



Adding value to the decision-making process of mega projects: Fostering strategic ambiguity, redundancy, and resilience

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ABSTRACT

Current practice in decision-making about mega projects seems to be aimed at reducing complexity by simplification. However, this is often detrimental to the resilience and added value of these projects. This article uses the concept of strategic capacity for analyzing the decision-making process on mega projects. This concept consists of three elements: strategic ambiguity (the tension between different purposes and goals), redundancy (having more options than necessary from an efficiency perspective) and resilience (is the process reactively or proactively resilient to outside demands?). Two transport mega projects in the Netherlands are analyzed. Our analysis demonstrates that creative solutions and added value are to be found in the recombination of policy options made possible by enhancing strategic capacity.

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1. Introduction

1.1. The opening and closing of mega project decision-making

As the construction of mega projects is continuing in an extensive rate across the world (e.g. Rizzo, 2013; Ponzini, 2011), the question of how to cope with the complexity and uncertainty characterizing their planning becomes increasingly important (Salet et al., 2012). The often adopted approach to planning mega projects is to keep uncertainty and complexity out by applying the KISS ('keep it simple, stupid!') mantra (Giezen, 2012; Giezen et al., 2015). According to this 'closed' approach the objectives of the project should be narrowed into a-priori defined trajectories and outcomes (e.g. only transport objectives) and 'predict and control' measures should be used to manage complexity (Bröcker et al., 2010; Hensher and Rose, 2007; Mouter et al., 2013). Knowledge and action perspectives should be compartmentalized (e.g. through piecemeal engineering, rational lines of decision-making and project implementation in successive isolated parts). Actor constellations should be reduced to the core group of stakeholders. Trajectories of decision-making should be rationalized for the sake of efficiency and to overcome the constraints of time and finance.

Yet, an increasing number of researchers claim that complexity and uncertainty should be considered as integral to the decision-making process (De Bruijn and Leijten, 2007; Giezen, 2013; Priemus et al., 2008; Priemus, 2010; Swyngedouw et al., 2002) and that the decision-making process needs to be organized to adapt and respond to changing situations. In short, these researchers argue that complexity and uncertainty should be at the heart of decision-making, in other words they propose an 'open' approach. They fear the 'tunneling' of the decision-making process; i.e., that it is closed off from outside influences. This would lead to 'entrapment' (Brockner et al., 1981) where there is not enough external input to justify deviating from the course set by the already invested time, money and prestige. However, working with uncertainty in an open manner is still counterintuitive to many project managers (Samset and Volden, 2015).

The differences of approach between the two poles seem so straightforward – with regards to both the diagnosis and the remedy – that the solutions of one perspective are often considered as being the crux of the problem for the other. European-wide comparative studies into decision-making on urban mega projects confirm the recurring tensions between the two different approaches (Majoor, 2008; Ratner and Goetz, 2013; Salet and Gualini, 2007; Spaans et al., 2013; Swyngedouw et al., 2002; Cantarelli et al., 2010) and mega infrastructure projects are no exception (Altshuler and Luberoff, 2003; Priemus et al., 2008). It seems that the closed approach adherents (which include most practitioners) feel the pressure of political feasibility: the demand for precise

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ambitions and outcomes together with prudent budgeting of time and money are seen as vital ingredients for making a project politically feasible. Simple and direct solutions are preferred above academic claims to bring better deliberation and even more efficient outcomes by widening and opening the horizon of decision-making. We do not attempt to simplify the assumptions of the different approaches; the solution is not somewhere halfway in between. Actually, we contend that both tendencies (both the opening and the closing) are necessary conditions for a well-balanced and rich decision-making process.

In this paper we thus argue that intelligent strategies of decision-making require *both* the widening *and* the closing of the decision-making process. Decision-making of mega projects consists of numerous operational decisions, both sequential and simultaneous (e.g. McCormack and Schwanen, 2011), rather than just a small set of hierarchical mega decisions. These operational decisions need to be embedded and rationalized within specific domains and competences, and are thus necessarily to a certain degree *closed*. It often makes sense to divide complexity into manageable parts and to adopt process planning. Nevertheless, the selective strategies of pragmatic decision-making have to be guided by *widening* perspectives, not just at the beginning but also throughout the whole process. The opening and closing of decision-making processes should be organized as forms of mutual enrichment. This *strategic capacity*, i.e. *the ability to open and close the process*, avoids the frequently-observed ‘tunneling’ of decision-making processes while at the same time allows practitioners to ‘close’ operational decisions, when required, to further the process.

In this paper we develop the concept of strategic capacity by discussing three basic principles in the organization of the project planning and decision-making process. These concepts have been introduced by Giezen (2013) and this paper analyses them more empirically explicitly for these projects. Firstly, instead of tunneling decision-making towards pre-determined outcomes, a *strategic ambiguity* of project mission is needed to create a productive interaction between moments of strategic reflection and moments of hedging and closing the process. Secondly, a certain *redundancy* of knowledge and actor constellation is necessary to enable innovative outcomes (via recombination of solutions) in the operational lines of decision-making that face emergent uncertainties. Thirdly, a balance needs to be found between proactive and reactive *resilience*. The project’s planning and decision-making process should be deliberately designed to estimate potential adaptations should the context change (proactive resilience) and at the same time enable it to prevail when changes threaten (reactive resilience) its survival (Eastman and Penz, 1974). These three concepts were chosen because they represent the balance between opening and closing of a mega project from three perspectives: the project as a concept, the project as a constellation of actors and associated knowledge, and the project as an engineering undertaking that needs to be managed. By using these three concepts, the analysis should be more comprehensive as a mega project is much more than just a technical endeavor.

