Managing Complexity: Achieving the Impossible?

Management between complexity and stability: a network perspective

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Summary
Modern decision-making is highly complex. Every initiator of a decision-making process is dependent upon a wide variety of other actors (and their resources) to achieve meaningful results. In this paper we track the resources of complexity in three dimensions:

- The uncertainty about content (and resulting negotiations about problem definitions and knowledge)
- The strategic uncertainty (as result of the involvement of many actors with different strategies, but also as consequence of the many places were decisions are being taken)
- Institutional variety (the different set of rules which are used by the wide variety of actors from different networks)

We also show that in this chaotic pattern of decision-making a few stabilising factors exist. These include the interdependencies, interaction patterns, rules and trust relationships in a network. We use a case analysis to illustrate these complexities and their stabilising factors. We end with some successful management strategies to cope with complexity in decision-making.

Introduction: an impossible job?

It was the summer of 2003 and the city alderman of Delft thought he would at last enjoy his finest hour as a public and political manager. After more than 10 years of negotiation with all kinds of ministries, local and non-local societal groups, regional public bodies, private companies and a wide group of professionals including architects, constructors and scientists, it would finally happen: the realisation of a large tunnel for the rail track which now laid in the heart of the city of Delft.[1]

From the moment Dutch railways (abbreviated: NS) initiated a plan to expand the two tracks of the railway to four tracks , the successive aldermen and the city of Delft had done everything they could to achieve a tunnel. The NS in 1988 proposed to construct an additional viaduct (with two rail tracks) above the existing viaduct. A proposal which was firmly rejected by the municipality at that time (and still is). This was because an additional viaduct would have made the tunnel 16 meters high, thus becoming the highest building in the centre. It would create a huge barrier in the city centre and separate the old part of the city from its other parts forever . The challenge was to avoid this horror scenario and at the same time achieve something interesting that would benefit the city of Delft. It required the mobilisation of other necessary actors and resources (not in the least financial), and the identification of aa realistic solution for the experienced problems. This would demand the utmost creativity and management skills of the municipality.

As in other countries, decisions about infrastructure are not the monopoly of local actors since they lack the financial funds for such investments. This has the consequence that the decision making becomes even more difficult and complex. It means that the financial means of central government has to be acquired. In The Netherlands it is the Ministry of Transport (T&W) that is responsible for distributing these funds. They use a complicated procedure called MIT (multiple year investments in transport) which requires long and detailed plans and financial overviews at each phase of a project. At any moment the Ministry has the possibility to cancel the project.

Achieving the impossible?

Indeed the last ten years had been hard and laborious for the municipality. They had to create support all over again after the rejection of the initial plan of Dutch Railways. In addition they were to convince the national parliament of the plan, create support from the involved ministries (Not only the Ministry of Transport but also the ministries of inner affairs, housing and environmental planning, economic affairs, financial affairs), while at the same time holding the local coalition together. An incredible amount of plans and options had been drawn and information was collected. The original ideas were gradually enhanced and improved so that they received wide support. Almost every scrap of critique had been looked upon and when possible incorporated in improved versions of the plan. Even the Ministry of Transport, who were initially critical of the idea of a tunnel, had to admit that the plan and the process in which it was drawn showed a quality far above the average they encountered. The fact that 20% of the costs of the tunnel were financed by revenues of a Public Private Partnership construction

was unique for the Netherlands. It was to be used the development of offices and houses on the space that would come free when the rail was realised in the tunnel, Never before had there been so much revenue realised for a project of its kind . By 2002 the ministry of Finance and, especially the Knowledge centre for PPP, was very enthusiastic about the plan and the Minister of Finance was a supporter of the plan. Earlier (in 1998) Parliament had reserved approximately 170 million euros in the MIT scheme for the project. This was contrary to the wishes of the Ministry of Transport who considered the tunnel project too expensive. At a later date Delft also succeeded in obtaining another 130 million euros (also from the MIT (regional program) fund) to improve mobility. Together with some other small contributions Delft had reserved 310 million euross in the MIT fund. This was, however, still not enough to realise the tunnel. In the same year (2002) Delft had made a final plan for the tunnel in cooperation with Pro Rail. This is the implementing section of the Ministry of Transport responsible for the maintenance of the rail track. Instead of the more than 400 million euro, which originally was needed for the plan from the Ministry of Transport, only 344 million euros was needed. This was a dream come true. The city alderman could say that his Delft plan was probably the only infrastructure plan of the last 25 years, which had become cheaper in implementation as time went on.

