Lowering transport risks with the basic network: An adequate institutional shift or an insufficient change?

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Abstract: This paper 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, the feasibility of safety measures in accordance with the basic network must be implemented in the laws as it has some disadvantages. In this regard, some feasibility aspects of safety measures were analyzed. In this paper, we analyzed if the basic network for rail transport is a sufficient way for controlling risks. Besides these matters of feasibility of safety measures, there are also two challenges introduced in this paper. First of all, safety integrated design engineering in which safety measures are integrated in the functional and structural building design of in the vicinity. Safety integrated design engineering makes it possible to save costs and to make both activities - transport of hazardous materials and urban development adjacent to these transport routes - possible. Secondly, some suggestions were made in which the focus on other rules and institutions must be instead of trying to find loopholes in the present rules for external safety.

Keywords: Risk analysis; Rail transport; Basic network, Transport of Hazardous Materials.

1. INTRODUCTION

Every policy is based on a set of basic assumptions. In the social sciences these policy assumptions are often referred to with the concept of 'policy theory'. A policy theory can be defined as the whole of hypotheses and assumptions combined that underlie a certain policy [1]. These policy theories are something different than scientific theories on policy, and involve the reconstruction of the assumptions of policy makers. These assumptions of policy makers could even regard to social aspects - such as the behavior of persons or groups-, but also to the functioning of organizations or to economical aspects of policy. These assumptions often concern causal relations (cause and effect relations) and final relations (goal and means relations). Apart from these relations, normative relations are also important in policy theories. These relations are based on (political) principles, norms and values on the one hand and expected, existing or intended situations on the other and are also called institutions. According to North: "*Institutions are the humanly devised constraints that structure political, economic and social interaction*". They consist of both informal constraints (sanctions, taboos, customs, traditions and codes of conduct), and formal rules (constitutions, laws, property rights)" [2].
Daily interactions between policy actors are assumed to gradually develop into more or less stable patterns, which may also include the substantive delineation of the problem at stake and its possible solutions. This could also involve, however, the processes between the actors and the formal and informal rules according to which these processes take place. These processes are usually referred to as institutionalism [3]. In the Netherlands, balancing the transport of hazardous materials on one hand and urban development adjacent to these transport routes on the other, the external safety policy is created to control risks.

One may expect that such a policy may also take both the formal and informal institutions into account. However, this is not always the case and in case that these are considered there is no streamlined policy which promotes an easier and rational decision-making process.

A shortage of land across the Netherlands has also 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 centers. 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 [4], 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 [5]. All these processes are institutionalizations of risk mitigation strategies. In the following, we will see whether or not the plans for a *'basic network'* for rail transport is a sufficient way for controlling risks, or that it has some flaws to overcome. We will argue that the way institutions are designed and used is reflected in the level of risk. Furthermore, this paper is meant to shed some light in one of the key plans by the Dutch authorities to control transport risks concerning the rail transport of hazardous materials by designing and implementing institutions for the basic network.

2 INSTITUTIONS AND TRANSPORT RISKS

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 a 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 group risk as risk-determining parameters and (iii) acceptability criteria for individual and group risk. Basically, risk consists of three components: the scenario, the probability of this scenario and the consequence of the scenario [6]. Risk is described in the Dutch policy practice as the formula: the probability of an accident multiplied by its effect. This is therefore the most frequently used definition in Dutch risk analysis.

Safety measures are implemented to increase safety levels to a certain level. There are several measures that can be implemented against critical scenarios in such projects. Risk assessment consists of the use of all available information to estimate the risk to individuals or populations, the environment or property from identified hazards and compares this with targets and search for solutions [7]. In risk assessment, generally some effort is made regarding scenario development, whereas most emphasis is put on frequency analysis and risk calculation [8]. In this respect, risk management is the application of risk information as an integrated part of the management process, including interaction with external bodies [9].

In order to reduce the risks concerning the transport of hazardous materials by rail within the boundaries of the risk criteria, technical measures are generally taken. For example, if the risk exceeds the norm on a certain location, measures taken are for example the decreasing the maximum speed, removing track-changes from a certain part of the railway track or preventing the dispersion of hazardous substances [10]. These technical measures then reduce the risk of transport with respect to urban planning, due to the fact that either the probability variable or the effect variable (or, of course, both) are lowered. In practice, however, still problems occur with this more technical approach as the norms that are set for this so-called External Safety Policy are exceeded in several cases [5,11].

