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Structural measures for a safer transport of hazardous materials by rail: The case of the basic network in The Netherlands

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Abstract

This article focuses on the effects of a so-called "basic network" for the transport of hazardous materials by rail and its (dis)advantages. The basic network offers authorities an easier to use framework for external risk policy as well as an easier framework to analyse at the municipal level the possibilities for urban development and communicate risks to civilians from an external safety policy perspective. However, there are still a number of disadvantages that should be taken into account. In this article five disadvantages are addressed. The first disadvantage is the fact that in the future the proposed limited numbers for transport are in certain parts of the network higher than currently and thus allow volume growth. Secondly, problems may occur if the transport numbers are fixed on basis of law. The third disadvantage is that some existing problems with external safety due to too much transport may be politically neglected in the future. This may lead to the realization of vulnerable objects too close to important railways, resulting in higher overall risks. Fourthly, there is a shift in coordination of safety between the responsible ministries which have diverging interests. This can easily lead to conflicting policies on the transport of hazardous materials and urban developments. The final issue is that two-dimensional safety zoning cannot be applied in cases where the buildings are constructed above the infrastructure without taking into account the three-dimensional structure. The authors conclude that even though the intention of the basic network idea is a good one, other more structural measures are needed to reach the goal of a safer transport of hazardous materials and a less inhibited urban development.

Keywords: Risk analysis; Rail transport; Basic network

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1. Introduction

A shortage of land across the Netherlands has led to the development of design and construction techniques that enables intensive use of the limited space. In the last decade, the space available adjacent to and above the transport infrastructure – particularly railway tracks – has been used at a growing rate in city centres. In addition, line infrastructure for transport of hazardous materials is mostly also in use for passenger transport and therefore often crosses densely populated urban areas. The new development strategies of the Dutch Ministry of housing, spatial planning and environment regarding space in urban areas pay special attention to these issues. However, the Dutch spatial planning policy, which aims to intensify the use of space (VROM, 2001), may come into conflict with the intentions set out in the Fourth National Environmental Policy Plan, which states that additional (open) space is sometimes necessary to guarantee external safety (Raad voor de Verkeer en Waterstaat and Vromraad, 2003). However, this is difficult to implement since space is a scarce good in city centres.

The coordinating ministry, the Dutch Ministry of housing, spatial planning and environment has therefore introduced a number of projects in which large attention is given to external safety. These projects focus on urban developments necessarily adjacent to transport routes of hazardous materials, due to shortage of space. In most cases, these projects aimed at and resulted in a higher level of safety. Such projects include the KIEV-project in which problems related to external safety and the vicinity of station areas are monitored, the PAGE-project where external safety risks regarding railway yards are examined, or the test framework for external safety in the Dordrecht/Zwijndrecht railway zone where new possible solutions for external safety problems are being tested (see for example TNO, 2004; Ministerie van VROM, 2005).

In a quest for more physical safety for areas in the vicinity of rail transport nodes, the Dutch Ministry of transport, public works and water management has also developed a possible solution for the transport of hazardous materials by rail. This article focuses on these new developments, mainly aiming at the creation of a 'Basic Network' for the transport of hazardous materials. Despite the fact that this basic network will be introduced for rail, water and road transport, the focus of this article will be on the rail network, because the ideas on this network already, at least on paper, are further elaborated than for the other modes.

The reason to come to this article is that in the considerations in the Dutch house of representatives a great amount of disagreements existed and a number of proclaimed deficiencies were detected in the plans for this basic network. The association of the Netherlands municipalities wrote a pressing letter on the topic of the basic network in which they stressed possible future problems for the municipalities concerning the new approach (VNG, 2006). In the discussion in the house of representatives, it also became clear that the coordinating note transport of hazardous materials, in which the basic network is presented as a main principle, had numerous omissions and obscurities (Tweede Kamer, 2006; Schraver, 2006). After this discussion, the minister responsible was forced to revise her proposals in order to reduce the potential negative aspects. Basically, all parties agreed upon the need for a safer transport of hazardous materials by rail.

This article aims to discuss the original proposal and reflect on potential advantages and disadvantages. In Section 2, a short introduction on Dutch risk policy will be given, which is followed in Section 3 by its theoretical and practical problems. Hereafter the plans for the basic network will be discussed in Section 4. In the Sections 5 and 6, the advantages and disadvantages of the basic network will be given respectively. In Section 7 some conclusion will be dawn and some reflection will be given.