The next section of this paper discusses the concepts of ‘strategic ambiguity’, ‘redundancy’ and ‘resilience’ in more detail. In the subsequent section these concepts will be illustrated by means of two mega infrastructure projects in The Netherlands. In the final section we will return to the core question: how does strategic capacity within the decision-making process influence the potential for value added adaptations to a mega-project?

2. Three principles: strategic ambiguity, redundancy and resilience

The planning and decision-making process on mega projects is

complex, uncertain, and far from linear: it is like a big ocean with storms, lulls, whirlpools and sharks. And to skillfully sail through these complex and uncertain elements, it is crucial to adapt when needed. For this reason, it is essential to define the mission in a manner open to these adaptations while keeping a sense of direction at the same time. The latter is necessary to prevent the project from getting lost by making ad-hoc route changes. In the following paragraphs we discuss the meaning of three coherent concepts responding to this challenge.

2.1. Strategic ambiguity

Usually, the formal decision-making of a mega project starts with a principal document covering the aims of the project and a principal indication of means, organization, financial conditions and time horizon. The formal start may be preceded by initiatives of exploration, social debates and other research (sometimes already quite a long time back) but the starting policy document marks a new stage of decision-making and always reveals the principal mission of the project. The starting document is one of the strategic moments where open reflection is essential; it shapes the process further down the line. However, even with the most careful preceding exploration, emerging issues will challenge the decisions on the ambition and implementation of the project even within this principal stage. So if mega projects usually take more than 20 years from this initial phase to be realized (Priemus, 2010), there will be numerous changes in political and financial conditions, fresh insights and technical opportunities, fluctuations in financial, construction, labor and land markets, and other unforeseen events. The only certainty seems to be that conditions and resources of realization will develop differently than expected at the outset.

To deal with this conundrum we introduce the concept of ‘strategic ambiguity’. If the process of developing a mega project is riddled with uncertainty and complexity (Eweje et al., 2012), a very concrete and specific starting makes very little sense. Two operational qualifications are required. The first regards the level of abstraction of the project mission. Often, the ambition of the project is made operational as a very well-specified output target: a bridge, a tunnel, an airport, a railway connection. For political reasons and for reasons of communication with society it is thought to be important to visualize the aimed outcomes of the project with a clear design. It should reveal the general purpose and motivation behind the desire to construct a mega project. Yet the more concrete, the more closed the project is from the onset. In his seminal work *The Nerves of Government*, Karl Deutsch discusses the relation between purpose, goals and feedback (Deutsch, 1966). Decision-making about mega projects should start from a basic sense of purpose: “a major or strategic goal, preference, or value that is to be pursued through a set of intermediate movements towards intermediate goals” (Deutsch, 1966: 187). The purpose involves a definition of a problem at a level that leaves maneuverability. A problem definition is often a statement of a principal goal and the impediments to achieve this goal. And in order to achieve a principal goal or purpose effectively, a feedback mechanism must be in place. “The system must receive information concerning the position of the goal and concerning its own distance from it; and it must receive information concerning the changes in its distance from the goal brought about by its own performance. The messages are often negative in that they oppose the previous actions of the system, so as to oppose overshooting of the target” (Deutsch, 1966: 184). Therefore, the project mission should provide a *principal sense of direction* under changing conditions of complexity and uncertainty. This sense of direction is not identical to a desired stable state in the future: it is a principal mission instead of a goal-instrumental outcome.

The second qualification of strategic ambiguity goes further than Deutsch. It refers to the recognition of competing or even *conflicting purposes* behind the development of the project, for instance with regards to economic, social or environmental sustainability (Buck et al., 2005). Usually, in starting policy documents an indication of priority is given in case of competing or conflicting purposes. This is an important key to define the sense of direction of the project. However, this does not mean that all purposes should be subjugated to the dominant principle and that all conflicts between different principles are solved once and forever. It is important to allow for a tension between the different purposes throughout the decision-making process. Experiences with mega projects shows that conflicts of purpose are not negotiated and resolved in one single principal project decision but will return in later stages and are continually renegotiated within the smaller decision ranges of singular parts of the project, as particular project effects become clear (Altshuler and Luberoft, 2003; De Bruijn and Leijten, 2007). These conflicts lead to useful intermediate evaluations during the long realization period of projects. In planning and decision-making on mega projects, it often seems that such feedback mechanisms are treated as a necessary evil. Because mega projects generally enter the process as an already developed solution, a problem-driven search is thought superfluous (Priemus, 2007). Decision-making becomes focused on getting a project through as undamaged as possible, instead of creating a solution with most added value. In addition, there is a perceived necessity to use legal contracts for safeguarding all aspects when entering into a public private partnership, also resulting in closure of the project mission. Instead, strategic ambiguity is crucial because it recognizes complexity and emergent properties, and that the framing of a project is never finished (De Bruijn and Ten Heuvelhof, 2010; Glasbergen and Driessen, 2005).

2.2. Redundancy

Having a sense of direction and a properly functioning feedback mechanism in place thus reduces the chance of arriving at an unbalanced result. However, it is also important to have something to choose from when tensions arise. The generation of knowledge about alternatives is crucial in this respect. Not just at the start of the project, but throughout the whole decision-making process, there needs to be a *redundancy* of knowledge about possible alternatives. Such knowledge can be generated by a project organization. However it is just as important to receive knowledge from external sources (Allen, 2001; Nonaka, 1994; Schindler and Eppler, 2003). Yet, in practice the tendency is to reduce the number of participants in decision-making and to be efficient in organizing project information. And this opens the project to high risks of deadlock (Teece et al., 1997) and groupthink (Henningsson et al., 2006).