3 NEW INSTITUTIONS: THE CASE OF 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', [12]). The Mobility Policy Document states that the government is to create a basic network which consists ofthree 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 is limited and next to which urban development should not be hindered at all.

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	12500	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, 33*, X33, 336 (except for UN 1093, Acrylonitril).	5000	4000	1250
Toxic liquids *(Matter category D3)*	336 (in this case UN 1093, Acrylonitril).	15500	6300	1200
Highly toxic liquids *(Matter category D4)*	66, 663, 668, 886, X88, X886	1500	750	750

Table 1: Maximum allowed quantities transported on railway tracks per year per category for the Basic Network [14]

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 [13]. 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) [14]. 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 following limitations are given:
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 Figure 1). Thus, all the Dutch railways are part of the basic network.

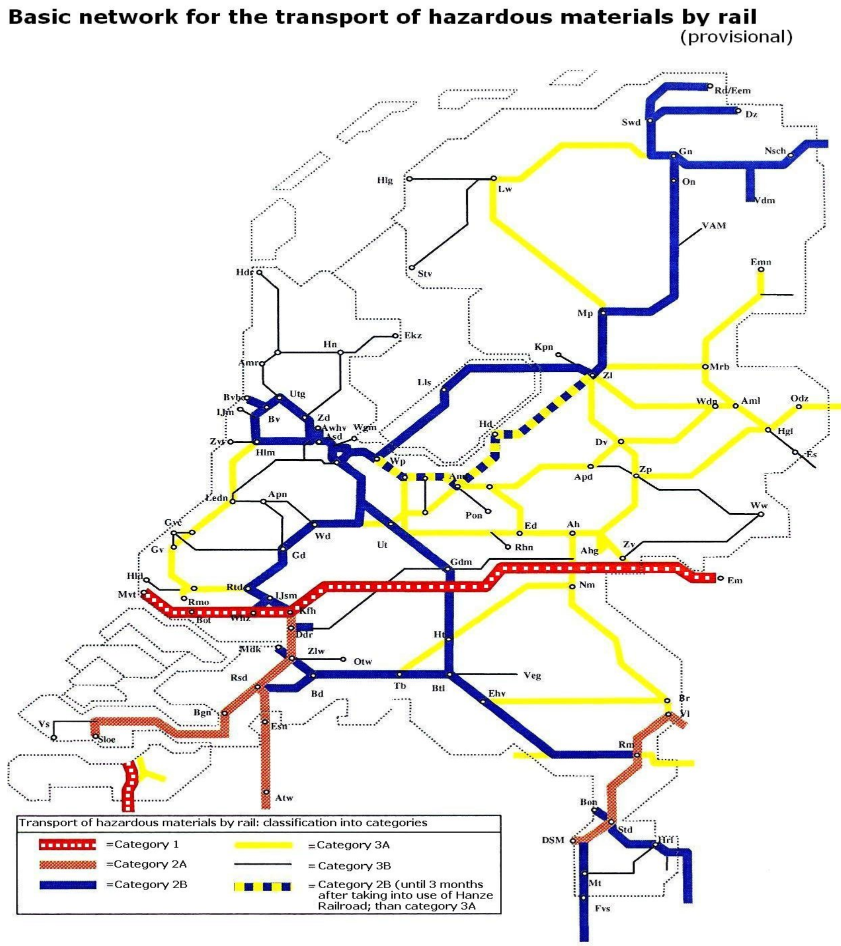

Figure 1: Map of the Netherlands with the corresponding railroad categories (based on [14])

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 thirty meters. Hence, the safety zone for category 1 railroads is set to be thirty meters. For category 2 railroads, a smaller zone should be established according to the Note Transport of Hazardous Materials [13]. 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 meters from the rail track. Beyond this zone there are, in theory, no limitations for spatial development.

4 FEASIBILITY OF THE MEASURES

The Basic Network has advantages as well as disadvantages (for an overview see [15]. It is however the question whether these newly developed plans are able to become institutionalized into new policies or legislation. Questions arise surrounding the feasibility of the network and the expected transport figures. The questions surrounding the feasibility are based on the following points of concern:

1) International institutions (directives, legislation) form the starting point for the basic network:
International laws and directives such as the free transport of goods directive and the *'**A**ccord européen relatif au transport international des marchandises **D**angereuses par **R**oute'* (ADR) and the *'**R**egulations concerning the **I**nternational Carriage of **D**angerous Goods by Rail'* (RID). These institutions are of course very important for regulating transport and making transport safer. However, especially the free transport of goods directive is of concern when it comes to safety. Due to this directive, transporters are free to transport their goods from place A to B for international transport. Routing is only possible when authorities have a sufficient alternative and have taken counter measures [16].