2. Dutch risk policy in a nutshell

In the Netherlands, regulations for land-use planning in the vicinity of major industrial hazards are explicitly risk-based. This implies that potential adverse physical effects of incident scenarios are considered along with their probability of occurrence and their possible impacts. One of the main reasons for implementing the risk policy is simply the shortage of space, as a result of which the optimal space according to the effect distance of a worst case scenario between a risk generating activity and urban development cannot be achieved. Three main elements constitute the Dutch regulatory risk framework. These elements are: (i) quantitative risk assessment, (ii) the adoption of individual and societal risk as risk-determining parameters and (iii) acceptability criteria for individual and societal risk. Besides these criteria, the ALARA-principle is adopted, implying that although in a certain situation the formal risk standards are met, efforts should be made to further reduce the risks up to levels that are as low as reasonably achievable. Whether additional investments in risk reduction are reasonable is determined by implicit or explicit societal cost-benefit analysis (Vrijling et al., 1998).

Basically, risk consists of three components: the scenario, the probability of this scenario and the consequence of the scenario (Kaplan and Garrick, 1981). Risk is described in the Dutch policy practice as the formula: the probability of an accident multiplied by its effect. This is the most frequently used definition in risk analysis. In practice, transportation risks with hazardous materials are estimated with several mathematical quantitative risk assessment (QRA) models, resulting in a presentation of the risk picture. One of these QRA models used in the Netherlands is the so-called RBMII model (Ministerie van Verkeer en Waterstaat, 2006a). This standardized model is free of use and distributed by the Dutch Ministry of transport, public works and water management. This is done to satisfy a need for a relatively simple, standardized and validated method to calculate relevant risk values (Ministerie van Verkeer en Waterstaat, 2006b). This model is assumed to be the benchmark model for all risk analyses to be made regarding transport of hazardous materials, except for highly complex non-standard situations, such as risk calculations in case of a building realized above the infrastructure (Ministerie van Verkeer en Waterstaat, 2006a; Suddle, 2004).

The RBMII model uses many more assumptions in its calculations than just probability and effect, but it basically boils down to the standard formula of risk of Kaplan and Garrick. The model considers input parameters such as accident frequencies, the speed of the train on the considered rail track, the amount of level crossings, the amount of track switches et cetera. The effect of a possible derailment is calculated by such variables as the amount and the type of hazardous materials released, resulting in physical effects on people, which depends on the amount and duration of people living in the adjacent area and the distance between the centre of the track and the built-up area.

The calculated data can be ‘visualized’ in two different ways. The first one is called individual risk (IR). This is the probability that an unprotected person dies due to an accident with hazardous materials per year on a certain spot when this person resides here a full year. The individual risk depends on the geographical position and is displayed in the form of iso-risk contours on a geographical map. The individual risk is thus not characteristic for any person, but only for the location for which it is calculated. Thus, the individual risk contour maps give information on the risk of a location, regardless of whether people are present at that location or not (see Fig. 1). The maximum allowed risk as laid down in Dutch law, is 1×10^{-6}. This means that an additional involuntary risk which is lower than once every million years is found acceptable according to Dutch policy. The second risk indicator generally applied in the Netherlands is group risk (GR). GR is defined as the probability per year that in an accident more than a certain number of people are killed. Group risk is usually represented as a graph in which the cumulative frequency of more than n fatalities is given as a function of N, the number of people killed. This graph is called the fN curve (see Fig. 2).

The calculations made for the IR and the GR are based on all possible scenarios. These scenarios are based on imaginary incidents with different types of transported hazardous materials. The effect of the transport of Category C3 materials (flammable liquids) is dominant for the IR-contours. Sometimes the effects of toxic

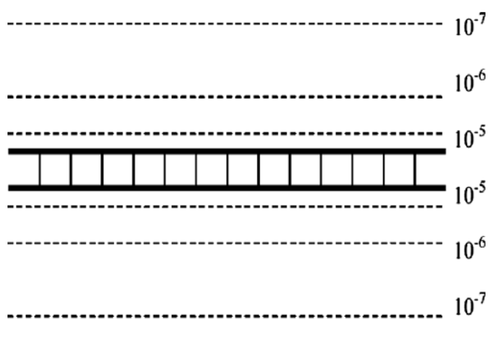

Fig. 1. Schematic visualization of Individual Risk near a railroad.

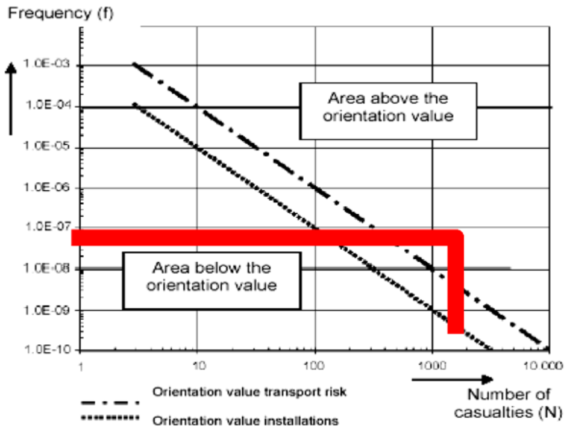

Fig. 2. Schematic reproduction of an exceeding of the Group Risk criterion.

