Urban planning and rail transport risks: Coping with deadlocks in Dutch urban development projects

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1. Introduction

The general debate on involuntary risks has intensified since the 1980s. In the Netherlands, this is due to some large incidents among which the crash of a Boeing aircraft in a large apartment building in Amsterdam in 1992 with 43 casualties among residents and the explosion of the SE Fireworks production plant destroying a complete neighbourhood in the city of Enschede in 2000, killing 23 people. Risks related to rail transport of hazardous materials received particular public attention after several near misses with freight trains in the cities of Tilburg (2007) and Barendrecht (2009, 2011) for example. Moreover, De Wilde (2006) argues that more than in other European countries, rail transport of hazardous materials in the Netherlands is organised right through city centres, creating a strong interaction between rail transport, urban planning and the (re)development of real estate near railways. However, this growing Dutch awareness is not unique. Other disasters involving hazardous materials have occurred internationally in recent years. The city of Viareggio (Italy) experienced a so-called vapour cloud explosion after a derailment discharged liquefied petroleum gas (LPG) from a tank wagon in June 2009, causing 27 casualties.

Due to these disasters, society has become more aware of the risks involved in the production, storage and transport of hazardous materials. In the Netherlands, this has led to more attention for the institutionalisation of risk management approaches in order to prevent disasters and improve the safety of people in areas adjacent to risky activities. This is formalised in what is known in the Netherlands as external safety policy. External safety policy aims to control the risks related to the production, storage and use of hazardous materials (for instance: fireworks, liquefied petroleum gas, ammunition), the transport of hazardous materials by road, rail or water and through pipelines, and the use of airports (Ministerie van VROM, 2006). The basis for the Dutch external safety policy is constituted by generic norms for acceptable external safety levels.

The first way to describe risk is in terms of individual risk (IR) (see Fig. 1). This is the annual probability that an unprotected person will die as a result of an accident involving hazardous materials at a certain spot if that person resides there for a full year. The risk is visualised on a map by dots interpreted as spatial contours. The maximum allowed risk for ‘new’ situations as laid down in Dutch law is \(1 \times 10^{-6}\).

The second way to describe risk is in terms of group risk (GR) (see Fig. 2). This is the cumulative probability for each year that at least 10, 100 or 1000 people die as a direct result of their presence in the influence area of an establishment or transport route if an incident happens with hazardous materials. This is visualised on a logarithmic scale by using the \(fN\) curve, where \(f\) represents the frequency of an accident and \(N\) the number of people expected to die as a result of that accident.

It should be noted that there are of course more ways to conceptualise risks, such as in economic loss, catastrophic potential or the number of potential injuries. Dutch safety institutions
however, have a very strong emphasis in the number of potential casualties. Therefore, in the following we will also elaborate on the number of potential casualties instead of other potential risk criteria.

In the Netherlands the issue of rail transport of hazardous materials in interaction with urban planning receives relatively much attention. According to an Environmental Resources Management (ERM) study (2005), the approach to risk management in the Netherlands is unique to some extent due to its strong focus on the forementioned generic standards. Moreover, Dutch authors stress the differences between the Netherlands and other countries due to some unique spatial characteristics. Perhaps because of this somewhat distinctive position of the Netherlands in this respect, almost only Dutch authors seem to explicitly address external safety in relation to urban planning. Suddle (2004, 2006, 2008), van der Vlies and Suddle (2008), for example, focuses on measures to reduce the possible impact of disasters on the built environment, whereas research performed by Ale (2002, 2003, 2005) focuses more on the performance of risk institutions in the Netherlands. In contrast, authors from a variety of nations focus on quantitative aspects of release of toxins or quantitative aspects of routing. Examples of the latter are Glickman and Rosenfield (1984), Verter (1998), Leonelli et al. (2000), Høj and Kröger (2002) and Verma and Verter (2005). Also, this does not imply that there are no similarities concerning risk management. In Europe, the Seveso directive aims to improve the safety of sites containing large quantities of dangerous substances and strategies for urban planning to improve safety (see for example Cahen, 2006 or Basta, 2009).

The considerable attention to the issue of transport and external safety resulted in a unique document published in 2003 by the Dutch National Advisory Boards on Transport and Spatial Planning on the (problems with the) integration of external safety policy, transport policy and urban and regional planning (Raad voor Verkeer en Waterstaat en de Vromraad, 2003). In this report an analysis is given of the trends, the complex institutional contexts and the problems of integrated policy development at different government levels. The report warns for future incidents and calls for innovative (mainly institutional) solutions. In a recent study (van der Vlies, 2011), initiated in reaction to this 2003 report of the advisory boards, some possible approaches for improvement were explored. The study mainly focused on the structure and impacts of relevant institutions in relation to the rail transport of hazardous materials in connection with local urban developments. It was hypothesised that the present institutions to some degree create an obstacle for finding good solutions for the tensions between the transport domain and the urban planning domain, tensions that often result in policy deadlocks in decision making in day-to-day reality. Changing the institutions might be helpful for unfreezing these deadlocks, reframing the local debate and finding attractive and widely supported solutions.

This article aims to present some of the findings of this study. The structure is as follows. In Section 2, the main problems with decision making in relation to the institutional setting are summarised, based on the exploration using different methods by van der Vlies (2011). In Section 3 an adapted view on rail transport risks
management in relation to urban development will be presented. The impacts of this adapted view are explored in an experimental context using simulation games. The set up are described in Section 4, the main results in Section 5. The article ends in Section 6 with conclusions and a brief discussion on the results.

2. The institutional problem

The first part of the study of van der Vlies (2011) explores the problems of decision making on urban development in areas adjacent to railways accommodating hazardous material transport. Three methods were applied: document analysis, a study of six cases in Dutch cities and workshops with experts from practice. Based on these analyses, six different problem categories in the practice of decision making are identified.

The first category concerns problems related to risk modelling. In practice, local governments are obliged to make risk calculations in the context of the environmental impact assessment for planned larger projects. There are numerous problems related to the, for this purpose prescribed, risk calculation model (called RBMII). These problems are due to what is qualified as the ‘black box’ nature of risk modelling and the use of the calculated risks in policy practice. It appears to be difficult in practice to understand how the complexity of risky situations is modelled, how the risk levels are calculated and how the results should be interpreted (for an overview of all the benchmarks, criteria and rules for the RBMII model, see Ministerie van Infrastructuur en Milieu, 2011).

With regard to the second category (problems related to the use of risk norms), the observation is that the norms for allowable risks are difficult to interpret and to control in practice. The norms are debatable and subject to different interpretations: norms are often exceeded in practice, and there are few possibilities to prevent this. The consequence of violation of norms is that the options for urban development are less limited. Therefore, local authorities tend to interpret the results of risk calculations in favour of the local interests of urban development.