Although redundancy refers to everything that is not essential for the immediate functioning of a system, in many instances it is seen as essential for survival over a longer period of time. In his seminal paper on the principle of redundancy, Martin Landau underpinned the need for additional information in order to enable the recombination of solutions under unexpected occurrences (Landau, 1969). An airplane is a widely used example of redundancy. There are about 15,000 systems identifiable in a plane, while it would be possible to run a Boeing 777 on a few hundred systems (Low et al., 2003). However, because of the many uncertainties involved in air travel there is a multifold of systems designed for safety purposes. This means that if one system fails an alternative is able to take over its function.

Redundancy is a way of dealing with uncertainty in decision-making and planning (Journard, 2010; Kane and Del Mistro, 2003; Low et al., 2003; Keeney, 1996). “If facts are in question, then we

simply do not have knowledge of the appropriate means to use in seeking an outcome. We may have hunches and rules of thumb and we may write elaborate plans which anticipate all conceivable outcomes, but these are only hypotheses. It is, therefore, an obvious and “rational calculus” to employ a pragmatic and experimental procedure: that is, a policy of redundancy which permits several, and competing, strategies to be followed both simultaneously and separately” (Landau, 1969: 355).

In practice, however, there are tendencies to close the system to external actors and information early on in the process. Decision-making may proceed via the selected trajectories but planners and policy- and decision-makers need to find a balance between closing moments moving towards the intended goal and re-opening the process time after time to develop a proper feedback mechanism, such as Allen illustrated with the so-called Law of Excess Diversity for complex systems: “For a system to service as a coherent entity over the medium and long term, it must have a number of internal states greater than those considered requisite to deal with the outside world” (Allen, 2001: 175).

We identify two operational indicators of redundancy: 1) redundancy of actors and 2) redundancy in knowledge. The implementation of mega projects is generally organized via the closed arrangements of project organizations (the contractual decision-taking). The process of reflection and making decisions, however, should involve a wider range of actors and provide more feedback mechanisms than is strictly necessary. The second operational indicator of redundancy is closely related to the open actor constellation of decision-making. It focuses on the organization of knowledge to examine different trajectories and realize the project. Knowledge should be fueled by ‘outside-in’ strategies instead of being monopolized by stake-holding project management.

2.3. Resilience

The concept of resilience deals with the ability of the decision-making process to deal with unexpected influences without risking indefinite delays in the process. This involves the ability to entertain “flexibility and adaptability, and preparedness to cope with uncertainties and unanticipated situations and directions” (Handmer et al., 1999: 269). Resilience can be reactive or proactive (Dovers and Handmer, 1992). In other words, decision-making can be aimed at returning to a particular equilibrium or it can already be designed to change and adapt.

Reactive resilience is the approach whereby a stable position is assumed that is protected against external shocks. A proactive approach assumes that an unstable environment requires adaptation. “Moreover, in the face of recognized uncertainty and complexity, policy formulation processes, and the research that supports these, [planners] must be open to the possible need for unexpected or unconventional responses to issues. The emphasis becomes the development of an ability to manage a range of possible directions.” (Dovers and Handmer, 1992: 276). Resilience relies on the availability of a redundancy of options, alternatives, and directions in order to recombine different pathways.

Clearly, resilience is closely related to the previous notions of strategic ambiguity and redundancy. First of all, there should be adequate redundancy of information to enable recombination of the policy trajectory. Secondly, it is important not to close the process to external influences more and earlier than necessary. Resilience implies that key decisions are made in the short term that leave space to maneuver in future decisions. If the mega project starts as a narrowly-defined solution as mentioned above, then everything becomes a threat to it. It becomes path dependent: options to improve the project more than marginally are unlikely to be generated. From a problem perspective, resilience means that the commitment to the mission and overarching goals

Table 1
Conceptual scheme.

Strategic ambiguity	Redundancy	Resilience
Abstraction of project mission	Actor constellation	Proactive
Recognition of competing purposes	Organization of knowledge	Reactive

remain intact; however, the chosen solution can still change.

To summarize, we advocate a strategy guided by a certain ambiguity on the principal aims of the project; a redundancy of actors and knowledge stretching beyond the project organization; and measures to enhance the project resilience, or its capacity to overcome the unexpected. This approach contrasts with strategies prevalent in practice, which are directed at closing the decision-making process. We introduced three coherent concepts of feedback aiming at the widening of project horizons and present an overview of them in Table 1. The operational indicators of these concepts will be tested in the next sections that investigate the management of mega project decision-making in practice.

3. Methodology

For this paper we have investigated two large transport projects in The Netherlands to expand on work done in Giezen (2013). The first is a high-speed train line that runs from Amsterdam to Brussels and Paris. And the second is an interregional transport project that links different transport systems between Rotterdam and The Hague. These cases are chosen because they concern both line transport infrastructure that cost more than \$1 billion, with the latter seen as indication of their ‘mega’ status, an indirectly of their high degree of complexity and uncertainty (Flyvbjerg, 2014). There are not many of these projects in the Netherlands and these two were especially interesting because of the different actor constellations of ownership. For the HSL the ownership of the project lay primarily with the national government, while for the RandstadRail the ownership is divided between the municipalities of Rotterdam and The Hague, and the national government. The analysis is done on the basis of newspaper articles, policy reports, and interviews with key stakeholders (see Table 2). The interviews consisted of narrative interviews and hypothesis-led interviews generally combined in one interview. The first focused on reconstructing the process through stories about crucial moments in the process (in particular, moments of stagnation and breakthrough – seen as key for identifying how the project dealt with the need to adapt). The second focused on particular issues such as the driving forces of decision-making and issues of risk and uncertainty. Questions in the first interview were of the following type:

-What were the crucial moments in the decision-making and planning process?