liquids or flammable gasses are dominating (AVIV and Saxxion, 2005). Since the influence of the C3 category is dominant for IR-contours, the 10^{-6} contour appears to be hardly more than 30 m from the centre of the railway track. The theory behind this is that a leaking tank generally cannot create a pool (fire) with a diameter of more than 30 meters. Moreover, a minimum amount of more than 3000 tanks per year is needed to create a 10^{-6} contour outside the railway track. For the GR, the worst case scenario is a BLEVE (boiling liquid expanding vapor explosion). A BLEVE is the consequence of the failure of a pressure vessel containing a liquefied, mostly flammable, gas. The quick change of the liquid phase to the vapor phase goes hand in hand with a big volume increase, causing the explosion-effect. In the most cases, the evaporated gas is ignited, resulting in a fireball with an effect diameter of possibly more than 300 m causing large number of fatalities (Berg and Weerheijm, 2004). This scenario influences the GR value by more than 90%.

In the Dutch risk policy, the risk acceptance standards for the IR are included in legally binding rules. Therefore, vulnerable objects cannot be built within the 10^{-6} contour. However, the GR is rather an indication criterion with a so-called orientation value as decision standard. Fig. 2 shows two diagonal curves which represent the orientation value for GR installations (below) and transportation risk. When a calculated GR exceeds the orientation value, the acceptance of the GR must be motivated by local authorities. Economic aspects and repressive measures are widely considered in such a motivation. So, the orientation value is not binding by law and acts more as a guideline for policy-makers and planners to review their plans including safety aspects. Moreover, the decision-makers – mostly the local municipality – can weigh the risk (qualitatively) with e.g. economic or environmental aspects. It should be noticed that the decision-makers are juridical responsible for accepting the exceeded risk. In practice, the GR orientation values are generally taken into account when deciding upon new projects with relation to urban planning (Van der Heijden and Van der Vlies, 2005; Staatsblad, 2004).

There are around 40–50 spots (railway tracks and urban locations) in the Netherlands where the standards for group risks are exceeded (AVIV and Royal Haskoning, 2005). These situations generally contrast with the following rule of thumb. Due to safety considerations and given an acceptable level for group risk, there is in general an inverse relation between the population density and the number of transported dangerous goods in a specific area. This means that higher the number of transported hazardous materials, the lower the population density that can be allowed (see Fig. 3).

3. Problems in theory and practice

The previously indicated considerable exceeding of risk standards triggers various debates. We will address them in Section 3.

A number of objections can be made regarding the method of calculating risks. Several authors, such as Perrow (1999), Fischer (2003), Healy (2001) object to these risk calculations since they consider it a

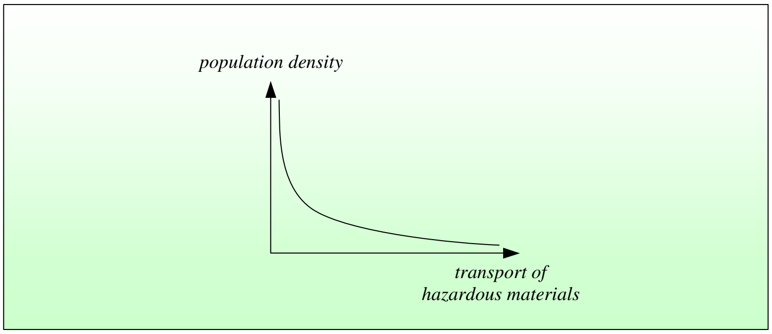

Fig. 3. Inverse relation between the population density and the number of transported dangerous goods. Suddle (2004).

technocratic rational way of risk management and design of risk policy. In their opinion, this way of managing risks is either a strategy designed to supply a technical rational basis for a centralized regulatory decision making (Fischer, 2003), a scientific weakness to provide an instrumental, calculative and purposive rationality (Healy, 2001) or complicated technical processes functionally woven together by networks of socio-organizational controls (Perrow, 1999).

To start with the last one: Perrow argues that it is not a matter of sheer risk calculations which should be the dominant matter. A risk of once in a million years does not mean that something cannot happen tomorrow. Apart from this, he points out that it is irrational from a calculative and a cost-effectiveness point of view to invest in the safety measures of e.g. nuclear safety, because it is much more expensive to save one life by making nuclear power safer than it is to make automobile driving safer. Besides, Perrow adds, normal accidents will always be possible, due to a possible failure of organizational controls.