The third category stresses problems related to risk perception. A negative perception is more easily created than confidence that a situation is safe. Near misses, for example, receive a great deal of media attention. Moreover, it appears difficult to communicate to other parties about risks (generally in terms of the rather abstract notion of probability on incidents with particular size of impact). There is no evident strategy to create positive attention to the way risks are reduced.

Problems related to uncertainty about transport flows constitute the fourth category. Stable and reliable forecasts are important to create a trustworthy picture of future risks in urban areas. Risk calculations largely depend on how much material is transported. However, at present the available forecasts are experienced as being unreliable and actual data appear in practice often not available or not up to date. Moreover, the transport of goods is in principle unlimited within the EU. Consequently, figures on the transport of hazardous materials in The Netherlands differ significantly from year to year (see for example Prorail, 2003; Prorail, 2005, 2006, 2008). The resulting uncertainty has a direct consequence for the reliability and the usability of the calculated risk for deciding on a certain spot along the network.

The fifth category stresses problems related to governance issues: local authorities hesitate too often to take responsibility to reach decisions, whereas at the national level authorities put too little effort into harmonising relevant institutions.

The final category concerns problems related to conflicting interests. The various corporate actors involved in decision making (transport companies, real estate developers, local authorities, railway station managers, rail infrastructure managers, fire fighting organisations) have different, often conflicting, interests. This is not only caused by different goals, but may also be strengthened by the way in which the different policy fields are institutionalised. Reaching the goal for one actor (for example more transport in favour of transport operating companies) means more problems for another actor (for example less real estate development options for the municipality because of an increase of risks).

Due to these problems, decision making with regard to external safety issues concerning urban development and rail transport of hazardous materials is rather complex. In certain cases this might result in deadlock situations (van der Lei, 2009). In The Netherlands some of such cases can be observed in which local authorities have high building ambitions whereas safety norms are seriously violated. In order to unlock these situations, an unfreezing and perhaps reframing of decision making is necessary. For that, an adapted view on decision making in this context and in particular the role of the relevant institutions is needed.

3. Towards an alternative approach

Based on the analysis summarized in Section 2, there are three main goals for planning and decision-making identified which should be pursued with an adapted view. The first goal is to enrich the process of the management of risks related to urban planning in areas facing transport of hazardous materials. For unfreezing deadlocks, a shift is needed from the traditional focus on finding the optimal solution to a focus on a satisfactory solution, taking into account local unique circumstances. Organising a real debate with relevant stakeholders with different interests and preferences is crucial, accepting not only technical optimisation, but also social satisfaction as criterion for success.

The second goal is to balance different positions due to different institutional frames that come together in this field. The main problem concerns the dominant role that the EU ‘free transport of goods’-principle plays with regard to local risks. It causes a defensive attitude of local authorities with respect to their interests and hinders a constructive debate on making urban areas or rail transport safer. The violation of the orientation value of the group risk criterion in specific urban situations today has very little effect on the freight transport services. This leaves the local authority to primarily solve the risk problems. This imbalance between institutionalised international interests (transport companies), national interests (rail infrastructure provider) and local interests (municipal authority) frustrates the debate between the stakeholders and should therefore be reduced.

The third goal is to analytically support all stakeholders in such a way that they are enabled to better take responsibility for the outcome of decision making. Presently, there is too much debate on who should pay the costs of reducing risks or even who is responsible for reducing risks in the first place.

In order to explore to what extent these goals can be met in practice, four institutions and their respective interpretations are introduced. Together, they constitute the core of an adapted view on the institutional framework for external safety, transport and urban development that is hypothesised to be able to prevent or unfreeze deadlocks in decision making. Although some of the institutions are used in, for example, environmental policy, or even in risk management, their interpretation for the field of external safety differs from current practice.

The first principle is that instead of rigidly using fixed risk norms for decision making, the relative use of risk calculations is considered a valid approach. In the present situation, the standards are used in an absolute sense: the practice is to calculate risks and to test them against the standard to see whether they exceed it. It is more productive to focus the debate on how changing the situ-
ation can lead to more safety. This does not imply that decision making does no longer need supportive risk calculations nor imply a denial of their potential value. Risk calculations should however be used in relative terms. By this it is suggested that alternative building plans should be compared to the situation as it is ‘today’, without implementation of the plan, in order to explore which plan contributes in what way to a change in the level of risks. It is then no longer strictly necessary to check whether the calculated risks stay within the norms, but to evaluate the project in terms of its own pros and cons with regard to safety.

By doing so, risk-modelling tools are not used by analysts to merely check compliance with the standards, but are used more dynamically and interactively with decision-makers to structure the agenda for decision making and to generate decision-supportive information (in the sense advocated by Geertman (2006) and van Kouwen et al. (2009)). An advantage of using calculations in a relative way is that an input for the calculations that is less accurate compared with the focus on absolute safety standards, is acceptable. This implies for example that the degree to which transport changes over time becomes less important for the risk calculations. If the most recent transport figures are uncertain, for example, it is possible to use older (but validated) transport numbers without losing the value of risk calculations, as is the case in the present situation. Making relative comparisons is valid as long as all the input variables and their functional relations remain the same, except for the levels of the independent variables representing the features of the alternative plans.

The second principle is to implement a stand-still principle for the increase of risks. The stand-still principle implies that the risk level of an area may not deteriorate due to the intended building programme. This is an analogy of the more generally formulated stand-still principle for environmental deterioration (see Kuiper, 1997). If a change in the spatial–physical configuration of the area reduces environmental quality – or in this case, increases risk – compensation is needed to overall achieve a stand-still in environmental quality. The stand-still principle helps to sharpen the focus in the debate on the intended development better than when abstract standards are used. It strengthens the idea that decision makers can be held accountable for their decisions, encouraging them to take responsibility.

This leads to a third principle. In environmental law and economics, the ‘polluter pays’ principle is a commonly known principle which serves the goal of internalising environmental costs, as reflected in the prices of the polluter’s products (see for instance OECD, 1973; Stenis and Hogland, 2002; Rahman and Edwards, 2004). In risk management the corresponding principle would imply that the risk causer pays for mitigating risks. Here, the contra-principle of ‘the risk mitigator should be rewarded’ is proposed. The idea matches the considerations by the Dutch Ministry of Transport, Public Works and Water Management regarding the position and responsibilities of transport companies (Ministerie van Verkeer en Waterstaat, 2006). The idea is that safety improvements due to efforts and investments made by the transport companies should be rewarded by allowing more transport volumes in the future. Applying this idea to local authorities implies that if local authorities increase safety through mitigating measures (either by paying for safety measures in the urban area or by compensating the rail infrastructure manager Prorail for rail adaptations), they should be allowed to be more ambitious in their building programme for the adjacent urban area. Implementing such a principle will give an important incentive to local authorities to initiate tripartite negotiations with the rail transport related parties and real estate building companies to actively explore the possibilities of risk reduction at local level, accepting that this might result in the creation of budgets by the municipality and/or building companies for investments in local rail infrastructure.