But just before his holiday the unthinkable happened. The city alderman received the message that the 310 million euros, which had already been included in the planning and budget scheme of the MIT of the Ministry of Transport, was being withdrawn. This was announced in the latest version of annual budget. The money had suddenly been shifted to the post maintenance of the railroad, another issue for which Dutch Railways had lobbied for intensively in 2001 and 2002. With the port in sight the ship had stranded.

Complexity in modern decision-making: a network perspective

Although the story is unique to Delft, it is reminiscent of cases in other countries. Many managers involved in partnerships in the UK, which required funding from central authorities (who would also impose performance indicators to those partnerships) could tell similar stories (Sullivan/ Skelcher, 2002). On the one hand, it involves a narrative about how such a change in decision could possibly happen. On the other hand, it can be consider an example of the incredible complexity, one could easily say chaos, in almost every public management domain in modern society. Decision-making takes place in an enormous amount of varying arenas and networks, it includes a staggering variety of actors that all have to be connected to one another. The movement of actors, their strategies and autonomous developments in arena and networks creates the image of complete chaos in which nothing seems to stand still or appeal manageable. This could also be the story of an extremely gifted network manager that succeeds in reining in these chaotic situations and almost succeeds in achieving a project in which no one else believed was possible from the start.

In this article[2] we focus on the complexity of decision-making. We consider both the stabilising aspects in these decisions and networks where decision-making takes place, and possible managerial strategies to tackle complex decision-making. In order to do this a number

of theoretical concepts are used to analyse and explain complexity in decision-making.[3] We use our case study both as an illustration of the theoretical concepts and as a vehicle to illustrate the way complex decision-making processes in networks can be analysed.

We will first focus on the causes and nature of complexity in decision-making and how it affects public managers (section 2). We then look at stabilising factors like interdependencies, rules and trust relations, which diminish the complexity somewhat (section 3). This is followed by an account of the managerial strategies that were used to tackle complexity in the case study (section 4). Finally, we concludee with some observations about the need for management strategies designed to deal with complexity in modern times (section 5).

Complexity in public management domain: the causes of complexity

The case we have selected is typical of modern decision-making. Decision-making takes place in networks of actors, but while they are all involved in the decision-making, cannot decide on the issue alone. The literature on network theory stresses that decision-making takes place in networks of interdependent actors that need each others resources or knowledge to achieve outcomes that are meaningful to them (Scharpf, 1978; Rhodes, 1988; Marin/Mayentz, 1990; Marsh/Rhodes, 1992; Kickert/Klijn/Koppenjan, 1997). We take this network perspective to illustrate complexity in decision-making and apply it to the case study.[4]

Reconstructing a decision-making case

Reconstructing a complex decision-making process is not easy. In this article we use the concept of rounds (Teisman, 2000; Koppenjan/Klijn, 2004) to describe the reconstruction. We view decision-making as a series of rounds marked by crucial decisions. Crucial decisions are decisions that change the number of players, the course of interactions or the content of the game. Crucial decisions can be decisions by political institutions but also the decisions (sometimes joint decisions) of other actors or crucial external events. The first crucial decision selected in this case[5] was the one that was taken to choose for a separate track for the high speed rail to Paris. This was selected because the consequence was the loss of interest of some of the main players in the Delft case, including the ministries and Dutch railways. The next crucial decision is the decision of Parliament in 1998 to reserve money for the project. At that moment several new actors re-entered the arena and the content, as well as the interactions, changed in character. The interactions became more intensive and they were more focused upon realising an acceptable proposal. Table 1 gives the general characteristics of the three rounds that result out of the two identified crucial moments.