Fischer (2003), Healy (2001) object to the quantitative rational view on how to manage risks. This means that, in their opinion, risk is more than just a number based on which one can decide on whether something is acceptable or not. To come to a better understanding of risks, Healy (2001) concludes that a more substantive dialogue between the natural and social sciences needs to be achieved. Fischer (2003) adds that it is also necessary to provide a framework for a more participatory approach due to which laymen can also speak out to risks. In addition, he notes that there is a lack of coordination between the technical and the social aspects of risk. This time it means there should be coordination between the quantified risk and the subjective side of the story, which is the opinion of the public on the question of what is acceptable. Even more studies can be found in literature, regarding similar and critical notes on the approach to calculating risk (see, e.g. Vlek, 1990; Suddle and Waarts, 2003). According to Bedford and Cooke (2001), the risk analysts must bear in mind that the calculation of a fN-curve/GR is based on uncertain data and hence is not more than a rough estimation, rather than an exact presentation of risk results. Besides, Laheij et al. (2003) showed in a benchmark exercise for a hypothetical establishment, wherein a comparison is made between five software tools available in the Netherlands for conducting a quantified risk analysis, that large differences in outcome exist among the used software. In addition to that, the presented models and results are simplified depictions of reality and will in fact be used to measure the effect on both human and economical risks regarding safety measures (Vrijling et al., 1998; Suddle, 2004).

According to the Fourth National Environmental Policy Plan (Ministerie van VROM, 2001), two main problems can be identified in practice. The first problem is a hollowing out of external safety policy due to an insufficient risk management. The second problem is a hollowing out of spatial development policy, because spatial functions are possibly planned on less desired spots (see also: Raad voor de Verkeer en Waterstaat and Vromraad, 2003).

Hence, the Dutch spatial planning policy, which aims to intensify the use of space, may come into conflict with the intentions set out in the Fourth National Environmental Policy Plan, which states that additional space is sometimes necessary to guarantee external safety. In order to prevent such problems, the following recommendations regarding the transport of hazardous materials by rail and external safety measures were made by the advisory council for transport, public works and water management in collaboration with the advisory council for housing, spatial planning and the environment (Raad voor de Verkeer en Waterstaat and Vromraad, 2003):

1. One should accept living in a risk society, but one still has to make a continuous improvement of the situation surrounding external safety: space in the Netherlands is an intensively used good and the public and political attention for safety is characterized by a swing movement. This means that the longer the time after disasters with many casualties, the lower the public and political attention for safety issues. In order to prevent this, actors should strive for a continuous improvement of external safety, by reducing risks and taking measures.
2. Create a sound basic level of safety but do justice to the diversity of opinions. It is not realistic to give each opinion as much weight as the other. However, the deliberation of several aspects must be transparent and well-balanced, because the system of quantitative risk analysis and singular norm standards do not comply.
3. Responsibilities and competences with regard to risk and external safety policy should be clearly allotted: continuous amelioration is the most important goal. Only then the norm standard should be an important instrument. Explicit assigning of responsibilities leads to the making of choices and consideration of different aspects of the structures of responsibilities. Hereby it becomes obvious who is responsible for what hazards and these persons are inclined to think along.
4. The responsibility of the causers of risks should come first: too often it seems as if the liability by the authorities is divided, because one may presume that the authorities should compensate for damages or losses. The responsibility, however, lies with the causer of the risk and this party is therefore responsible in juridical terms.
5. Decision making and communication should be transparent. Possible casualties often blame decision-makers for accidents. Risks must therefore be well explained to civilians. Underlying arguments must be clear, for which transparency is needed. This is hard to accomplish as long as the government has several 'roles' as risk regulator (legislator), risk causer and supervisor (Raad voor de Verkeer en Waterstaat and Vromraad, 2003).

These practical recommendations and the objections made in scientific literature form the context for the discussion on the basic rail network in the remainder of this article.

4. The basic network

The so-called basic network for the transport routes of hazardous materials was recently launched by the Dutch Ministry of transport, public works and water management. In fact, the basic network focuses on transport routes by road, railway and water. However, considering the scope of this paper, as mentioned before, we will focus on the railway track. The basic network categorizes the total amount of transport of hazardous materials by rail, measured in tank wagons, for the current and future railway tracks in the Netherlands. In this regard, a first elaboration on the basic network is given by the mobility policy document ('Nota Mobiliteit', Ministerie van Verkeer en Waterstaat, 2004). The mobility policy document states that the government is to create a basic network which consists of three types of routes with different importance to either spatial development or transport. Also, along the basic network a safety zone will be created within which limitations to certain activities will be set. A distinction is made between three main categories for transport of hazardous materials, with a different value of importance to either transport of hazardous materials or spatial development.

- Primary routes with unlimited transport of hazardous materials. Urban development has large limitations due to safety zoning.
- Secondary routes where transport of hazardous materials as well as urban development have their limitations.
- Tertiary routes on which transport of hazardous materials are limited and next to which urban development should not be hindered at all.