To make the risk mitigating more efficient for the causer of the risk, the fourth principle is that risks should be lowered ‘as low as reasonably practical’ (ALARP). This ALARP principle is not new in the field of risk management, in particular in the UK (see e.g. Ale, 2005). Ale (2005) argues that The Netherlands, as compared to the UK, apply a different interpretation of what ‘reasonability’ implies and whether risks are acceptable. The Dutch practice is that complying with the formal norm also stops the discussion, whereas in the UK the norm has the aim of achieving a risk that is as low as reasonably achievable. According to Ale, this means that in the UK the norms are taken as a starting point rather than a destination. Although recent Dutch policy documents emphasise the ALARP principle (Ministerie van Verkeer en Waterstaat, 2004; 2006) the problems described in Section 2 show that the principle is not well operationalised and applied yet in Dutch practice. Since reasonability is generally seen as the ratio between the costs and the benefits of a risk-mitigating measure, the methodology of cost-benefit/effectiveness analysis seem to offer in this context a good basis for the support of the planning and decision making process.

The four institutional principles together constitute a partly adapted but also newly interpreted institutional framework for external safety management. The flavour of the four principles structuring local planning and decision making processes is very different from the current approach in Dutch planning practice. The challenge is to improve the way the principles are operationalised and applied in these processes. The first principle (focus on relative change in risk level) asks for the use of a validated model that helps to indicate the change in risk level due to different urban development plans adjacent to the railway. The risk calculation models currently used in practice can facilitate this need. The stand-still principle refers to the evaluation approach and can also be supported by using these models. The third (the mitigator should be rewarded) and the ALARP principle are basically facilitated by organising a multi stakeholder process of deliberation, supported by reliable cost-effectiveness data and insights in the reasonability of different risk mitigating measures.

The above described framing of the main institutions in the field of safety management is expected to have a significant impact on the nature and result of decision making processes in that context, in the sense that the rules of the game are altered. Given these rules, local authorities are assumed to work as follows:

- A local authority that wishes to develop/redevelop or intensify its territory near a rail transport axis, should make an early judgment on how this will influence the risks at the start of the design process.
- If the risks increase due to the planned activity, the local authority should lower the risk to the level before the activity was planned by implementing risk mitigating measures that the local authority itself pays for, even if this means that an actor that is not involved in the development (for example a rail transporter or a the rail network operator) needs to be hired or compensated by the local authority for taking actions to lower risks.
- To help the local authority decide how to lower these risks, the reasonability ratio (based on a cost benefit analysis model elaborated in van der Vlies, 2011) of risk-mitigating measures can be used to ensure that the municipality spends its money well and makes a well-informed safety decision.
- Both incident probability and effect lowering measures can be considered. A local authority must be enabled to financially compensate others for taking risk-mitigating measures.
- If it is impossible to mitigate risks, a project cannot be carried out or should be redesigned.

In the following paragraph we will elaborate on how to measure these principles and the methodology we used to do so.
4. Exploring the impacts: set up of two gaming-simulations

4.1. Test goals

In order to explore the potential impact of the adapted institutional view, we set up a test to investigate whether the hypothesised effect of unfreezing and reframing of deadlock situations in local urban development can be observed in real-world situations with real world planners and decision makers. Hence, the overall goal of the test is to gain insight into whether the adapted institutional view will, as hypothesised, improve the quality of the decision making process related to urban development plans and risk management. More specifically, the expectation is that by applying the principles of the adapted institutional framework, the real-world actors will encounter fewer problems with respect to the planning of urban development projects as compared with the present way of working, that the participants' understanding of risks will improve and that the accountability of decisions becomes better.

This primary goal was translated into three subgoals, each of which has been operationalised in indicators for measurement (Fig. 3). The first subgoal of the test is to investigate whether it is possible to build more real estate without increasing the risks or possibly even reducing the risks. This subgoal reflects the potential benefits of the stand-still principle and the idea of rewarding risk mitigators.

The second subgoal is to investigate whether the decision making process itself improves with regard to reaching a decision. This is interpreted in terms of whether decision-makers use more and better-targeted information to base their decisions on. This effect is expected to be the result of the creative use of the risk calculation model and the cost-effectiveness model. It is also investigated whether the improved information helps stakeholders to reach consensus on the details of the plan for the development area. This subgoal reflects the potential benefits of the relative use of risk calculations and the application of the cost-effectiveness model as a specification of the ALARP principle.

The third subgoal is to investigate the extent to which the participants have an improved understanding and acceptance of the impact of their plans on risks. It is measured whether they are aware of the impact of various risk mitigating measures as well as whether local authorities are better able to explain to residents how they plan to achieve acceptable levels of risk. Are the stakeholders more willing to accept responsibility for a potential risk increase caused by new urban development plans and do they take their responsibility for reducing those risks? Hence, the third goal reflects the polluter pays principle/risk mitigation rewarding principle.

4.2. Methodology

Preferably, the intended test is performed in real-world cases. However, that is a hardly feasible approach. Therefore, it was chosen to apply a gaming simulations approach. The approach is suitable for understanding dynamic multi-actor decision making and learning about the interactions of humans in a system. The participants of the game, normally real-life actors, have to play dedicated roles and should attempt to meet certain objectives in interaction with other players, given a set of rules of the game and a limited timeframe. It requires an adequate representation (model) of the structure of a real or hypothetical system, process or environment, where changes in the dynamics are the result of the decisions taken by stakeholders (see Geurts et al., 2000; Salen and Zimmerman, 2003; Rouwette, 2003; van der Leij, 2009).

In this study, two gaming simulations were performed representing two different cases in The Netherlands: the city of Roodendaal the city of Dordrecht (see Fig. 4). Further details about the two cases are presented in Section 5.

Both cases represent cities facing serious risk problems. Dordrecht faces a large exceeding of the GR criterion as a result of the...
large transport flows of hazardous materials on the rail lines to the south (Belgium) and to the east (Germany). Roosendaal shares this problem in part, as a large transport flow to Belgium passes through the city. High risks related to rail transport have in the past significantly limited the cities’ ambitions with regard to urban development. Both cases were, at the time of the test (2009), therefore known as deadlock situations (van der Lei, 2009) with regard to planning and decision making. Choosing these two rather extreme cases for investigating whether the alternative institutions will create a different outcome, is in line with the suggestions by Eisenhardt (1989), Pettigrew (1990) and Yin (1994) on so called selective case study research strategies. Although these authors on case study research stress that the more cases are performed, the more robust the conclusions can be, a trade-off had to be made with the efforts to prepare and execute each simulation. This included past policy reconstruction, collecting the necessary data, modelling the specific situation, organising the gaming simulation, executing the games and analysing the observations. In this case, a limitation to two simulations was made given the amount of required preparatory work versus the limitations in time, funding and available research capacity.