Table 1: The Game around the Delft Central Station

	Prelude (1988-1992)	Toward a sustainable proposal (1992-1998)	Negotiations about execution (1999-2003)
Actors	Central actors: Delft, National Rail; Peripheral actors: Traffic and Water Management, municipal council	Central actors: Delft, Ballast Nedam (since middle of the 1990s); Involved actors: inhabitants	Central actors: Delft, VROM, T and W, RIB, BOSD
Intensity of interactions	Interactions more ad hoc and not structural	Intensive between municipality and local actors, between municipality and Ballast Nedam; no interaction with national actors	Intensive interactions between all actors involved
Stakes	Discussion about how a four-track rail line can be realised	Agenda formation: bring Delft tunnel to attention of national actors	Manoeuvre towards a financially, technically and socially acceptable solution
Important decisions[1]	Intention of four-track rail line (start of game) and Delft decides for a tunnel	Granting of money, stimulating intensive use of space (1998) and decision of Second Chamber to grant 360 M (1998)	Process agreement (2002) and tentative start document. Financial commitment of Delft for 100 million guilder, Haaglanden, 11 million Euro, BOR 280 million guilders.
Scope of interactions	Game is mostly local, some links to national arenas, modest ambitions (realising a tunnel)	Game is mostly local, national actors hardly involved. Substantive ambitions aimed at search for interesting solutions	Game unfolds in many arenas (local and national). Substantive ambitions increase (integrated development of rail, station, and city)

The first round consisted of starting up the decision-making process. It resulted in the decision of the municipality to aim for a tunnel and the loss of interest of central actors in this game (to complex, lower urgency). The second round is characterised by attempts of the municipality of Delft to activate central and private actors and develop the plan for a tunnel to attract support and attention. This round was concluded with a parliamentary decision and the renewed interest of central ministries into the project. The third round is characterised by strong negotiations between various actors, and particularly between the ministry of Transport and the municipality.

The complexity of the decision-making is primarily a consequence of the interdependence between actors to tackle the policy problem. This can be illustrated in the case of Delft by the inability of the municipality to finance the tunnel alone. Aside from money, which had to be acquired from various actors, the most important being the Ministry of Transport, Delft needed

support from a range of other actors. These included local societal groups and local political parties (legitimacy), support from central politicians in parliament (to attribute the money to the Delft project), support from all kind of specialists to bring in knowledge (constructing the tunnel but also creating architectural images of what could be realised after the tunnel is build) and support from private actors who can realise the ideas.

One actor could not take the decision of the Delft tunnel alone, but decisions were taken in a network of actors who all have had some influence on this decision. Realising the tunnel in Delft has not been about just one decision but a whole range of decisions that have to be in accord which each other as the introduction above has indicated. After a long number of decisions that gradually appeared to favour for the project, there was suddenly a negative decision taken in 2003.

Previous work has already indicated that complexity essentially derives from three causes (Koppenjan/Klijn, 2004):

- The fact that problem definitions and knowledge are not given but contested;
- The fact that decisions are the result of a wide variety of strategies in various arenas;
- The fact that decisions are embedded in complex institutional settings

Negotiations about problems and knowledge

Complexity arises when one begins to discuss the content of decisions. Identifying complexity from a network perspective should include an analysis of the various perceptions of the actors (Koppenjan/Klijn, 2004). This illustrates that content is fundamentally ambiguous in the sense that actors perceive the problems that are being discussed differently, have different opinions about the desirable solutions and make different interpretations of available information or research that is being done (Lindblom/Cohen, 1979; Rein/Schon, 1994).

This becomes clear if we look at how the various actors in the Delft case perceived the nature of the problem and the desired solutions. Table 2 provides an impression of the most important actors and their problem perceptions (but also their perception on solutions and urgency of the problem). For each actor the perception is given for each demarcated period of the decision-making process (period to 1992, from 1992 till 1998 and the period 1999-2004).

Table 2:
Perceptions of Actors according to Decision Making Period

Actor	Perception of dimension	1st period (1988-1992)	2nd period (1992-1998)	3rd period (1999-2005)
Municipality of Delft	Urgency	not at first, but growing fast after NS (Dutch Railways) initiatives	High	high priority, important intervention in city
	Nature of problem	Noise and pollution	pollution, the station and rail functions as barrier in the city	pollution, transport, economy
	Solutions	tunnel (possibly as part of the high speed train track)	tunnel, but with new buildings added	Tunnel and restructuring of area including a multi-functional station
Inhabitants (~organisations)	Urgency	first accepting the existing situation, quickly increasing	High	High
	Nature of problem	rail causes noise and pollution	Rail causes noise and pollution	Pollution and noise remain but also need to strengthen quality of area in city centre
	Solutions	not available	tunnel, no deterioration of the area	
Local economic actors (mostly represented by the chamber of commerce	Urgency	Reasonable	High	high
	Nature of problem	linking city with economic potential	linkage, economy, limiting inconveniences during construction	linking, (economic) liveability of city, limiting nuisance during construction
	Solutions	Tunnel	Tunnel	city architectural restructuring, new economic opportunities as a consequence of offices etc.
T and W (ministry of transport)	Urgency	only interesting when high speed line comes	no priority	hesitant but forced by political pressure and commitment of other actors

