFollow.
TransFollow provides real-time insight for all partners in the supply chain on one central platform. So that senders, carriers and recipients can view the digital consignment note before and during transport to adapt their planning when needed. The data are and remain the property of those who provide them; eCMRs are managed and secured by TransFollow engine. TransFollow is ISO27001 (information security) certified. The TransFollow signature (TFA) is used as a digital signature. Larger companies are connected by an API (Application Programming Interface); smaller companies usually access to the TransFollow application via Transport Portal. Goals: less administration, lower failure costs, streamlined transport and flexible quality control.
TransFollow is a Dutch initiative by Evofenedex and Transport Logistics Nederland (TLN). These independent branch organizations contribute to the implementation of the legal standard for eCMRs. The IRU (the International Road Transport Union) also supports TransFollow. TransFollow is now working hard on the international rollout of its eCMR solution.
There are distributors of TransFollow in the Netherlands, Romenia, France, Italy, Czech Republic, Spain.

In aanvulling op voorgaande zijn de volgende vragen gesteld aan René Bruijne (General Manager TransFollow); de antwoorden zijn per mail ontvangen op 25 november 2019:

Welke rechtsvorm heeft TransFollow? (NV, BV, stichting, vereniging)? Wie zijn de eigenaren en wie hebben zeggenschap?
TransFollow is een BV. Eigenaren is ViaService in Genève (nauw verbonden aan de IRU)

Wat is de betrokkenheid van overheden bij TransFollow?
TransFollow is een zuiver privaat initiatief.

Wel marktaandeel heeft TransFollow in Nederland, Europa, wereldwijd?
Als het gaat om e-CMR wereldwijd schat ik ons marktaandeel op 50%, binnen Nederland 75%.

In hoeverre is eCMR een wereldwijde standaard? Is het een ISO standaard? Zijn er concurrerende standaarden?
Er is alleen een UN standaard voor het datamodel op basis waarvan een e-CMR aangemaakt kan worden. Helaas is roaming tussen de verschillende e-CMR partijen (nog) niet mogelijk.

In hoeverre hebben de API's van TransFollow een status als (inter)nationale standaard?
TransFollow was de pionier en dus 'de facto' de enige aanbieder in het begin (zelfs voor de UN standaard er was).

Is de eCRM van TransFollow op te halen via het kenteken van de truck?
Ja technologisch is dat mogelijk; de vraag is alleen wie dat waarom zou willen.

Appendix I: Aantekeningen bij een vergadering over LZP

Aanwezig: André van Schenkel (ILT), Azis (LZP), Joost van Delft (LZP), Bert Schreurs (NAM), Henk Eleveld (NAM) en Erik Groen samen met nog iemand (Den Hartogh) en Stijn Frima (gast)
Tijd: donderdag 5 december 2019, 10 – 12 uur
Plaats: bij Den Hartogh in de Rotterdamse haven

André van Schenkel meldde dat er een voorlopige vrijstelling van bepaalde ADR-eisen was voor Transfollow. ADR is de regulering die voor transport van gevaarlijke stoffen over de weg geldt. Die vrijstelling geldt niet voor iedereen. De eCMR (digitale vrachtbrief/Transfollow) is in principe een Beneluxproduct.
De ideale situatie zou zijn één centrale portal waarop iedereen kan inloggen. Lzp (Logistiek zonder Papier) is nationaal gericht; dat is te beperkt. En als we op Europa moeten wachten dan zijn we nog wel 10 jaar aan het wachten.
Bij de Europese Unie stellen ze dat het centrale portal vanuit de markt moet komen en niet door de EU moet worden gebouwd of bedacht. In zo'n centrale portal moet in principe alle informatie over digitale vrachtbrieven zijn te vinden.

De E-BGB, de begeleidingsbrief bij lzp functioneert goed, nu nog de eCRM (digitale vrachtbrief). Er moet vooral gekeken worden naar het Lading dragend materiaal van het transport. Daar moet informatie over beschikbaar zijn.

De aanwezigen waren niet geheel overtuigd van het correcte handelen van de brandweer. Niet iedere brandweer weet wat er in de vrachtbrief staat en kan hem lezen. In de praktijk bellen ze vaak naar het bedrijf dat de goederen vervoert. Zo verkrijgen ze het UN nummer van de gevaarlijke stof.

Als er een incident is met gevaarlijke stoffen dan gaat de brandweer eerst meten; daarna doen ze hun pakken (kleding) aan, enzovoort. Ze zijn daar lang mee bezig en als ze onzeker zijn over de gevaarlijke stoffen, blijven ze op afstand. Hoewel de hulpdiensten niet het onderwerp van vergadering was, is er dus wel even over gesproken. Ze wilden namelijk wel een oplossing kiezen waar de hulpdiensten ook baat bij zouden hebben, ondanks dat incidenten met gevaarlijke stoffen vrijwel nooit voorkomen (zoals al bleek uit eerdere gesprekken).
Als de hulpdiensten op basis van kenteken zou kunnen inloggen, zouden ze wel direct naar het ongeluk kunnen en zouden ze geen afstand hoeven te houden. De digitale vrachtbrief moet altijd werken, ook als de stroom uitvalt. Anders kunnen de hulpdiensten alsnog niet bij de informatie.

Een centrale portal gaat dus jaren duren, maar vrachtbrieven vinden op basis van kenteken zou kunnen op korte termijn. Een centrale portal zou opgelegd moeten worden door de EU. Elk land heeft een ander idee over wat digitalisering van een brief inhoudt. Bijv. in Rusland is een ingescande papieren vrachtbrief ook al een digitale vrachtbrief.

De digitale vrachtbrief moet ook compatibel zijn met het transport management systeem van Den Hartogh: Transfusion. Er kan ook een combinatie van een papieren en digitale vrachtbrief zijn bijvoorbeeld in een stukgoed-auto.

De oplossing die uiteindelijk gekozen is de mogelijkheid om ter plaatse de digitale vrachtbrief in te zien met een app van de boordcomputer. Hiermee zou de ILT dan de digitale vrachtbrief in moeten

kunnen zien zonder handleiding. Dit zou op korte termijn geïmplementeerd moeten worden. Er is ook nog even gesproken of er wetten zouden moeten worden aangepast, maar dat bleek niet het geval. Dit is in het beginsel enkel nationaal (of zelfs regionaal) geregeld. De rest is wel internationaal. ILT maakt het in principe niet uit hoe de applicatie wordt geïmplementeerd, als ze de informatie maar krijgt.

Een systeem gebaseerd op eCall is ook nog besproken. In het bijzonder hoe dat bij personenauto's is geïmplementeerd; het is verder niet uitgewerkt tijdens de vergadering. De boordcomputer heeft wel een simkaart en zou dus vrij veel informatie door kunnen sturen.

Het perspectief van de hulpdiensten wordt dus wel benoemd tijdens de vergadering, maar het staat niet centraal en de digitale vrachtbrief zal niet op korte termijn voor de hulpdiensten (dus wel voor de ILT) beschikbaar zijn.