4.3. Set up of the simulation games

The set-up of the game was based on the participation of practitioners from three relevant parties. This included civil servants from the cities’ spatial planning departments who are involved in preparing urban plans in interaction with public safety management. Next, real estate agents who sell or let houses and office spaces in that area participated. The third party was the organisation ProRail in its role as the rail network manager. It was chosen to use this set-up and these participants, as this was the closest way to resemble real life decision making. Between six and ten people familiar with the projects were invited to take part in the simulation game for each case. The invited practitioners were informed by email and telephone about the nature of the meeting, but they were not informed precisely on the nature of the adapted view to avoid anticipating behaviour.

Each gaming simulation was divided into two parts. In the first part the participants were encouraged to produce alternative plans for the urban area concerned, while the second part focused on generating risk-mitigating measures.

At the beginning of the gaming simulations, the group of participants were subdivided into two random groups. Each group discussed the potential for a new urban project in the relevant area. Participants were invited to produce as many ideas as possible and to operationalise these in rough figures, such as the number of houses that should be added to the planning area. After about 30 min, the two groups took a critical look at each others’ proposals with the aim to improve them.

Next, the participants were invited to evaluate the ideas by ‘voting’ for the most preferred ideas. The two ideas with the most votes were then translated into input data for a computer model for risk calculations, called URBIS EV. This model, provided by The Netherlands Organisation for Applied Scientific Research (TNO), had been filled beforehand with essential information on the relevant characteristics of the existing urban situation, including the rail tracks. In addition a model was used to calculate the Potential Loss of Life as the indicator for group risk.

During the modelling of the selected ideas on the project, the participants were asked to start thinking about any mitigating measures that might be necessary to lower risks. They were told that it might not be possible to model all the measures proposed. However, to facilitate the creative process, it was not made clear on forehand which measures could not be modelled. The participants were again divided into two groups to discuss possible risk-mitigating measures. During this discussion, the results of the risk calculations were given to the participants to show them the impact of their ideas on the risk level. Having this information, the participants were asked to choose the combination of urban plan and risk-mitigating measure(s) they considered to be the best.

The two gaming simulation sessions, each lasting for one day, were moderated by the first author, with the support of a researcher from TNO who dealt with the model exercises. The game literature emphasises the need for careful registration of the process. This is generally done by chronological registration and observations of actions, the behaviour of actors, the type of discussions, the outcome of deliberations and the like. The moderators were not in a position to systematically make such observations and take notes during the discussions. To nevertheless ensure objective and clear reporting of each session, two independent scientific researchers were added to the team as observers. Their only role was to (simultaneously) make observations and take minutes. In addition, they specifically looked for indications as to whether the suggested principles in the adapted institutional framework influenced the process. They therefore received a checklist of indicators, which served as a guideline for taking minutes (see Table 1). Based on their notes, the two observers produced detailed minutes of the process as a basis for the analysis afterwards.

Finally, an evaluation form was handed out to the participants at the end of the day, in order to evaluate the simulation game (the process and the resulting outcomes). The open evaluation questions are shown in Table 2.

5. Findings

5.1. The first gaming simulation: Roosendaal

Before the simulations were performed, the major characteristics of the area were modelled in URBIS EV. The modelling was...
The questions on the provided evaluation form.

- Do the participants understand the relative use of the risk calculations?
- Do the participants feel responsible for risks and can they justify these risks?
- Are the results of risk calculations contested, and if so, what causes this?
- Are the input and output variables of risk calculations contested?
- How do the participants react to the results of risk calculations?
- Do the participants gain insight into what their building ambitions mean for the level of risk?
- How do the participants use the cost-effectiveness model, and if so how do they value it?
- Do the participants take responsibility for the choices made?
- Do the participants value the new set-up as useful or better?
- Do the participants have the idea they are the just problem owner of risks?
- Do the participants think that an urban development project can be planned better/more easily than before?

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<td>The indicators on the checklist for the observers.</td>
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- What do you think of the relative use of group risk?
- How did you experience the use of risk calculations as a decision supportive tool?
- What do you think of the idea that urban development projects may no longer increase risk as a replacement for the orientation value? (stand-still principle)
- What do you think of the idea that transport is no longer an important variable for the calculations?
- Do you think that the cost-effectiveness model has an added value? If so, why?
- If not, why not?
- Do you think you can use the cost-effectiveness model to justify the choices you make concerning risks? If so, why?
- If not, why not?
- Did you experience less dependence on other parties as far as information is concerned? If so, what information do you no longer need?
- If not, why not?
- How did you experience today's decision making process?
- Are there results other than in the 'real' process? If so, what are the differences and what do you think causes these differences?
- Do you think that there are advantages to these 'new' rules? If so, what are these advantages?
- If not, why not?
- If you have any remarks or tips or wish to mention something that has not yet been addressed, please feel free to write them down here

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- What do you think of the relative use of group risk?
- How did you experience the use of risk calculations as a decision supportive tool?
- What do you think of the idea that urban development projects may no longer increase risk as a replacement for the orientation value? (stand-still principle)
- What do you think of the idea that transport is no longer an important variable for the calculations?
- Do you think that the cost-effectiveness model has an added value? If so, why?
- If not, why not?
- Do you think you can use the cost-effectiveness model to justify the choices you make concerning risks? If so, why?
- If not, why not?
- Did you experience less dependence on other parties as far as information is concerned? If so, what information do you no longer need?
- If not, why not?
- How did you experience today's decision making process?
- Are there results other than in the 'real' process? If so, what are the differences and what do you think causes these differences?
- Do you think that there are advantages to these 'new' rules? If so, what are these advantages?
- If not, why not?
- If you have any remarks or tips or wish to mention something that has not yet been addressed, please feel free to write them down here

The reason for these suggested options stems from the fact that the area is densely populated already due to which there is a relatively high demand for leisure and housing. Other options, such as the construction of parks or industrial sites was deemed unreasonable due to relative high costs and low gains (parks) and the low demand for industrial use of land.

During the discussion on these options, it appeared that the participants were quite aware of the risks generated by the transport of hazardous materials as well as of methods to protect the area adjacent to the railway. They mentioned urban designs that could be used as a safety buffer for houses, as well as options to improve the safety of the railway transport. After a while, the participants reached consensus on a plan (hereafter called scenario 1), including 200 houses (480 people) and 25,000 m² of office space (2000 people). Scenario 1 was consequently modelled in Urbis EV.