	Nature of problem	Infrastructure (Rail 21)	not a capacity issue	not really a priority for capacity problems, insufficient financial means
	Solutions	tunnel for high speed train	tunnel too expensive	tunnel but as cheap as possible, and fitting in the existing budget
NS (Dutch Railways, privatised company that runs trains) and Pro rail (organisation that maintains the track)	Urgency	at first present with expansion plans (laid down in document Rail 21) and with high speed train to Paris; after that limited	no urgency	no high urgency but interesting given bottlenecks in (distant) future
	Nature of problem	rail capacity issue	no problem	future capacity problem, financially too expensive
	Solutions	double the rail tracks	None	broaden tracks but as cheaply as possible; minimise financial and technical risks
VROM (ministry of Housing)	Urgency	Low	Low	interesting in context of policy towards combining environmental function (multiple land use)
	Nature of problem	no problem	Inner city structure problem, strengthening the central function	combining of functions, limited use of space
	Solutions	-	growing interest in opportunities to combine functions	multiple use of space through clever city architectural design
Ballast Nedam (private developer)	Urgency	Limited	interesting as development area	increased interest, development area and possibilities for knowledge enhancement
	Nature of problem	-	no good proposals available	financial and too limited opportunities for development
	Solutions	possible tunnel	tunnel and opportunities for re-development	integral re-development plan, enhancing economic benefits through integral plan

As should become clear from the table there are significant differences in the perceptions of the actors. While the inhabitants saw the rail as a noise and pollution problem, Dutch railways (NS) saw it as a capacity problem. It is not surprising that Dutch Railways has only been interested in a solution to their capacity problem. Their proposal to put another viaduct on the existing one solves this problem but actually makes the problem for the city and the inhabitants a lot worse. It is no exaggeration to say that there are strong conflicts in the perspective on the problem and the desired solution.

There is not only a conflicting negotiation in the process about the nature of the problem and the desired solution, however, but also on the available 'facts' (Lindblom/Cohen, 1979; Koppenjan/Klijn, 2004). There has been discussion about the amount of noise that trains on the track cause, about the necessary costs of a tunnel, about the benefits (both financially and otherwise) of the tunnel, about the number of trains that will run over this track in the future, and in short, about nearly everything. The main actors have been constantly collecting data on all these topics to fuel the discussion and steer it towards solutions that are favourable to them. The Ministry of Transport has conducted a lot of studies that have demonstrated that it is possible to run more trains on the two-track rail if more advanced information systems are used. Delft has frequently conducted inquiries into the amount of noise etc.

An important role has been played by research and information that has been organised jointly. In 1992 an inquiry was made to investigate underground solutions to various bottlenecks in the Dutch rail infrastructure. Delft was also included in this study after a request from the Municipality. The outcome of the research, which was initiated by the Ministry, was that the underground solution would result in the most benefits. Delft has always reminded the Ministry of that research and because both actors accepted its starting points, as well as the nature of the research, no one could deny the value of the results.

This illustrates that complexity in decision-making is strongly enhanced by the differences in perceptions between actors., the resulting different interpretation of information and research plays a role in the process. Among other things, decision-making is about negotiating different perceptions and trying to find a solid accepted base for searching for information and using information.

A myriad of decisions: strategies and arenas

The complexity of decision-making is also greatly enhanced by the different and autonomous strategies of all the actors involved. In most decision-making processes in networks of actors there is no great design to coordinate interactions but every actors chooses its own strategies (Hanf/Scharpf, 1978). The clash of all these different strategies can cause many unforeseen effects. In essence the classic prisoner's dilemma tells a similar story, but it is only relevant for two players. One can imagine the possible complexity effects when many more actors are involved in the game (Scharpf, 1997).