Table 2
List of interviewees.

Type actor	RandstadRail	HSL
National government	2	2
Regional government	2	–
Local government	2	1
Rail Network Provider	1	1
Municipal Transport Aldermen	2	–
Transportation company	3	2
Academic expert	1	2
Local community member	1	1
Consultancy	–	1
Environmental Action Group	–	1

-What were the moments of breakthrough or stagnation?

Questions in the second interview are of the type:

-What role did risk play in the decision making and planning process?

We then coded the answers in Atlas.ti. We first coded for moments of change or deadlock, and then we classified these according to our definitions in the theoretical framework above. Table 2 provides a list of the anonymous interviewees according to function title or company. These were selected on the basis of a Parliamentary Enquiry (TCI, 2004a) and suggestions made by interviewees. Additional documents were used for the reconstruction of the decision-making process but the interviews were used to determine whether and what type of adaptation took place.

4. Strategic capacity in two mega projects

4.1. HSL-Zuid

The high-speed train line HSL-Zuid, between Amsterdam and Brussels and Paris, is probably one of the best-known pieces of rail infrastructure in the Netherlands (well documented through a parliamentary inquiry (TCI, 2004a, 2004b). Famous for its cost and time overruns, is it nevertheless an innovative project in issues such as public private partnerships and cost-benefit analyses. The project is very much a child of its time as there was at the outset a lot of funding for infrastructure projects due to profits for the State from selling and taxing natural gas and the privatization of state entities. The route is schematically shown in Fig. 1.

In 1977, the HSL first entered the public domain with the AmRoBel report (Ministerie van Verkeer en Waterstaat, 1977). For about a decade it remained on the agenda through PCBA, a working group consisting of the Ministry of Transport, Public Works, and Water Management, and the railways. The group continued to explore possible high-speed connections between



Fig. 1. Route HSL-Zuid (Giezen, 2013).

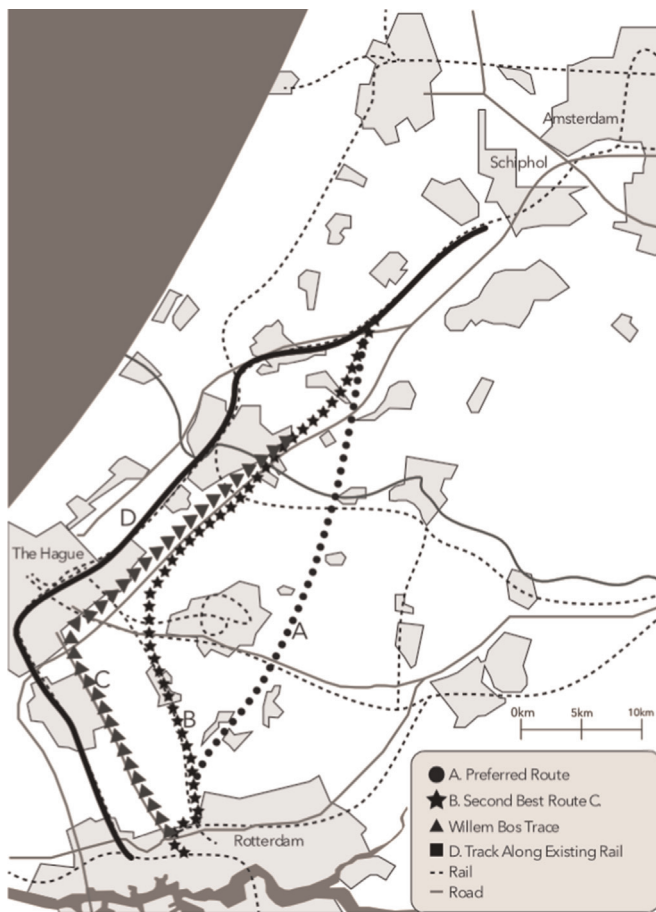


Fig. 2. Map of alternative routes (Giezen, 2013).

Paris, Cologne, Brussels and Amsterdam and presented its final report in 1988 (Ministerie van Verkeer en Waterstaat, 1994a; SCNF et al., 1988).

At crucial moments in decision-making on the HSL, the process was dominated by political discussions about route alternatives and in particular the options shown in Fig. 2. Route A, the preferred option by the project initiators, offered the most direct connection between Rotterdam and Amsterdam, straight through the open space of the so-called 'Green Heart'. Route B, by contrast, would avoid the Green Heart completely. Route D followed existing tracks connecting the cities and Route C bundled the HSL with existing road infrastructure between Amsterdam, The Hague and Rotterdam. Eventually the preferred Route A route was realized, although route C, an option proposed by engineer Willem Bos late in the process, gained strong political and public support. Route C would have solved many problems as it spared the Green Heart and also linked The Hague to the HSL, without losing too much on speed. The current state (April 2015) is that the line is in operation with a speed of 160 km/hr for trains with national destinations and up to 300 km/hr for journeys to Belgium and Paris. There have been large delays because of issues with the safety system that had not yet matured. The trains that were supposed to travel at high speed to national destinations have been found to have so many structural flaws that both the Dutch and the Belgium railways have canceled them. The reduced travel times are thus purely the consequence of reduced distance, not an increase in speed. (Tables 3 and 4)

4.2.. Strategic ambiguity

During the decision-making process two ambitions dominated. The first was to link the Netherlands with the European high-

Table 3

Crucial moments HSL-Zuid 1977–2009 (problems with the trains continued till present but this research focusses on the infrastructure).