Table 1
Maximum allowed quantities transported on railway tracks per year per category for the basic network (Ministerie van Verkeer en Waterstaat, 2005)

Type of the transported hazardous material	Hazard identification numbers (Kemler codes)	Allowed amount of tank wagons transported per year		
		Category 2A railways	Category 2B railways	Category 3A railways
Flammable gasses (matter Category A)	23, 263, 239	12 500	2500	350
Toxic gasses (matter Category B2)	26, 265, 268 (except for UN 1017, Chloride gas)	6600	5400	1250
Highly toxic gasses (matter Category B3)	268 (in this case UN 1017, Chloride gas)	0	200	0
Highly flammable liquids (matter Category C3)	33, X33, 336 (except for UN 1093, Acrylonitril)	5000	4000	1250
Toxic liquids (matter Category D3)	336 (in this case UN 1093, Acrylonitril)	15 500	6300	1200
Highly toxic liquids (matter Category D4)	66, 663, 668, 886, X88, X886	1500	750	750

In November 2005, the note transport of hazardous materials was sent for approval to the house of representatives by the minister of transport, public works and water management (Ministerie van Verkeer en Waterstaat, 2006c). In this note, the names for the primary, secondary and tertiary routes changed into Category 1, 2 and 3 routes.

In the concept version of 12 December 2005 of the decision on the routing of the transport of hazardous materials by rail ('Besluit routering vervoer over de spoorweg van gevaarlijke stoffen'), a new distinction is made in five categories (**Category 1, 2A, 2B, 3A and 3B) (Ministerie van Verkeer en Waterstaat, 2005). The idea behind this distinction is still the same as in the mobility policy document, but now the nature and volume of hazardous materials to be transported is more specified. Category 1 and Category 3B are the extreme categories. For Category 1 railways there is still no limitation as to the nature and amount of hazardous materials transported. The Category 3B railways are free from transport of hazardous materials. These quantities form one of two central principles for the basic network, which is the 'user space'. For the categories 2A, 2B and 3A, the limitations are given in Table 1.

The combination of these principles, limiting volumes and the Dutch railroad network results in a map with the qualified railway tracks. Subsequently, the entire railway infrastructure in the Netherlands forms the basic network (see Fig. 4). Thus, all the Dutch railways are part of the basic network.

The other central principle of the basic network is safety zoning. This means that a static safety zone is created where no vulnerable objects may be built. Examples of vulnerable objects are hospitals, homes or schools, since the self rescue of people inside such objects is relatively low. This zone is assumed to be three-dimensional. Therefore constructions cannot cover the rail infrastructure, except for when the infrastructure is strengthened to withstand large explosions. The safety zoning is mainly meant for the category one railroads and is based on a pool fire, which has a maximum reach of about 30 m. Hence, the safety zone for Category 1 railroads is set to be 30 m. For Category 2 railroads, a smaller zone should be established according to the note transport of hazardous materials (Ministerie van Verkeer en Waterstaat, 2006, p. 16). In case an increase of the group risk is expected near category one or two railroads, a '*consideration*' should be made on external safety and the development plan up to a zone of 200 m from the rail track. Beyond this zone there are, in theory, no limitations for spatial development.

5. Advantages of a basic network

The basic network and the coordinating note transport of hazardous materials reflect an answer to the first and the last of the five recommendations made by Raad voor de Verkeer en Waterstaat and Vromraad (2003): (a) one should accept living in a risk society, but actors still have to make continuous improvements of the situation surrounding external safety and (b) decision making and communication should be transparent. This reflects the two following advantages.