Indeed the complexity arising from interaction is exacerbated when we consider the fact that different (policy) decisions are often made in different arenas (playing ground of more or less coherent sets of actors, with organisational arrangements where decisions are being taken).

If we look for instance at the decisions on the financing of the Delft project which required the authorisation of the Ministry of Transport, it becomes apparent that these decisions were being made in a separate arena. This is arena where the earlier mentioned funds for infrastructure projects the so called MIT fund, are divided. It is an arena to which the municipality of Delft has no access. Only civil servants or the Ministry, The Minster and members of Parliament have the capability to enter this arena and influence decisions. In the case of Delft, there were many of these separate arenas where decisions were taken, and all of these were and are essential to the project. Table 3 gives an overview of the most prominent arenas and also identifies the networks where the arenas were located. From that table we can see that the case has truly been an example of multilevel governance.

Table 3: Arenas in the Game around Delft CS

Arena	Actors	Networks	Nature of arena
Delft Platform	Municipality, inhabitants, chamber of commerce,	Local network	Discussion on Central Station area between local parties
Delft cluster	University of Delft, Technical research organisations, municipality	Local network	Especially about knowledge development and exchange
PPP	Municipality Ballast (private developer), sometimes other actors (architects, contractors, other private parties)	Local networks and national private network	Discussion between municipality and private parties about possible development of area after tunnel is realised
Parliament	Political parties, and incidental actors (municipality of Delft, inhabitants)	National political network	Decisions about rail investments, priority of projects etc. (decision about the MIT fund!)
Accessibility offensive of the Randstad (BOR arena)	Ministry of Transport, provinces, city districts, municipalities	National and regional transport networks	Decisions about improving mobility and accessibility of the *randstad* region (= area between Amsterdam, The Hague, Rotterdam and Utrecht)
Stimulation multiple land use (STIR/IPSV arena)	Ministry of Housing (VROM), Innovation Institute (SEV for innovative projects on housing), external advisors and knowledge centres	Arena in network of Ministry of Housing (VROM)	Arena in which ideas about multiple use of space and innovative city development is supported and stimulating and where funds for that purpose are distributed
Infrastructure Investment Fund (MIT arena)	Ministry of Transport (T and W), Parliament	Arena in national transport network (T and W)	In this arena decisions are made about investments and infrastructure (according to strict phase model and requirements to enter each new phase)

As can be seen in the table these arenas were embedded in different networks. This makes connections difficult and laborious (Koppenjan/Klijn, 2004). Sometimes actors in one arena are confronted by important decisions from other arenas, which they did not anticipate. This creates a completely different game situation.

The theoretical notion of game (or games) and arenas also gives us a view of the 'flow of the game'. The game can become more extensive (and complicated!) because new arenas are activated. But the game can also become less extensive as arenas are disconnected.

Interestingly enough from a network perspective activating new and more arenas makes the game more complicated. It also enhances the opportunities to connect actors and decisions, however, and thus mobilises necessary resources. The case of Delft once again provided an interesting and stimulating example of this paradox of enhancing complexity and opportunities for problem solving, and achieving interesting solutions at the same time. Table 4 shows which arenas were activated during the various stages of the game

Table 4:
Decisions and Interactions in Distinguishable Arenas and Networks

Arena	Period up to 1992	1992-1998	1999-2003
Delft Platform	Interaction municipality and economic actors. Especially problem analysis and first formation of ideas	Access of organised inhabitants (BOSD)	Discussion in arena is formalised
Delft cluster	Does not exist in this period		Activated to enhance the number of alternative solutions, no decision making authority
PPP	Not activated	In the middle of this period an alliance of Delft-Ballast, first elaboration of tunnel alternatives and the surrounding area	Tight cooperation between Delft and Ballast, incidental involvement of other actors (e.g., architects, but also Dutch railways (NS) as owner of part of the land), further elaboration of solutions and their visual impact
Parliament	Not activated	Incidental lobby activities municipality and inhabitants organisations, success in 1998	Ad hoc participation of the municipality of Delft
BOR	Not activated	Not or hardly activated	Through the regional body (Haaglanden) this arena is activated by Delft. Results in contribution to tunnel, involvement and support of Haaglanden
STIR/multipl e use of area	Not activated	Toward end of period: request of example project of municipality (and inhabitants organisation). Accepted in 1998	Arena continues to be activated through VROM (budget investment of spatial quality). Plan must meet conditions
MIT	Activities in this arena are negligible	Except a brief discussion about the high speed train, this arena is not activated	The Second Chamber decision (end 1998) brings Delft into the MIT arena