2) Market expectations on which the basic network is based are already out of date:
In a recently published market expectation (December 2007), the rail network administrator, Prorail, came with future transport figures for the period until the year 2020. These transport figures are actualized numbers for the so-called 'policy free market prognosis 2003'. The latter forms the basis for the transport ceilings on which the routes of the basic network are based. At first, it seemed that the transport ceilings were much higher than the market prognosis of 2003 deemed necessary. However, the actualized market prognosis of 2007 now shows even higher numbers than the transport numbers on which the basic network is based. It would lead to too much detail to prove this point by picking out all the places on the network. A quick reference is, we think, sufficient for making this point by using the flammable gasses as an example.
The Brabantroute is a transport and passenger route in the southern part of the Netherlands (for more information see [17]) and due to a number of problems with high risks categorized as a 2B route on Figure 1. Table 1 shows that this means that not more than 2500 wagons of flammable gasses may pass here. However, the minimum expectation for this route in the future is 11260 wagons, with a maximum of 14110. Even if this transport route is categorized as a 2B freight category, this could lead to an institutional problem even before the basic network is taken into use. This leads to a paradox, which is that the responsible Ministry forms new policy that could already be outdated before it is even implemented. This also leads to another problem.

3) Group risk considerations should still be made:
Due to the fact that Group Risk considerations should still be made for category 2 and 3 railroads, a problem arises when the transport figures increase so drastically. Due to the way risks are modeled, an increase in the transport of hazardous materials leads to a higher risk as the probability of a disaster increases. When a local authority wants to develop its territory near a transport route, it also increases risk (if there are more people present near the transport route) due to a higher possible effect. There is, however, a problem. Due to the European directives, there are hardly any limits to transport of hazardous materials. Hence, transporting parties are allowed to freely transport there materials through the territory of local authorities. Local authorities, however, cannot freely develop their territory as they need to meet with the rules surrounding the Group Risk criterion. At present, this is of course also the case. Due to the foreseen increase of transport however, this will become much more difficult than it even is at present.

4) Permanent amelioration of safety is not embedded in the decision-making process:
A much heard complaint of transporting parties is that they meet all the European safety standards and still need to do more about the safety of their packaging materials. Besides this complaint, it is also very difficult to meet higher standards without doing damage to the competitive position of the transport parties. When a national government demands higher safety standards this could be contradictory to the European directives. Also, the costs for the implementation of measures are only necessary for a small part of the covering area of the wagons. As wagons travel throughout the whole of Europe, extra demands for safety are only necessary for the national territory of the Netherlands.

5 CHALLENGES

Besides these matters of feasibility, there are also two challenges that should be taken into account before the basic network is taken into use.
First of all, Suddle [18] introduced a new way of dealing with external safety problems in relation with urban development. He suggests to integrate the safety measures in the functional and structural design of (the buildings in) the vicinity, in order to save costs and to make both activities - transport of hazardous materials and urban development adjacent to these transport routes - possible. Especially safety measures to buildings adjacent to transport routes with hazardous materials can be integrated in the safety zone (see an example hereof in Figure 2 [18]).