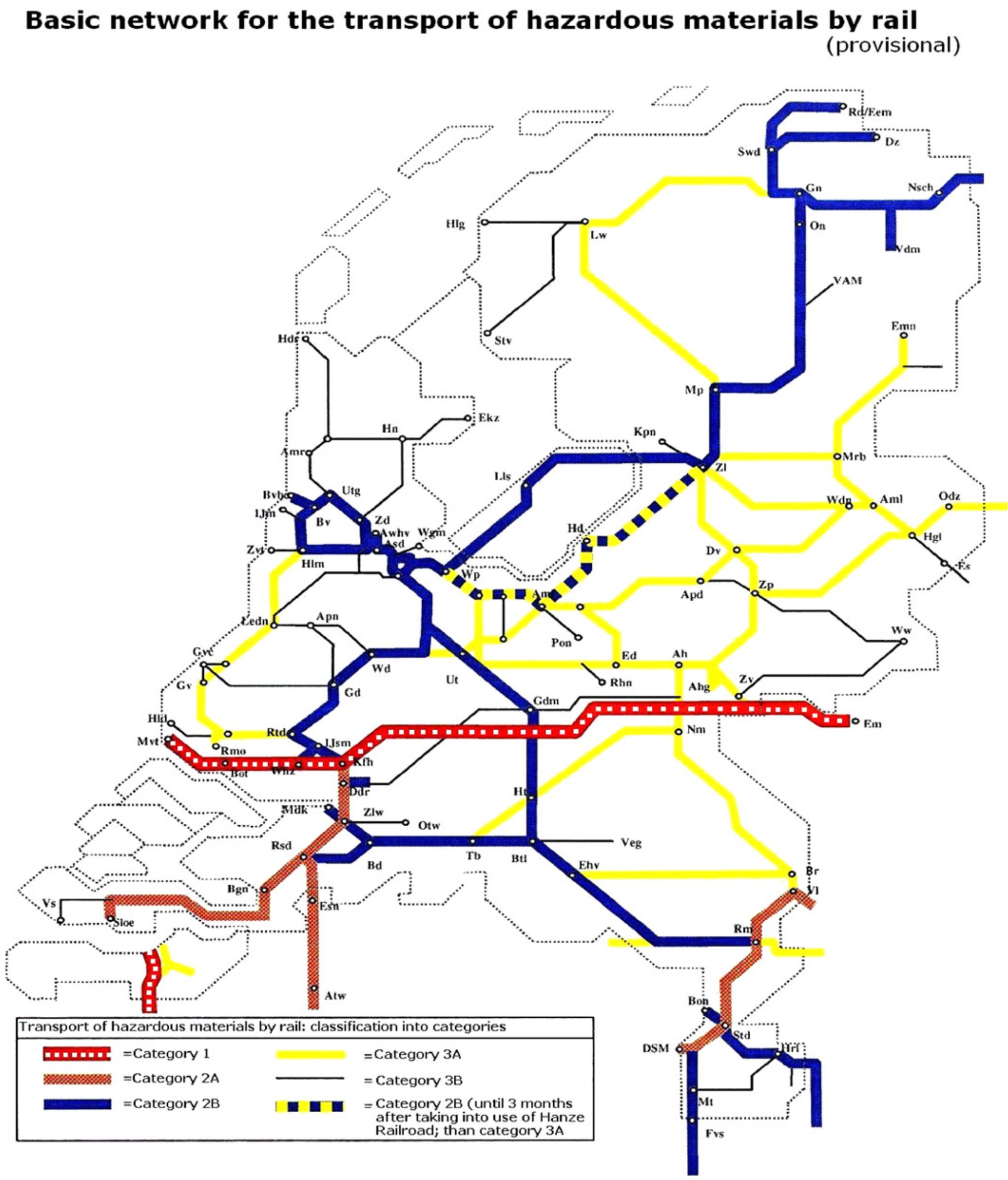

Fig. 4. Map of the Netherlands with the corresponding railroad categories (based on Ministerie van Verkeer en Waterstaat, 2005).

The first advantage of applying the basic network is the new approach on risk policy enabling solutions for bottlenecks in the rail network regarding urban development in the vicinity of those routes. This network provides a transparent overview of transport routes and transport volumes on those routes in the Netherlands on the one hand, while on the other hand it represents potential conflict locations where intensification of urban spaces is planned in the future near those routes. Structural measures such as the creation of a newly dedicated freight railroad, the Betuwe Railroad, does not seem to lead to risks as low as desired in Dutch policy (Van der Vlies, 2006). Since the use of the basic network will be less dependent on risk calculations, but more on monitoring the use up to the maximum amount of hazardous materials that are allowed to be transported, the basic network could be a strong tool to avoid technocratic rationalistic problems. In other words, the basic network could fulfill the need for a transparent risk policy, both for local governors (decision-makers on local spatial development) as well as policy-makers. Therefore, the possibilities of urban development adjacent to the railway track are possibly easier to analyse. However, this could also have a downside which will be mentioned in Section 6.

The note transport of hazardous materials also mentions that the Dutch government strives to permanently improve safety. This should be done through a thorough attention and registration of incidents, amelioration of legislation, good communication of risks and some specific measures (which are not important for the underlying case).

This brings up another advantage of a basic network: adequate risk communication between authorities and civilians. As is also expressed by Adriaansen (2006), it is hard to explain to civilians what safety and risk mean. Each human has his own view on safety. Especially estimates such as group risks or individual risks of for example, 3.4×10^{-6} are not easy to understand if you are not a specialist on safety or risk.

It becomes even more difficult when new calculations show that risks have increased due to adjustments to the model itself. For that matter it could be much easier to communicate to other parties or civilians that on certain railroads of the basic network an agreement on maximum volume of transport cannot be violated. The idea for a basic network could therefore serve as a tool for a more rational way of coping with risks. This is also the main notion of a recent report by the Dutch National Institute for Public Health and the Environment 'Coping rationally with risks' (RIVM, 2003), which argues that a less rigid and emotional way of regarding risks is necessary for a sound risk policy.

6. Disadvantages of a basic network

Unfortunately there are not only advantages to the basic network to be pointed out. The following disadvantages should be mentioned:

1. The proposed limits of the fixed numbers for transport are in the future for a number of cases higher than at the moment.
2. Possible problems may occur if the transport numbers are fixed on basis of law.
3. Some existing problems with external safety due to too much transport may be politically neglected in the future.
4. There is a shift in coordination between responsible ministries for safety.
5. The three-dimensional limitations of using the basic network.