As can be seen in the table decision-making expands and shrinks when arenas are activated and deactivated. The moment the decision-making game expands this requires more effort and skills from a management point of view (Koppenjan/Klijn, 2004). The complexity of the game enhances, more connections between actors have to be managed and developing a coherent content also requires more effort and attention. This is because there is a need to connect and incorporate more different perspectives of actors. It was not until the municipality of Delft succeeded in expanding the decision-making process to other arenas that the project

attained opportunities to succeed. This would indicate that complexity has been a necessary condition to reach satisfactory outcomes and achieve the project!

Institutional variety: the complex institutional settings of decisions

Besides complexity caused by the perceptions of actors and their different interpretation of information and knowledge, and the complexity caused by strategies and arenas, complexity of decision-making processes is also generated by institutional factors (Scott, 1995; March/ Olsen, 1989). If decision-making takes place in different arenas, which can be situated in different networks, actors will probably act from different institutional regimes. This creates difficulties in interactions because participants are not sure about basic interaction codes (Koppenjan.Klijn, 2004).

The already mentioned MIT fund, the procedure in which the Ministry of Transport attributes money to infrastructure projects in The Netherlands, prescribes precisely what type of decision has to be made at what time. It also prescribes the information and type of plans that have to be available. These very dominant rules, however, do not always accord with other deadlines and important decision moments. Another example of clashing institutional rules was the involvement of the private actor Ballast Nedam. From 1998 on this builder and project developer was involved in the process and conducted several studies on the development possibilities. These included both investigations into the area after the tunnel is realised, as well as on the construction of the tunnel itself. There is no possibility to reward this actor other than through payment after each activity was completed. Nevertheless both parties have viewed their cooperation more as a partnership than an incidental contractual relationship. Everything that is to be realised (be it the tunnel itself or any commercial activity in the area after the tunnel has been realised) has to be tendered according to the tendering rules of the European Union. These are strongly focused upon free competition and prohibit any guaranteed work in an earlier stage. They also prohibit the contribution of ideas from a private actor because if the work is later on tendered to another contractor the private actor in the partnership receives no benefit for its activities. This problem was solved by the municipality of Delft and Ballast with an agreement that if the tunnel was realised Ballast would be able to buy a section of the area at market price for development. The selling of land is not regulated by EU regulations and by this construction Ballast was made partner with profit possibilities in the future. These could only be realised however if the decision-making process was concluded. If the process failed to complete the project the costs of Ballast would be labelled as 'market risks'.

Thus decision-making takes place in a highly complex institutional setting. Each sector decision, like decisions on safety, on the construction of the tunnel, on noise and environmental aspects and so on, is ruled by their own separate rules (both formal and informal!). It requires that managers have to know and adjust to each others arenas (if possible). So while on the one hand decision-making is taken in a very crowded institutional space (which seems a better indication of the situation than institutional void as some authors argue (see Hajer, 2003), on the other hand there lacks a clear institutional framework for joint interactions because the game includes various rules from different networks (Koppenjan/Klijn, 2004). It

is an understatement to label this situation as a 'challenge' for the involved manager (or managers) of the decision-making process.

Conclusion: decision-making as chaos

Due to the complexity of various actors with different perceptions, the clashes of their strategies in various arenas and the institutional variety, public policy decision-making often looks like a complete chaos. It is a chaos caused by:

- Actors choosing and changing strategies that cause sudden changes in the decision-making process;
- Unexpected decision taken in various arenas (often not even included in the decision game) that pose sudden and unexpected conditions or change the relevance of already taken decisions;
- And complex institutional settings that cause difficulties in understanding or interactions between actors.

No wonder practitioners frequently complain about the difficulties to oversee and control decision-making, or about the possibilities to acquire adequate information to reduce the content uncertainty about a decision. Not to mention their dread of the laborious task of connecting necessary actors for vital decisions. Indeed it is no wonder that governments all over the world have been searching for new forms of governance that can meet the new requirements and situation they find themselves in.