	1977	AmRoBel report: route study for high speed train Amsterdam-Rotterdam-Belgium
	1979	HSL Zuid first appears in Strategic National Documents
	1986	PBKA report: viability study on train lines between Paris-Brussels-Köln-Amsterdam
	1987	Starting Note: beginning spatial core decision procedure to establish HST
September	1993	Decision to make a new HSL Green Paper (Ministerie van Verkeer en Waterstaat, 1994)
March	1994	Presentation of 'the new HSL Green Paper'
	1994	Public consultation, marked by intense debate about the route to follow
May	1996	Decision made to build a tunnel under the Green Hart
May	1996	Final decision by the government sent to parliament
July	1996	Belgium and Netherlands reach an agreement about the route. The Netherlands pays €400 m as compensation
July	1997	The Spatial Core Decision HSL Zuid comes into force
September	1997	Parliament ratifies agreement with Belgium
February	1999	Start tender for infrastructure provider
April	1999	Start tender for transport provider, exclusively for NS
March	2000	Official start of HSL-Zuid construction
July	2000	Signing of base construction contracts
December	2001	Signing of contracts for infrastructure provider and transport provider
2003 to	2004	Parliamentary Inquiry on Infrastructure Projects (2004a)
	2005	Construction base finished
	2006	Southern section Rotterdam to the border finished
	2007	Northern part finished
September	2009	First paying passengers are transported

speed train network. The second was to use the HSL to improve the accessibility of Schiphol airport (an important flywheel of the national economy) and at the same time substitute air travel thus making a significant contribution to the environment (Ministerie van Verkeer en Waterstaat, 1996a).

The first ambition was clear. Linking to the European network was deemed crucial for the so-called 'main port' strategy of the Netherlands (Aarden, 1997; NRC Handelsblad, 1996). In general, the ambition to link to the European network was widely supported.

The second dominant ambition, using high-speed trains as a substitute for air travel, was also popularly supported. For environmental reasons it seemed important to provide a rail alternative to air travel for mid-range distances. At the same time, it could complement the long-range links offered by Schiphol airport, improving its intercontinental competitive position. However, the fact that low cost carriers and the low taxation on kerosene would limit the influence of the line was not discussed or foreseen. Yet the substitution ambition was abstract enough to receive support from a broad section of organizations, politicians and the public.

An ambition that received little exposure initially was the importance of the HSL for national rail transport. A number of respondents argue that opponents of the project did not pick up this ambition because they "aimed to show that the investment was too big for just a few yuppies traveling to and from Paris" (interview NS official). Later on, however, the importance of the investment on a national level would spark a discussion on not only alternative routes but also alternative projects such as alternatively investing the money in upgrading the whole railway network to 25,000 V. Keeping this national ambition out of the public debate might thus have been more important for proponents of the project than for opponents. In the main, however, both camps kept the tension between different purposes out of the decision-making process. This tension might have sparked more feedback cycles and alternatives than the decision-making on a

Table 4
Milestones decision-making process RandstadRail (1989–2010).

	1989:	First plans surface for a regional public transport network linking The Hague with Rotterdam.
	1995:	The public transport companies RET, HTM, ZWN (now Connexxion), and the NS publish the report “RandstadRail, de file voorbij”
	1995:	Introduction of the Stadsregio Rotterdam (SRR, Rotterdam region) and Stadsgevest Haaglanden (SGH, The Hague Region)
November	1996:	Exploration study. SRR, SGH, and the Province of Zuid Holland suggest a light rail system that would cost between 3 and 6 billion guilders (€1.3 to €2.7 billion, (1996)). National government requests cheaper solutions
December	1999:	Additional advice by the RandstadRail Steering Group (State, PZH, SRR and SGH) to achieve higher quality of transport suggesting linking the lines to the urban rail networks and making the line between Rotterdam and Zoetermeer a high quality bus line. The foreseen investment is €0.84 billion.
December	2001:	Administrative Agreement between the national government and the regions about the financial aspects pending the subsidy application
December	2002:	Approval of the application by the Minister of Transport. This enables the regions to continue with the preparations for construction.
June	2003:	Start of construction in Rotterdam.
September	2005:	Concession for transport and maintenance of the infrastructure in the region Haaglanden and the RandstadRail line 3 and 4 is given to HTM (The Hague Transport Company)
February	2006:	Concession for transport and maintenance of the Hofplein line section (the Erasmus line) is given to RET (Rotterdam Transport Company)
November	2006:	Derailments occur in line 4
October	2007:	Line 3 and 4 is operational between the Uithof and Zoetermeer Oosterheem. This means that RandstadRail The Hague is now fully operational
August	2010	Rotterdam Section RandstadRail becomes fully operational

high-speed train connection could have withstood.

A similar reasoning might be applied to a second neglected ambition, that of spatial development. The project was presented solely as an infrastructure/transport project while the ambitions on spatial development (e.g. impacts on cities and natural areas) were not included in the discussion. As some respondents mention, the legal procedure for planning large transport projects is not very compatible with an integrated spatial planning approach (Interview Green Lobby Stichting Natuur and Milieu). The institutional system around large transport projects is strongly aimed at getting the project through the decision-making process and not on developing alternative solutions to the spatial planning problems that one would like to solve. It is not designed for, nor do the dominant actors see the benefit of a tension between these different purposes.