Ad 1: The first disadvantage is the fact that the levels of allowed numbers for transport are in a number of cases higher than they are at the moment. The previously mentioned Table 1 shows the maximum amount (ceilings) of hazardous materials to be transported in the future on the designated railway tracks. When comparing these numbers with the present numbers, the future numbers will in some cases be much higher than in the present situation. Cities where the safety standards are already (highly) exceeded could face even higher risks due to doubled or even tripled transport volumes. Two examples are given to clarify this statement In the most recent transport figures, the cities of Roosendaal and Dordrecht had to deal with the transport flows as given in Table 2. In the same table, the allowed future situation is given:

It is not very likely that these figures will grow overnight, but what should be noted is that Roosendaal already has to deal with an exceeding of criteria for the group risk norm between a factor 3 and 10 in the present situation, while the current exceeding of Dordrecht is by more than a factor 10 (AVIV and Royal Haskoning, 2005). Since there is a linear interdependence between the amount of transported materials and the risk they cause, doubled transport will cause the risks to increase by a factor two.

For the group risk, this means that the risk of the dominant BLEVE scenario happening may increase due to the allowance of a larger transport of flammable gasses. This is also the most sensitive, thus difficult, subject for debate. As indicated before, with the new Note for the transport of hazardous materials, risk policy is being changed from qualitatively and risk-based to a more fixed situation with a maximum amount of allowed hazardous material transports. From the 'old' risk policy perspective, it would probably be a problem in terms of quantified risks to have these new and high ceilings. For the new situation it will of course not be a problem as long as the transport does not reach its ceiling.

It should be noted that not for all cities in the Netherlands, an increase of transport will be allowed and is necessarily required according to the Chain Studies ('Ketenstudies'). The survey of the KPMG et al. (2004) shows that on some routes in the Netherlands, the transport of hazardous materials at least will remain

Table 2
Example of transport figures in the present and future situation in Roosendaal and Dordrecht, two cities in the Netherlands (Based on: Prorail, 2005; Ministerie van Verkeer en Waterstaat, 2005)

Type of the transported hazardous material	Example one: the city of Roosendaal		Example two: the city of Dordrecht	
	Situation in 2003	Allowed future situation	Situation in 2003	Allowed future situation
Flammable gasses (matter Category A)	4500	12 500	6350	12 500
Toxic gasses (matter Category B2)	100	6600	100	6600
Highly flammable liquids (matter Category C3)	1850	5000	13 150	5000
Toxic liquids (matter Category D3)	400	15 500	1800	15 500
Highly toxic liquids (matter Category D4)	200	1500	1300	1500

constant or may even decrease in the future. For the cities along the so called Brabant railroad, a railroad in the southern part of the Netherlands which is used for passenger transport as well as all sorts of freight transport, the ceilings will be lower than the transport in the present situation. In the 'old' situation with calculated risks, this would however still imply that the risks will be too high according to the group risk norm (Van der Vlies, 2006).

Ad 2: The second disadvantage is a possible problem concerning the enforcement of these ceilings. The note transport of hazardous materials shows that the transport and water management inspectorate should monitors and promote the safety of transport by rail. Currently the monitoring and controlling of the most recent figures is done by Prorail, the Dutch rail infrastructure management agency, and is delayed or at least not done in real time. The present counting of the amount of transported materials is in fact a snapshot and consequently may vary in time. To give an example, the most recent transport figures for hazardous materials by rail in 2005 that were accessible to the public were the transport figures of 2003. Therefore, the maintaining of these transport ceilings is a hard nut to crack if it is only to be discovered that there are more hazardous materials transported than allowed, when the discovery is made months after the breach of the rules. It is plausible that these numbers could be more up to date, should this be obliged by the Dutch legislator, but for the moment there is no reason to either believe that there is political pressure or a political will to achieve this. Perhaps a possible registration by satellite is an option to register the amount of transported hazardous materials per track. However, this might have constraints regarding introduction of a registration system per vehicle for international transports (the so-called tracking and tracing system).

Ad 3: A third possible disadvantage could be a possible problem in time. This means that what is forbidden or from a policy perspective less desired now could be viewed upon differently in the future. As is also stated by the Raad voor de Verkeer en Waterstaat and Vromraad (2003), the attention to safety is characterized by a swing movement. Presently, the attention for risks and external safety is very serious due to various disasters in the recent past. This could easily be less in the future. It is neither unfounded nor absurd to believe that a policy of tolerance could originate from this attitude, because of which, due to a scarcity of building space, building near Category 1 railroads will in practice be tolerated. It is therefore a serious possibility this could eventually lead to an undermining of external safety policy.