It was also proposed to model another plan (called scenario 2). This plan – which the representatives from the municipality intended to implement as a project in the real-life situation – consisted of 350 houses in combination with a large cinema with six screens each with a seating capacity of 200. The participants were eager to learn about the impact of these ideas on risks.

The risks were calculated, showing the following Potential Loss of Life (PLL):

- $1.76 \times 10^{-4}$ for the original situation.
- $3.51 \times 10^{-4}$ for scenario 1.
- $4.02 \times 10^{-4}$ for scenario 2.

Both scenarios created a significant increase in risks. The risks were even higher than anticipated by the participants, which caused substantial annoyance and debate again confirming the deadlock nature of the situation.
In the second round, the participants were asked to think of risk-mitigating measures to arrive at a level of risk that was not higher than the PLL for the original situation of $1.76 \times 10^{-4}$ (in accordance to the stand-still principle). The first discussions, focussed on building offices and an indoor car park right beside the railway to increase safety by using these buildings as a buffer against the blast of a possible BLEVE and thus protect the houses behind them. This approach is very much in line with the debates in the past on the situation. Therefore, after the participants were asked to broaden their scope and to come up with other measures, they summed up a number of potential risk-mitigating measures that had been investigated by a leading Dutch consultancy firm (ARCADIS, 2008). Removing switches and implementing ATBvv\(^1\) on a number of railway signals were mentioned together with a number of larger rail infrastructure projects, such as deepened rail tracks, removing the entire railway yard or creating a dedicated freight railway outside the city. Since however some of these projects are very expensive, the debate switched to less costly adaptations of the present railway configuration. The following information was used in interaction with this downsizing in discussion (see Fig. 5):

- Measure 1: Removing the level crossing has a risk lowering potential, and would cost €51,000,000.
- Measure 2: Removing two switches on the route to Belgium has a risk lowering potential, and would cost €2,000,000.
- Measure 3: Equipping ten signals with ATBvv would cost €35,000 each, and has a risk lowering potential.
- Measure 4: Implementing hot-box detection would cost €450,000, and has a risk lowering potential.

During the discussion on these measures, four new risk calculations were performed to establish what effect these measures would have on the total risk. A fifth risk analysis was performed to find out the risk-reducing potential of the three cheapest measures. The results are summarised in Table 3.

As shown in Table 3, the scenarios 1 and 2 will not reduce the related risks by measures 1, 2, 3 or 4 separately up to the level of the reference situation. In fact, measures 2, 3 and 4 would have to be implemented simultaneously in order to reduce the risks in accordance with the stand-still principle. Thus, if the city of Roosendaal would compensate ProRail for taking measures off (in total) €2.8 million, both scenarios 1 and 2 could be carried out. The suggested measures would reduce the risk to a level lower than in the original situation, or (coincidentally) lead to exactly the same level of risk.

Confronted with these results, the participants were instantly enthusiastic, stating for example:

- ‘The deadlock can be resolved.’
- ‘I really like these results.’
- ‘The novelty is that this creates insight into the fact that you can make investments to keep risks controllable.’
- ‘Very refreshing.’

Table 3

<table>
<thead>
<tr>
<th>Measure</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Original situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure 1</td>
<td>$3.11 \times 10^{-4}$</td>
<td>$3.55 \times 10^{-4}$</td>
<td>$1.76 \times 10^{-4}$</td>
</tr>
<tr>
<td>Measure 2</td>
<td>$2.04 \times 10^{-4}$</td>
<td>$2.31 \times 10^{-4}$</td>
<td></td>
</tr>
<tr>
<td>Measure 3</td>
<td>$3.16 \times 10^{-4}$</td>
<td>$3.61 \times 10^{-4}$</td>
<td></td>
</tr>
<tr>
<td>Measure 4</td>
<td>$2.81 \times 10^{-4}$</td>
<td>$3.22 \times 10^{-4}$</td>
<td></td>
</tr>
<tr>
<td>Measures 2, 3 and 4</td>
<td>$1.47 \times 10^{-4}$</td>
<td>$1.76 \times 10^{-4}$</td>
<td></td>
</tr>
<tr>
<td>Risk without mitigating measures</td>
<td>$3.51 \times 10^{-4}$</td>
<td>$4.02 \times 10^{-4}$</td>
<td></td>
</tr>
</tbody>
</table>

‘[It’s now become a] common sense appraisal [instead of one] done by a bunch of technicians.’

After drawing conclusions on the conditions under which the preferred scenarios would be feasible, a group evaluation took place in which the differences between the applied approach during the game and the traditional approach were explained. The participants appeared enthusiastic about three features of this framework.

Firstly, they said that the local authorities themselves would again be responsible for risks:

- ‘Both safety and investments are arrogated to the local authorities.’
- ‘Increased quality of the whole city, including the already existing city.’
- ‘The local authorities need to keep control of the city.’

Secondly, they said that the local authorities would find it easier to give account for the existing risks:

- ‘This is explainable.
- ‘This shows the consequences of the urban plan and risk-mitigating options in the area to be developed.’
- ‘You can show the citizens that you have much better control of the risks.’
- ‘The infrastructure is more controllable. That is a good political argumentation.’

Thirdly, they said that the urban development programme is more manageable in an early phase of planning:

- ‘[This way of looking at risk] has a great benefit due to its practical use.’
- ‘It’s great to have these insights at an early stage [of planning].’
- ‘At the same time we can develop [our urban territory] and control risks.’

But there were two types of criticisms. The first was that some participants expected a lower incentive to increase transport safety, as is illustrated by the quotes:

- ‘This removes the incentive for the Ministry of Transport, Public Works and Water Management and ProRail to improve safety.’
- ‘But what incentive remains for the central government if we solve the problems for them?’

The other criticism was directed at the long-term effects of this new approach in relation to transport volume. Some participants stated:

- ‘What happens when the transport volume increases?’
- ‘If we need to change the local land use plan in ten years’ time and the transport has tripled: what happens then?’

\(^1\) Is the enhanced version of the automatic train protection system (Automatische Trein Blessing Verheterende Versie; ATBvv), which is an improved version of the ATB system – a fail-safe signalling system that continuously controls the speed of trains above 40 km/h. The system intervenes automatically when a train driver exceeds the maximum permitted speed or fails to brake after passing a signal that indicates a lower speed. The ATB first warns the train driver by means of an acoustic signal; if the train driver does not respond within seconds, the system applies an emergency brake. However, this ATB does not control speeds under 40 km/h or the passing of signals that indicate danger if the maximum speed is restricted to 40 km/h. In principle, this means that train collisions between two trains can occur. The worst-case scenario is a head-on collision between two trains, each running at 40 km/h.
As described in the set up, the participants were asked to fill in an evaluation form. The participants wanted to fill in the forms at home or on their computers, and asked if we could provide a digital copy. This had the effect that only some participants in the end filled in the evaluation form.