A concrete ambition mentioned in the starting document of the HSL was that the line would have to accommodate speeds of up to 300 km/hr. This served to limit the number of route options as the radius of turns, slope of the track, and the construction techniques for such high-speed track all have special requirements. Indeed, from this perspective the alternatives considered in the decision-making all compared poorly with the preferred route that was more or less a straight line between Schiphol and Rotterdam. The 300 km/hr criterion was introduced early in the project life cycle, thereby limiting alternative projects and routes in the decision-making process. The 300 km/hr criterion was also reflected in assumptions about the image of the project: “A direct high speed line upon which a speed of 300 km/hr can be reached has a larger appeal than a connection that is 20–25% longer with a maximum speed of 160 or 200 km/hr.” (Ministerie van Verkeer en Waterstaat, 1994b: 93).

4.3. Redundancy

The first starting document (Ministerie van Verkeer en Waterstaat, 1995) failed because it was very limited in its analysis of alternatives and consequences. There were so many unanswered questions in the consultation round that the document was pulled back from the decision-making process. One problem a respondent noted was that the note was prepared by the Dutch Railways, and then sent to the ministry to be analyzed for impacts and effects (Interview Project Leader). The comments from the ministry would then be sent back and the response was generally that the suggestions were impossible to implement. There was a strong communication problem within the project organization. For the new document, a new project organization was set up that incorporated many different specialist competences and eventually over 100 employees. As one respondent reflects, this created a machine that could calculate the effects of adjustments within a

week (Interview project group employee)-important in the negotiations with the municipalities as they could show how adjustments would affect the whole route and not just the section within that municipality. However, access from outside sources remained very limited. As a result, the Route C ‘Bos alternative’ (see Fig. 3), which appealed to many different interests, emerged only at a very late moment in the decision-making process and had to be hurriedly appraised and go through an environmental impact assessment (Ministerie van Verkeer en Waterstaat, 1996b) while the rest of the developed routes had already reached a final stage. Similarly, the possibility of a tunnel under the Green Heart came even later in the process (this solution was finally adopted). As one respondent argues, with the tunnel option the whole route could have been redesigned as going underground opens up a world of different possibilities (Interview Consultancy Group). The tunnel idea came as a compromise offer from the Ministry of Spatial Planning (VROM) who opposed the preferred route developed by the Ministry of Transport (Interview civil servant VROM). Although it would obviously make a lot of sense to include the institution responsible for spatial planning in the design of a spatial project, the HSL was developed within the transport sector and its ministry resulting in VROM’s opposition.

Information was a key element of the decision-making process. When making the decision on the alternative routes, the discussion focused on minutes of travel time. The Bos alternative was perceived as slower-between 6 min (interview Community Leader) and 20 min (Interview NS)-than the preferred route through the Green Heart. Information like this is often contested because it is difficult to determine which aspects are taken into consideration. One respondent (Interview Project Leader) stated that the project organization always presented all information without choosing. This is of course only partly true. In the selection of appraisal criteria and in determining the weights there are always choices that will influence the result of the appraisals. Interestingly, alternatives that once were filtered out, such as the Bos alternative, returned back to the table. So the narrow selection of alternatives, causing a lack of redundancy, was done too early and too rigidly, which led to alternatives coming back at a later moment, when there was insufficient time to appraise them properly, or to explore implications for the rest of the project.

4.4. Resilience

The HSL exhibited the general reactive resilience tendency that seems to be shared by large infrastructural projects. At one moment in time there is an alliance of actors who feel that a particular type of project should be developed and then it becomes very dedicated. One respondent (interview journalist) stated: “At one moment you decide to draw a line on a map and then it



Fig. 3. RandstadRail project.

becomes very difficult to stop that idea.” The HSL, from concept to definitive design, spreads over decades with different politicians, coalitions and actors. Yet the basic preferred route remained the same. The tunnel solution was the culmination of the reactive resilience of the preferred route. As it seemed the support for the Bos route was becoming a majority in the parliament with even two of the three parties in the government coalition backing the alternative, Prime Minister Kok had to step up and wield his power to push the preferred route through (Haan, 2004). He had to pressure his own minister of spatial planning and find the additional 900 million guilders (about €400 million) for the tunnel under the Green Heart in order to please this minister as well as the Liberal (VVD) minister of transport who favored the preferred route.

Two main resilience strategies can be identified in HSL-Zuid. The first was to create an organization that could generate many appraisals of alternatives. Theoretically, this could lead to a highly adaptive design strategy. Practically, however, the use was to show why alternatives were less desirable and changes in the route would be difficult. The second strategy was to develop an organization that could move in parallel. When a certain aspect would be obstructed, the organization would try to find a solution but would also at the same time work further on other aspects. The first type of organization would generate so much information that it would crowd out the opposition. It thus focused on generating a redundancy of information as a means of resilience, while the second looked for resilience by redundancy of manpower to develop the project in parallel.

Overall, it seems that reactive resilience is related to the availability of financial means (allowing e.g. to fund the tunnel and a large project organization). Or stated differently: the access to financial means limits the need for pro-active resilience.

4.5. RandstadRail

RandstadRail is an interregional transport project between the city regions of Rotterdam and The Hague. It consists of two light rail connections and a dedicated bus line as schematically shown in Fig. 3. The decision-making process for RandstadRail was dominated by a long period of negotiation under the umbrella concept of light rail without much detail on the specifications (TU Delft, 2008). The first concrete plans for interregional transport between the two areas surfaced during the late eighties. However,

it remained a latent desire until the public transport companies of the regions restarted the discussion with a jointly written report in 1995 (ANP, 1995; *Het Financieele Dagblad*, 1995). This was the same year the city regions – a metropolitan transport governance body – were founded. Together with the province of Zuid Holland, an exploration study was conducted the year after. The estimated cost of the proposed system was between €1.3 and €2.7 billion (ANP, 1995; *Het Financieele Dagblad*, 1995). The national state, as prime funder of infrastructure projects, requested a cheaper solution (Algemeen Dagblad, 2000). In 1999 the solution was found by using the existing heavy rail lines between the cities and the existing urban transport systems of the tram (The Hague) and the metro (Rotterdam), and downgrading the line between the town of Zoetermeer and Rotterdam from light rail to a dedicated bus line (Algemeen Dagblad, 2000). In 2001 an administrative agreement was reached between the different parties and construction started. The different sections were phased to be brought into use whenever finished, with the first section opening in 2006. However, in the same year already transport on certain sections was stopped because of derailments (Haan, 2011; OVV, 2008). In August 2010 the final section in Rotterdam was finished and RandstadRail is now fully operational. The project is especially interesting because of its long period of deadlock in negotiations, its taboo on the specifics of light rail, and the complexity of the different parties responsible for the project (e.g. Leijten et al., 2010).