Ad 4: The fourth possible disadvantage is the relation between the two leading ministries. Formally, the Ministry of housing, spatial planning and the environment is responsible for the coordination of external safety policy (Ministerie van VROM, 2006). For the basic network, however, the ministry responsible is the Ministry of transport, public works and water management. Both stakeholders have different interests. The question is whether or not there is room for two captains on one ship. It is plausible that this could lead to conflicting policies on the transport of hazardous materials as well as urban developments. This is especially the case since the Ministry of transport, public works and water management has, in the context of their plan for the basic network for hazardous material transport, announced the spatial zones near the railroads. As argued, this could have large implications for spatial planning when the regulations are well observed, which is the policy area of the Ministry of housing, spatial planning and the environment. This problem is even more complex if different ministries with different stakes are involved in safety issues in the Netherlands as presented in Table 3.

Table 3
Coordinating ministries are responsible for different kind of safety issues

Category	Object exposed to risks	Ministry
Internal safety	Personnel users	Social affairs and employment
	Passengers	Transport, public works and water management
External safety	Third parties	Housing, spatial planning and the environment

Ad 5: The final issue which should be considered using the basic network is that two-dimensional safety zoning cannot be automatically applied in cases where the buildings are constructed above the infrastructure without taking into account the three-dimensional physical structure. The static safety zone where no vulnerable objects may be built is discussed in the basic network as a two-dimensional parameter. However, Suddle (2004) showed that physical and structural aspects determine the risk-reducing effect of a probable scenario with transport of hazardous materials. So, one may conclude that safety zones in the third dimension (perpendicular to the ground) largely depend on the functional section of the covered infrastructure along with the mitigating measures taken on the boundaries of the building above the infrastructure. E.g. if a simple fire protecting layer is applied on the boundaries of the building above the infrastructure (let say 5 m form the ground level), this may reduce the height of the pool fire from 30 m to 5 m. Hence, safety zones in the third dimension could be in some cases lower if simple measures are implemented. This means that safety zoning in the third dimension needs to be reconsidered before taking this aspect into account.

7. Conclusion and discussion

In a need and a quest for a safer transport of hazardous materials by rail, the Dutch government has come up with a new possible solution for problems concerning the exceeding of risks in built-up areas in The Netherlands. The basic network, an idea mentioned for the first time in the mobility policy document and more detailed in the note on transport of hazardous materials and a couple of provisional documents from the Ministry of transport, public works and water management, should serve as this solution. Due to the problems on the Dutch railroad concerning external safety, a new way of viewing problems could prove to be a good first step in the direction of solving problems regarding external safety policy. Because it is presumed easier to communicate to other parties and stakeholders or even civilians that on certain railroads of the basic network a maximum amount of transport cannot be exceeded, instead of using the language of risk management which uses risks of once every million years, the idea for a basic network could also serve as a tool for a more rational way of looking to risks.

Despite all the positive remarks, the disadvantages are not to be overlooked easily. Especially the allowed increase of transport of hazardous materials is rather dubious: it depends on the political arena in the future and the snapshots taken for the transported amount of transport of hazardous materials. Of course, when the policy changes into a policy limited by ceilings, the new policy is leading and the 'old' policy will be replaced.

Another large point of concern is the apparent shift in coordination from the Ministry of housing, spatial planning and the environment to the Ministry of transport, public works and water management. Not only is there the concern of two captains on one ship, but moreover there is a concern on the different interests the both ministries represent and the possible conflict it could create. The other two disadvantages are also to be taken seriously. However, it is to this moment hard to tell how these possible disadvantages are to evolve. At the moment, a lot of attention is paid to external safety and it is therefore unlikely that municipalities will build vulnerable objects too close to category one railroads. Nevertheless, as stated before, the attention paid to safety policy is characterized by a swing movement.

Another reservation should be made regarding all of the stated before. Because there is still no final and approved concept of the note transport of hazardous materials and its main component, the basic network, all of the preceding is not certain yet. This can only be determined when the definitive plans are approved.

Finally, safety zones in the third dimension could be lower in some cases if simple measures are implemented. This means that safety zoning in the third dimension needs to be reconsidered before taking this aspect into policy advice.

All these comments and remarks seem to lead to a conclusion that despite the positive intentions and applications of a new approach to external safety, a definitive new and desired policy is yet to be developed. In general, one can say that a new institutional design is hard to make overnight and should not be regarded as a simple task as it is closely linked to a number of policy fields. However, it cannot be denied that for a new way of coping with risks this is a welcome initiative. Nevertheless, one can say that the institutional design leaves much room for different interpretations on how to deal with risks, especially when two powerful different actors (the two ministries) with opposing interests are involved. For this reason and all the others as mentioned above, the authors welcome a new approach but nevertheless feel the need for a better elaboration on risk policy in general and, more specific, to the transport of hazardous materials by rail. In future publications the authors hope to contribute in this need.

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