In addition to the group evaluation discussed above, the responding participants stated that it was ‘refreshing to see the effects of design options’ and ‘good for creating alternative plans and gaining quick insight into risks’ (evaluation question 2). The idea that urban development should not increase the risks in an area did not receive negative comments as such, although the long-term tenability was questioned (evaluation question 3): ‘Good for the short term’ and ‘Provides a neutral basis for a good discussion that actually improves the adjacent areas.’

The respondents were relieved as well as sceptical about using the transport of hazardous materials as a constant factor in calculations (evaluation questions 4 and 7). Especially for the short term, it was ‘realistic’, ‘comforting’ and ‘very pleasant’; however, it was ‘not based on the reality’ and ‘ignored the problem source’. On the other hand, it was also said that ‘you can avoid using unreliable transport data (…) that currently leads to endless and difficult discussions’.

Because three risk-lowering measures were needed simultaneously to reduce the risks to the initial level, it was not possible to compare the measures separately on their cost-effectiveness to assess the extent to which the measures were ALARP. Consequently, it was difficult to use the model directly as a decision-support tool. Nevertheless, the respondents were very optimistic about the potential use of such a model (evaluation questions 5 and 6). They stated, for example:

- ‘Safety and functionality can be geared to each other.’
- ‘A useful addition to the design phase that will ensure it remains realistic.’
- ‘The same approach could be useful (…) in negotiations about the costs related to the basic network.’
- ‘(It will give) quick insight into the proportions of the investments, the effect and the options.’

With regard to the simulation of the decision making process (evaluation questions 6 and 7), the respondents said that it was ‘refreshing (…) compared with the safety discussions of the last ten years,’ ‘quick, easy and useful’ and ‘the session has (…) made clear that risks should be taken into account right from the start of the design phase’. However, they also repeated their earlier statements about the need to give incentive to others to implement safety measures and their concerns about the long-term effects of the approach. The final two evaluation questions (8 and 9) evoked similar reactions. The respondents felt there were short-term advantages of applying the approach, but in the longer term the approach might have disadvantages too.

5.2. The second gaming simulation: Dordrecht

The case in Dordrecht concerns an area adjacent to the railway. In 2004 a master plan had been made, but not politically accepted. Due to the high costs of land procurement and soil decontamination in the area, the building programme should be more intensive than the initial plan from 2004. To realise this, since 2004 the planned office space was expanded to a maximum of 100,000 m², including 40,000 m² for an ‘administrative cluster’ (for example new council offices). The area should become the business heart of the city. The number of planned dwellings increased to 850, around 750 of which would be apartments. Other options, such as a school for technical and vocational training and a multi-screen cinema, had also been mentioned but were not taken very seriously due to their relatively high costs and lower financial benefits. The plan also included parking spaces and some smaller shops. Other differences between these proposals and the 2004 plan are that a central overpass road from Zwijndrecht to Dordrecht in the present situation would be maintained and that the buildings would be raised from street level to the level of this road in order to generate more efficient land use. Due to these high demands, several blocks of houses and offices were necessary for higher investment returns. In addition, the height of the original blocks from the 2004 plan was increased. Other features involved a large tower from the 2004 plan and two other buildings beside the railway tracks. In sum: the ambitions, mainly due to financial investments, were high but appeared to conflict seriously with the external safety standards. The discussion went on for years, showing characteristics of a deadlock situation. For an overview of the Maasterras area, please see Fig. 6.

The preparation for this gaming simulation on his case differed in some respects from the preparation for Roosendaal. More data was available from previous research for modelling the area. Further, since the city of Dordrecht applies a more classic planning approach in which the city act as the key planner and developer, whereas the city of Roosendaal applies a more public–private interactive approach in which private partners are the key developer. As such, the group was smaller and more homogeneous than in Roosendaal, although this did more justice to real-life decision making than in the other case. It was decided therefore not to split up the group of resulting four participants (consisting of the project manager, an urban planner, an architect and the city’s safety specialist) into two groups in the first round of the gaming simulation, but keep them together as one group, creating a plenary session in this round. Another difference was that extended information provided in various documents was used to prepare three alternative urban plans as a back-up in case the smaller group generated less discussion. In that case we would be able to demonstrate how different urban plans might affect the risks in that area. One plan concerned the above discussed intensified plan. A second plan was based on the indicative programme but with a high density of housing only in the part of the area beyond the 200 m border. The third plan was a plan in which the office space and housing are evenly distributed across the area.

In the first round of the plenary the participants discussed the situation, the various plans and eventually concluded that the basic lay-out provided in the 2004 plan should be implemented. The planning area was divided into four areas, each with specific values for office space or housing. The average number of people present in these areas was assessed in discussion with the participants and in accordance with the rules for the URBIS EV model. They are summarised in Table 4 and here it is referred to as scenario 1.

In addition the participants, after intensive discussion, suggested three variants on this plan: scenarios 2–4.

Scenario 2 focused on the risks in case all offices were built in the area up to about 200 m from the rail tracks and the houses were built in the 100 m zone beyond this area. Scenario 3 was the same as scenario 2, but instead of using the blocks from the original plan, we used an average density for the first 200 m. Scenario 4 was the same as scenario 1, but without the tower directly positioned beside the railway but instead located beyond 200 m from the tracks.

These four scenarios were then implemented in URBIS EV for calculating the risks. The PLL for the original situation (hence the situation without development) and the four development scenarios appeared to be:

- Original situation: $3.2 \times 10^{-4}$.
- Scenario 1: $3.89 \times 10^{-4}$.
- Scenario 2: $3.45 \times 10^{-4}$. 
– Scenario 3: 3.52 \times 10^{-4}
– Scenario 4: 3.67 \times 10^{-4}

Concluding: all four scenarios showed an increase in risks and as such violate the stand-still principle. The figures also indicate that building in lower densities near the railway or further away from the railway can lower risks. After the $fN$ curves were presented, the risks concerning the plan just discussed by the participants (the ‘new plan’) were presented. The intensified building near the railway did show an increased risk compared to the 2004 plan: instead of a PLL as found in scenario 1 of 3.89 \times 10^{-4}, the new plan showed a risk of 4.1 \times 10^{-4}.

After providing this information, the participants discussed risk-mitigating measures that could be implemented to reduce risks. They proposed a number of possible measures:

– Enhanced version of ATB.
– Other train arrangements (for instance: remove other flammable liquids from trains carrying LPGs).
– Create gutters for rapid drainage of flammable liquids.
– Alternative building scenarios.
– Switch removal.
– Hot-box detection.
– Reduce the maximum speed on the railway in the city centre.
– Improve people’s preparedness by constructing escape routes.