Stability in decision-making: rules, patterns and trust

Although modern decision-making often looks like chaos, one can still find factors that create stability and continuity in decision-making processes. These can be called focal points because they create stability and a minimum of predictability in the complex processes of networks. The main focal points are:

- The resource dependencies between actors in certain problem situations
- The interaction patterns between actors involved
- The rules and regulations in networks as a source for certainty
- The trust relations between actors

We will deal with each of these focal points separately.

Resource dependencies and problem situations

As a consequence of the resource dependencies between actors around certain problems projects and problem solving processes, actors often do not have many alternatives than to rely upon a limited set of actors (Scharpf, 1978; Aldrich, 1979). We observed this clearly in the case of Delft. Despite changes in situations, conflicting strategies, differences in urgency and perceptions, and other obstacles or periods where some actors were less interested in

the issue, the constellation of core actors remained consistent. This is not surprising because these actors were in one way or another dependent upon each other for the ambitions they wanted to realise in this area. Even though these ambitions were quite different, the fact that they had to be realised in the same area and within the same crowded institutional space (with its number of protected rights and obligations) made life easier. It creates interdependencies and also reduces the possible courses of actions. Even in the case of strong conflicts and deadlocks actors have to take up interactions again so long as they have ambitions at stake. If they drop the ambitions completely they leave the arena until they are drawn in again because they have formulated new ambitions (or reformulate their ambitions) or because other actors in the area constructed ambitions that are interesting to them.

The municipality of Delft explicitly used this last strategy when she tried to enhance the content of the plan by adding extra elements like a safety plan for the tunnel. This safety assessment incorporated elements in a new version of the plan, and in turn led Delft to acquire the support of the Ministry of Home Affairs (which has strongly favoured the use of safety assessments). This provided additional support to Delft from within the central political arena.

These sometimes rather strong interdependencies can also be seen in large infrastructure projects in other cities in The Netherlands (Van der Ham/Koppenjan, 2002), and in other countries (see for the UK: Skelcher/Sullivan, 2002).

The interaction patterns between actors: the change of interactions

Within networks the same actors interact frequently which brings about certain kind of stable interaction patterns (Aldrich, 1979; Scott, 1991). If interaction and decision-making around a specific policy problem like the Delft tunnel goes on for a longer period within the same way stable interaction, patterns will emerge (or to phrase it differently the set of actors around the Delft tunnel itself becomes a network!)[7]

Through these interaction patterns actors can make contact with other actors and achieve relatively swift communication. Sustained interaction patterns make certain contacts easy and probably more likely. This is one of the reasons that the literature often speaks of closed networks. These are closed in the sense that they favour certain contacts over others. This is not to say that contacts with other actors are impossible or forbidden (although sometimes certainly rules of exclusion do exist. If this is the case they strengthen and sustain closed interaction patterns. This is discussed below). Regular interaction patterns simply create predictability and a situation wherein certain contacts are more likely than others. If the municipality of Delft has regular contact with Ballast and open channels to exchange information, it is more likely that they will use these channels, even for other aspects (maybe even aspects that are not connected to the decision of the Delft tunnel!). Sustained interaction patterns create the likelihood that certain interactions will happen. As such they form a focal point in chaos.

Rules: signposts in the chaos!

During their interactions actors are shaping rules (Burns/Flam, 1987; Klijn, 2001). These can be either formal or informal. Sometimes they are already available when the network is formed, as became clear in the previous sections about the crowded institutional space. Alternatively these rules can be formed by actors during their interactions in the game(s). Rules form thus the infrastructure of networks and as such are probably the most important focal point in the chaotic interactions in networks.

After a well-known distinction between structuring and regulating rules (see Searle, 1971; Duintjer, 1977), we assume a distinction between arena rules and interaction rules. *Arena rules* are rules, which provide the actors with a handle for determining the nature of the network and an arena in which they find themselves. They specify positions, realities and pay-offs. They are thus rules, which define the nature of a social practice. As such they are at times barely recognisable as rules and sometimes are of an almost tautological character. The rules have somewhat the character of what Searle, the English analytical philosopher, calls structuring rules (van Eemeren/Koning, (1981), Searle, 1971). A structuring rule, for example, is one, which defines when someone in a chess game has been placed in checkmate. Checkmate is when he is unable to make a move to get himself out of check. These are thus rules, which define the nature of the game.