4.6. Strategic ambiguity

For years, ambitions remained abstract – a light rail project to solve the increasing congestion in the region and linking the different new urban expansions between the two cities that were realized between 1998 and 2005. However, because the parties involved had different preferences for the specification of the system, clear decisions could not be taken. The Hague wanted a tram system and Rotterdam a metro system as these form the backbone of their respective urban transport networks. It was not until relatively close to the agreement in 2001 that the decision was made to separate the project into a section under responsibility of The Hague Region and another under responsibility of Rotterdam Region, or a tram and a metro solution respectively (Interview Transport Company). The early ambiguity was key, as we will see, to keeping the different participants on board. However, it had also less positive impacts. As one respondent notes, it

may have been the cause of later accidents (Interview local government employee). The specifications were decided upon at such a late date that there was not enough time to test the system properly and review the consequences of the decision. And the aldermen were strongly opposed to changing the starting date leaving only a few days for testing (Haan, 2011).

The abstract definition of the project mission as 'regional light rail' left the options open: it expressed strategic ambiguity in this way. However, as the two city regions would not change their local conditions the only alternative they could agree on was a completely new light rail system. This, in turn was much too expensive for the Ministry of Transportation to accept. Thus, after the first ten years, a deadlock situation was created. The plans had to be adjusted and the tension between the purposes only lessened when the novel idea of a combination of the two systems appeared to be cheaper than a new system and at the same time able to fulfill the dominant interests of The Hague and Rotterdam. The routes were divided, the money was divided, the responsibility for line management was divided, and the income was divided. The project is actually a collection of three projects that are kept under the same name because of the finance mechanism and a short overlapping section. This separation enabled the projects to move forward because this solution resolved the tensions between different interests.

The definition of the mission remained narrowly focused on transport because it was already difficult to reach an agreement on the functional specifications, let alone the surrounding spatial developments. The project linked several new urban expansions but was not used as an instrument of strategic integrative planning. The project avoided the potential tension between heterogeneous purposes by solely focusing on a transport infrastructure-defined project.

4.7. Redundancy

In line with the above-mentioned lack of integration with land use planning, the constellation of actors was limited. Nevertheless the group was already quite large and diverse with two regions and their municipalities, a national ministry, local transport organizations, heavy rail provider, and the national rail authority. Outside influence was limited to the obligatory consultations and responses to ad hoc concerns from lobbyists and inhabitants. Feedback mechanisms were not organized in a way to enrich the decision-making process.

The organizations of The Hague and Rotterdam also had different approaches to including a redundancy of actors and their knowledge. Rotterdam had an experienced civil engineering department tightly connected with the transport provider. Quick to tell the alderman or other administrators when something was 'unrealistic', the project team saw itself as a group of experts. This was less the case in The Hague where technical know-how did not match political desires (Interviews Regional Civil Servants). The lesser experience with large projects in The Hague can be seen in its problems with the tracks: the late decision to replace these and the choice for a particular type of switches was at the root of the accidents mentioned above. This shows that just organizing feedback is thus not enough, the quality and power of the actors also has to be adequate to provide a well-functioning feedback system. Redundancy is therefore not purely related to numbers of actors but also the specific characteristics and qualities of the actors and their knowledge.

In short, we can say that there was very little redundancy in RandstadRail's organization of knowledge and actors. Once the agreement was reached, there was no desire for external input because the feeling was that the decision was made and it was now just an issue of constructing the project. Knowledge was primarily organized at the municipal level as transport companies

and transport departments were still closely connected. The organization of knowledge was kept within the transport sector itself. For all its negotiations over the decades, the project remained a technical matter.

4.8. Resilience

The project showed several examples of reactive resilience. One was a tunnel in Rotterdam. This was not included in the original plans. However, public opposition against the preferred route at ground level was so strong that the engineering department had to explore alternatives. It came up with a drilled tunnel that would also offer the possibility to add an extra station in another area. This was a creative response of the project to external pressures.

Another reactive response was The Hague's late decision to replace the tracks. The quality of the tracks was found to be inadequate. However, this was only after the responsibility for the tracks had been handed over to them; a very reactive decision to something that could have been appraised well before.

An important decision that shows reactive as well as proactive resilience is the decision to strip the plans of the rail connection between Rotterdam and Zoetermeer. Although a few respondents and articles claim that there was not enough travel demand for such a large investment, it seems that the decision was mainly a financial and political one. The project had to become cheaper to fulfill the demands of the ministry. And this solution was something both Rotterdam and The Hague could live with as it was of lesser importance for them than the other sections. The decision to skip the rail line was thus reactive to financial constraints and a low transport potential. However, the decision to make a segregated bus line was proactive in the sense that it enables the municipalities to upgrade the line to light rail if and when the potential customer base grows. Whether this will ever happen is unclear but at least the option is there.