Discussing these options, it was concluded that it is difficult to gain more precise insight into the costs of some of these measures. Moreover, it appeared that ProRail had already installed or was planning to install the enhanced version of ATB at all important switches. In the end the participants decided to further focus on three possible risk-mitigating measures to be taken in the area:

– Hot-box detection (€450,000).
– Removing switches (€2,000,000).
– Different area planning or building densities.

The risk calculations then showed that the implementation of hot-box detection or the removal of the switches would reduce the risks in the original plan (scenario 1) from 3.89 \times 10^{-4} to 3.11 \times 10^{-4} or 2.43 \times 10^{-4}, respectively. This means that when the developers are willing to invest in reducing risks by taking these measures, they are lowering the risk level. Thus, if the representatives were willing to invest in reducing risks and apply these measures, they are expected to compensate for the increase in risks to a level lower than provided for by the stand-still principle for the original situation (3.2 \times 10^{-4}).

The participants reacted positively to these findings, mainly because decision making in the past had insufficient ‘foundation in figures’. The fact that these measures reduce the risk to lower levels than in the original plan was experienced as ‘a new result’. Moreover, €450,000 is ‘a lot cheaper than leaving hectares unused’ as one of the participants stated. A great advantage according to the participants was that numerical insight is created into how to reduce risks. The participants called this insight and the relative use of GR calculations ‘attractive’.

After generating these results, the participants received information regarding the cost-effectiveness of hot-box detection and switch removal for the original plan. It was calculated that hot-box detection was more cost-effective with a reasonability score of 2.3, versus 7.7 for switch removal. When confronted with these figures and knowing that a lower score implies higher cost-effectiveness, the participants responded enthusiastically: ‘This is interesting’ and ‘The presentation of the result really adds to the discussion’.

Next, at the request of the participants results for the new situation were shown in particular the effect that implementing hot-box detection and removing switches would have on the calculated risks. As shown in Table 5, the risks are reduced to nearly the original situation with hot-box detection only. Switch removal would

Table 4
Agreed area specification scenario 1.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Number of people</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area 1 50,000 m²</td>
<td>2000</td>
</tr>
<tr>
<td>Area 2 750 Apartments</td>
<td>1275</td>
</tr>
<tr>
<td>Area 3 35,000 m²</td>
<td>1400</td>
</tr>
<tr>
<td>Area 4 100 Houses</td>
<td>240</td>
</tr>
</tbody>
</table>

Fig. 6. Artist’s impression of the Maasterras area for Zwijndrecht (left) and Dordrecht (right). The Weeskinderdijk area is circled.
Table 5
The influence of mitigating measures on the new plan.

<table>
<thead>
<tr>
<th>Measure</th>
<th>PLL</th>
<th>New plan</th>
<th>Original situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot-box</td>
<td>3.28 x 10⁻⁴</td>
<td>4.1 x 10⁻⁴</td>
<td>3.2 x 10⁻⁴</td>
</tr>
<tr>
<td>Switch removal</td>
<td>2.43 x 10⁻⁴</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moving tower</td>
<td>3.85 x 10⁻⁴</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hot-box + moving tower</td>
<td>3.08 x 10⁻⁴</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

drastically reduce the risks. In addition, the participants accepted the idea to move the tower beyond the 200 m area, presuming that this would not increase the costs of the project.

After generating and presenting this information the participants again stressed that so far, most analyses and decision making processes related to the case were mainly based on 'gut feelings'. Consequently, they found the debate in this gaming and the presented results 'brand new', clearly having 'an added value to the policy choice and effort'. Moreover, the participants noted that such appraisals should be made at the start of the process rather than at the end, enabling urban developers to take these types of input as a parameter for designing plans. Also, the speed and simplicity of this calculation method could make an important contribution. Finally, it was stated that 'this approach could help to give feedback to the mayor and aldermen'.

The evaluations showed that the relative use of GR was found to be very useful (evaluation question 1): 'This emphasises the use of risk-mitigating measures', 'makes it easier to compare options', 'insightful and adds up to (...) good practice'.

According to the respondents, risk calculations as a decision-support tool 'create insight into the effects of different measures. It creates more support for [reducing] risks as a design task'. And (evaluation question 2): 'The usefulness is that this creates insight into the effects of different measures. This is useful in the planning process.'

Using the stand-still principle instead of the orientation value for GR (question 3) was supported by all respondents: 'The only way to decide on spatial plans', 'that's the right choice to make', 'very practical' and 'much better'.

The idea that transport is less dominant in the appraisal of the plans was found very useful (evaluation question 4). 'It [transport] does not really make a difference' and 'makes the influence of the urban plan more clear', although 'transport will always be important, only much less so in the proposed way'.

Evaluation questions 5 and 6 (about the use of cost-effectiveness model) were both answered very positively by all respondents. The respondents stated that 'the effects and the costs were made clear and insightful and that both are important for decision making'. Moreover, it 'enables insight into the choice of an option'.

Of the participants, three gave different answers (and one did not respond) to the question whether they were less dependent on information provided by other actors (evaluation question 7). One respondent replied affirmatively, one stated that a number of quantified measures still depend on the rail infrastructure manager and the third said that he had not yet experienced such a dependency. Therefore, a good conclusion cannot be drawn from the answers to this question.

Evaluation question 8 (referring to what the participants thought about the process), however, created a much clearer picture. The respondents stated that this process 'helped to get clarity fast', 'it was good that we could discuss the results of the calculations, their explanation and the presentation together. Also for non-experts, this makes clear what the effects are' and 'this helps to make the narrative explainable'.

According to the respondents (evaluation question 9), the difference between this way of approaching risks and the current approach is that 'some of the decisions are now taken on gut feeling'.

This process 'helps [•••] and most of the time the basic assumptions for the plans are imposed. This always leads to discussions and little support. In this case, there is more insight, [which leads to] more support [which in turn leads to] more enthusiasm to launch alternative plans.'

All the respondents mentioned advantages of the adapted rules of the game (evaluation question 10). 'Things are now possible that previously were not', 'plans become easier to carry out', 'the focus is now on measures instead of on exceeding [the norm]' and 'the Maasterras project appears to be feasible: the costs have been made more transparent and can be balanced'.

When asked whether the participants had any final remarks (evaluation question 11), two comments were made. The suggestions were to include other pictures instead of only the PN curve and – as had been mentioned during the discussion – that not only the PLL should be presented but also the factor by which it exceeds the GR norm should be shown.