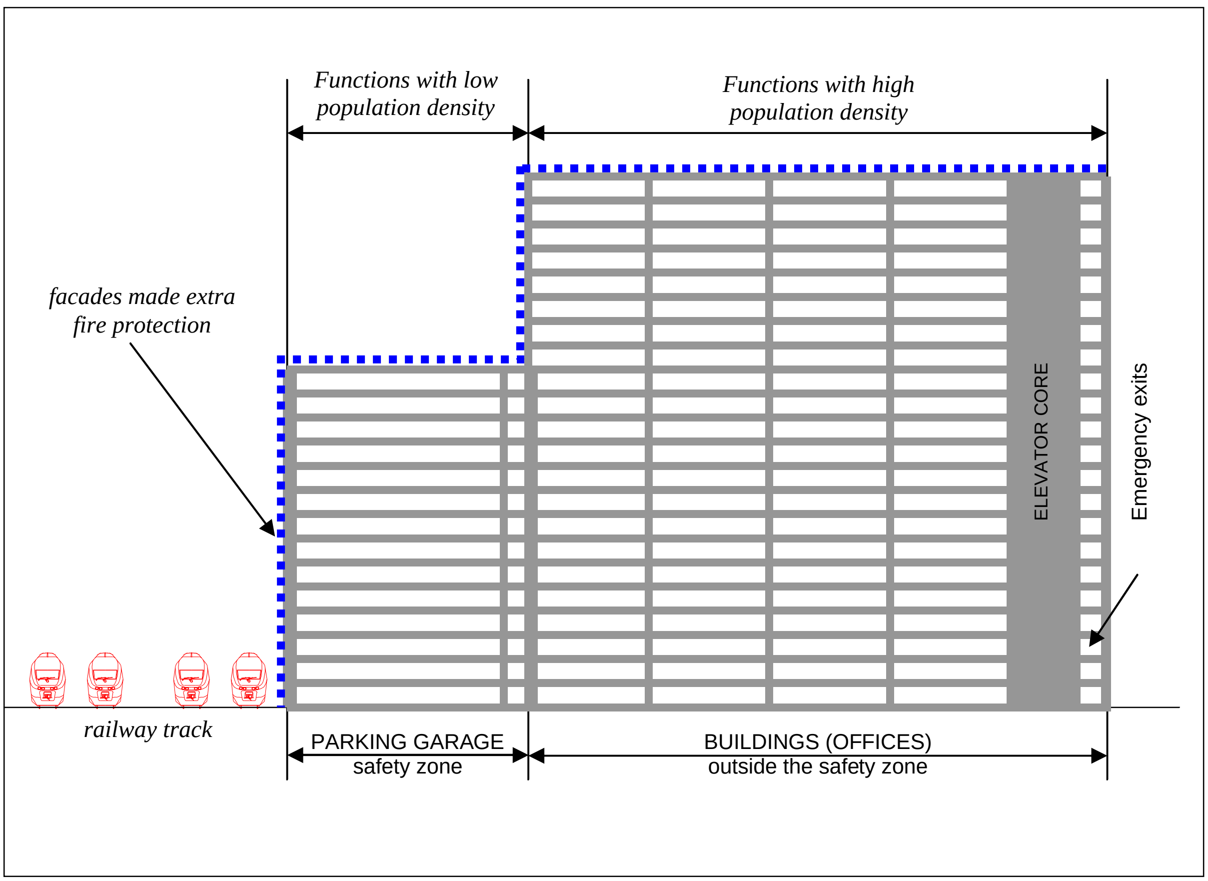

Figure 2: An example of safety integrated design engineering [18].

However, there is less knowledge in literature on this safety integrated design engineering. Some literature can be found on this topic, see e.g. [10, 19]. Furthermore, the risk reducing effect per measure has to be compared with the investments in that measure, because of efficiency considerations.

In this regard, the cost effectiveness of the safety measures is an important issue in safety integrated design engineering. When focussing on the Basic Network, safety integrated design engineering must be integrated in the development hereof, in order to implement such measures more effectively and on basis of law. Besides this, it also makes the group risk considerations much easier and legitimate, in which proper solutions are considered in the decision-making process. This methodology can support the decision-makers in a broader sense. Without these indications, it is difficult for decision-makers to decide rationally.
Secondly, there should be a focus on other rules and institutions instead of trying to find loopholes in the present rules. In earlier research done by the Dutch Institute for Public Health and the Environment [20] asked for a more rational approach to risks. Van der Vlies [21] made clear that the risks are not to be exaggerated when it comes to transporting hazardous materials by rail. In this respect, it is not strange that other suggestions are made surrounding possibilities for a new institutional framework [22]. Therefore, the whole present framework should be critically looked at to see whether or not it sufficient for the present and the future in transport.

6 CONCLUSION

Institutions determine how actors in a policy field can behave. In this paper we have presented a new policy goal by the Dutch Minstry of Transport, Public Works and Water Management for controlling risks surrounding the transport of hazardous materials by rail. We have argued that this framework has problems surrounding the feasibility. Also we have shown that there are challenges to overcome, before the Basic Network can serve as a real solution for risk problems. Therefore, we suggest that before the Basic Network will be an act of law, the responsible authorities take a really good second look at it. Otherwise, the risk of the Basic Network being superseded within the first few years that it is functional is too great. In order to make the basic network more useful for both the transport of hazardous materials and urban development, particular solutions, such as safety integrated design engineering, should be a judicial part of the basic network. This enables proper solutions to external safety policy and a streamlined rational decision making as well.

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