The tram tunnel in The Hague is also an example of proactive planning. As the plans were made to redevelop the inner city of The Hague, the transport professionals stated that a tunnel would be a good solution to future tram traffic caused by RandstadRail. However, at that time the RandstadRail project was all but certain. And thus the tunnel was built in such a width that also metro vehicles could pass through it. Thus resilience was proactively created in order to deal with the uncertainty of future developments.

5. Conclusion and discussion

This paper showed what might be needed to skillfully combine opening and closing strategies in decision-making on large infrastructure projects. Giezen (2013) discussed this need of balancing of the decision-making process and introduced the three institutional elements: strategic ambiguity, redundancy, and resilience. We have grouped it in this article under the notion of strategic capacity. While later articles have related this concept to adaptive capacity (Giezen, 2013; Giezen et al., 2014; Priemus et al., 2013), this article investigated the concept of strategic capacity more in depth by applying it to two case studies. While two cases are not enough to reach generalizable rules that hold true in every context, they do illustrate the usefulness of the concepts and the added value to the dominant mega project literature that mostly focuses on cost and time overruns (Altshuler and Luberoft, 2003; Cantarelli et al., 2010; Flyvbjerg, 2014; Flyvbjerg et al., 2003). The operationalization of the concepts seems to be the right level of abstraction for ex-post analysis. However, an ex-ante analysis might require more specific operationalization for policy makers to convince their political leaders to invest in for instance redundancy.

With respect to *strategic ambiguity*, the HSL case study became controversial and was attacked on the basic aims of its mission because it had not enough strategic ambiguity to be able to incorporate an emergent environmental perspective (preserving the Green Heart) and urban development perspective (connecting the city of The Hague). Connecting to *redundancy*, this was related to the fact that the project had too little redundancy of knowledge and actor constellation to enable innovative outcomes via recombination of solutions. This was less the case in the second project (RandstadRail). In this project the mission with respect to the aimed infrastructure was defined in more general terms, eventually allowing inclusion of different geographical and technological perspectives. However, also this project never moved beyond a narrow transport infrastructure planning definition of its mission, and never fully integrated a spatial development perspective. In both projects, there are expected spatial developments around the stations, but these are not integrated in the plans. The desire to close the decision-making process was greater than the desire to come to an integrative, adaptive planning process. As a result, in both cases the infrastructure planning and the spatial planning do not match optimally, which can be expected to become manifest in the next stage of exploiting the routes. Some evidence already appearing. The need to better connect the international city of The Hague to the European heartland and capital is leading to suboptimal ad hoc transport solutions and retrofitting. The lack of integration between RandstadRail and urban development is jeopardizing the realization of the potential for Transit Oriented Development (TOD) in the region.

With respect to *resilience*, from original conception to final go-no-go-decision, both projects showed mostly reactive behavior. The HSL was a national project and it was very unlikely that it would not be developed, which allowed it to be only reactively resilient. The reactive character of resilience was demonstrated in the numerous adaptations that were made to enable the realization of the initially preferred route, without questioning its rationale or seeking more than opportunistic integration with other perspectives. An environmental perspective came in only as counteraction that urged a compromise, while the urban development perspective was neglected. Linking resilience to redundancy, the analysis showed that the HSL organization did not offer the redundancy of knowledge and actor constellation that would have been needed for a more proactive resilience. For this reason, the very interesting option of policy recombination that incorporated all three perspectives (the 'Willem Bos alternative') did not get a real chance to be included in the adaptive decision-making process.

The second case study on RandstadRail illustrated an interesting tension between opening and closing strategies, proactive and reactive resilience. This project opened in a very general way with respect to the purpose of infrastructure, aiming for 'regional light rail infrastructure' without specifying how to integrate with the existing metro (Rotterdam) and tram (The Hague) systems. Following this proactive start however, the two city regions more reactively spent the first ten years quarreling about their different interests and, unable to find a compromise, came up with a proposal for a completely new light rail system. They then tried in vain to get it financed by central government. The situation that followed was a deadlock with parties trying to bring the project within the available budget at the Ministry of Transport without anyone losing out. Eventually they were able to resolve the deadlock by proactively breaking the project into separate but interconnected pieces of infrastructure, providing an acceptable compromise at an acceptable price. From then on a combination of metro system, tramline system and bus system became feasible: it was elaborated productively via the combination of different policy options.

The two case studies illustrate that it is important to have a predefined mission, but if the situation changes it is also important to be able to receive input from feedback mechanisms and to adapt the plan. There were important limitations in the measure in which the two cases realized the different components of strategic capacity, and it would be very interesting to explore in future research which possibilities and limitations a fuller realization would involve. We do not expect that the conclusion of this further exploration will be that the project mission and organization should be completely open, but that it should leave open alternatives and the possible reconfiguration of the mission and organization. As Giezen (2012) argues, the complexity of the decision-making should reflect the complexity of the project. The opening and closing of the decision-making process is assisted by having strategic ambiguities in its mission, redundancies in its knowledge and actor constellation, and both moments of reactive and adaptive resilience. Mega projects should accept this deliberate intricacy, as sensitivity to feedback mechanisms seems crucial to coping with the contextual complexity and uncertainty of the process. The cost and time overruns so prominent in mega projects (Flyvbjerg, 2014; Giezen, 2012) have many different causes. Our conceptual framework and empirical evidence indicate that many of the underlying factors cited in the literature such as scope creep, technological uncertainties and political ambitions could be attributed to the inability to reconfigure the mission and the project. While more research will be needed to make a definite inference about the relation between strategic capacity, the achievement of project goals, and time and cost overruns, this article opens the path to add an analytical layer to the well-established field of mega project research.

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