6. Conclusions and discussion

This article developed an adapted view on the institutional rules that govern the planning and decision making processes for urban development projects adjacent to railways accommodating transport of hazardous materials. The need for such an adapted view was argued from various observations in The Netherlands on the presence and the continuation of problems with meeting external safety standards in present situations. To test the value of the adapted view, a gaming simulation approach for two cases was set up, supported by TNO’s model on external safety in urban environments and an elaborated cost-effectiveness model. The gaming simulation approach was applied to two deadlock situations in medium-sized Dutch cities: Roosendaal and Dordrecht.

It is now possible to identify the differences and similarities between the findings in the two simulations and the extent to which the findings are in accordance with the indicators for the subgoals of the testing of the adapted institutional view, formulated in Fig. 3. The indicators are addressed and discussed separately below.

6.1. If risks increase, they can be reduced to the original situation

It was found in both deadlock situations that by hypothetically taking certain measures, the risks could be reduced to lower levels than in the original situation. The city of Roosendaal needed to implement three risk-mitigating measures to reduce risks to the original situation. The situation in Roosendaal appeared to be more complex than that in Dordrecht. Still, even in this difficult situation, it was possible to reduce risks without taking the most costly risk-reduction measure, namely the removal of the level crossing. In Dordrecht it proved easier to reduce risks. Basically, here the approach based on a smart redesign of the area was followed, combined with one risk-mitigating measure concerning the rail infrastructure: the implementation of hot-box detection. It shows that the approach followed in the gaming was contributing to a sense of solution for the deadlock.

6.2. Redevelopment of an urban area will not increase risks

In the case of both Roosendaal and Dordrecht, a significant increase in risks was proven to be very likely as a result of the initial plans for urban development. Both cities are nevertheless eager to redevelop their urban territory. However, based on a combination of measures, risks were reduced compared to the initial plans, and it appeared possible to adhere to the stand-still principle. These findings suggest that when a smart and pro-active approach is cho-
sen, the redevelopment of the urban areas does not necessarily increase risks if suggestions to mitigate those risks are taken seriously.

6.3. Local authorities have a possibility to redevelop their territory

The results for the two cases differ: it will be more difficult for Roosendaal than for Dordrecht to mitigate risks. This difference can be explained by the fact that the two areas are different in size. It appeared easier to reduce risks in Dordrecht, because the development area is much larger and a significant share of the buildings can be built further away from the railway. This difference is also partly due to the aspirations of the city of Roosendaal, that wants to significantly increase the built environment while the area under consideration is small and located directly adjacent to the railway. In the end, however, both cities appear to be able to redevelop a part of their urban area.

6.4. Modelling risk at the site gives the participants insight into their aspirations

The participants stated that the gaming simulation and the application of the described principles and support tools created a simple and clear setting in which the effects of urban plans could be assessed at an early stage of decision making, and thus be taken into account before the plans were finalised. This was experienced as added value, since (as the participants in Dordrecht explicitly stated) usually risk-related ideas are based on gut feelings. The presentation of the results provided the participants more systematically with extra insight into their actions and information to share with responsible politicians. This contributes to the need for a better informed decision making process.

6.5. Participants use the cost-effectiveness model as extra input in reaching a decision, and value this as useful

In the case of Roosendaal no full analysis of reasonableness was performed. Nevertheless, the respondents stated that they were optimistic about the potential use of the cost-effectiveness model. In the Dordrecht case, the cost-effectiveness model helped to gain insight into the consequences of various measures and which option was most cost-effective and thus more reasonable to take. It helped to reach consensus more easily.

6.6. Participants reach a decision on what they want to create

In both cases, the participants in the end agreed on a most preferred urban plan and on the related risk-reduction measures that should be taken in that context. The fact that the urban plans in Dordrecht were strongly inspired by previous plans contributed to the agreement on the results. The participants in Roosendaal were more open to changes in the initial plan.

6.7. The participants understand what their aspirations mean for the level of risk

The participants stated that the way in which we presented the effects of their plans was a useful way of gaining insight into and understanding of their aspirations. In the case of Roosendaal, the increased insights into the consequences of the local authorities’ plans created confusion among the participants; nevertheless, they learned more about the effects of their plans-and possible changes in it–on risk.

6.8. The participants are able to explain their plans to the residents of their city

Especially the participants in Roosendaal clearly noted that the plans could more easily be accounted for vis-à-vis the city’s residents. In Dordrecht, the participants mentioned that the approach made it easier to explain the plans and the associated risks to residents and other parties, including the mayor and alderman.

6.9. The participants take responsibility for the urban development and risk-reduction plans

In both cases, the participants stated that they were willing to take risk-reduction measures in order to be able to implement their projects. This – and the fact that they were able to account for the risks they cause and mitigate – implies that they are willing to take responsibility for the urban development project.

The conclusion, in sum, is that the approach indeed did seem to have the effect of unfreezing and reframing the local debate, resulting in new ideas to find a way out of the deadlock situations. Both gaming simulations confirmed the complex nature of the tension between the (inter)national interests in relatively unlimited freight transport on the one hand and the local, municipal, interests of realising an attractive area development. This tension is inherently determined by different and hardly harmonised institutional frames: the world of national transport networks and policies versus the world of city development. Stakeholders remain uncertain and sometimes pre-occupied about each other. Blockades in this type of situations can either be ‘solved’ by hierarchical decisions based on legal standards (the result of the present approach) or cooperation based on sharing views, discussion and negotiations (the result of the proposed approach). The first approach often leads to lack of support and invisible and creative attempts by local stakeholders to find other ways that do not always favour safety, whereas the second approach according to our study suggests that it contributes to more transparency and public support. Nevertheless, the analyses have several limitations.

Firstly, the models in the game had serious limitations with regard to the possibilities to deal with all potentially interesting measures to influence the risk level in the area under study. This situation however very well represents the problems that real life actors need to cope with and contributes to the frequently heard statement that decisions often have to be taken based on gut feelings.

Secondly, some corporate players appeared more reluctant then others to full-heartedly participate with an open mind. In particular the railway managers appeared difficult to involve, possibly because they feel themselves more protected or more important because of national economic interests (the international rail transport of freight). And although relevant technical information and data of rail infrastructure had been provided, this attitude implies a claim on the representative nature of the gaming simulations as compared to real-world processes. On the other hand: these different attitudes also represent the real-world situation well.

Finally, bringing together representatives of the most important stakeholders in a context of reflection, interactive thinking and debate, seemed to have a positive effect in itself. Creating an environment where an open debate is stimulated and where inspiring new rules are introduced, helps to bridge gaps. Whether such a process will also develop in practice, assuming new rules for assessment of options and interaction between stakeholders, remains to be seen. The study described in this article is promising in that respect, but reality is often more fuzzy and complex than can be simulated.
References