Interaction rules have a more procedural character and tell actors what is and is not permitted within a network. They modify as it were behaviours within the context of the arena rules. An overview of the two types of rules and examples can be found in Table 5.

Table 5. Types of rules in networks

	Description	Aspects	Examples
Interaction rules	Rules which regulate interactions in the game; i.e. Rules which specify what is and is not permitted in games between actors	Access to policy game (structure who may enter the game, exit options and more)	-Exclusivity -Selection -Exit options
		Interaction in policy game (structure what is permitted or not and 'normal' in interactions)	-(Non) intervention -Provision of information -Conflict
Arena rules	Rules which regulate the game setting; i.e. Rules which specify what type of game and network is under discussion in any given case	Reality (structure what actors consider as core business, crucial or as quality in their network)	-Identity of actors -Product rules
		Pay-off (structure the benefits and costs for the actors)	-Status -Evaluation criteria
		Positions (structure positions of actors and relations between positions)	-Status -Power

Adapted from: Klijn, 1996, 2001

Interaction rules may focus on the access to the network or the arena, or on the interactions within the game. Access rules determine how exclusive games are, how actors are selected for particular games, and which exit options they have. A non-intervention rule is a clear example of an interaction rule similar to those rules about what information is made available and rules for dealing with conflict.

Access rules determined for instance that the Municipality of Delft had no access to the MIT arena where the money is divided for infrastructure projects in The Netherlands. The only thing they could do was lobbying as a strategy in which an actor stays outside the arena and tries to influence the arena by means of another actor. Since this was not possible through the Ministry of Transport, Delft used the parliament repeatedly as mean to stress the importance of the project. The municipality of Delft successful lobbied at Parliament. This was first illustrated in 1998 when the Parliament first earmarked money for the project. In the years that have followed there have also been several parliamentary motions accepted which stressed the importance of the project accepted (the last time in the fall of 2003 after the money was withdrawn from the MIT schedule in the summer of 2003). In this way the Ministry was pressured to reserve the money or to sustain that reservation.

Within arena rules three subsets of rules may be identified: reality rules, pay-off rules and position rules. Reality rules specify primarily what constitutes good and bad arguments, information and standards for actors. Professional codes concern the behaviour (e.g. physicians) of actors and/or quality of products (e.g. good-quality housing). In addition, arena rules relate to the pay-off rules (financial but also non-material) and the dominant position in the network.

These sets of rules specify conditions and limitations for interactions. They thus form the main structure in the chaotic decision-making in networks. They construct well know aspects like the closeness, the 'language' and the power of networks:

- Closeness of networks; closeness of networks is regulated by the interaction rules which determine which actors are admitted into games in the networks. These may be formal rules (which regulate consultation, for example) but may also be informal rules. Closeness is however also determined by other rules. The product rules may be so specific and complicated that considerable knowledge is needed to master them. This does not refer to a closeness that is more or less conscious, but closeness as a result of high entry costs. Closeness may also be a consequence of the identity and product rules, certain problem formulations and/or solutions which are simply not taken into consideration. This touches upon the power dimension, which will be discussed further below.
- The language which is used in the networks; It is often emphasised that in networks, particularly those of a sector character, specific modes of expression, terminology and jargon are used that may cause misunderstandings. This relates chiefly to the identity and product rules which apply in networks. These may include the strict regulation of what constitutes quality products and services, which quality requirements are considered standard and thus how communication occurs regarding, for example, solutions or problems. The MIT for instance prescribed the product standards that had to be met

(in terms of details of the plan, financial underpinning and available research) very strictly. It also identified the procedure that had to be followed to be able to acquire the subsidy.

- The power and resource dependence in networks; Power is in essence the perception by other actors in the network of another actor's influencing potential. This perception is regulated by position rules, which determine whether or not an actor is respected. They are also determined by what is permitted in a network. In short, they are partly dependent on the access options (which actors may, consciously or unconsciously, be excluded), and the mode of communicating about (policy) issues (which subjects are allowed in discussion and how). In other words they are able to determine the product and identity rules of the network. This last dimension of power is usually referred to as mobilisation of bias (Barach/Baratz, 1962). Through an analysis of these dimensions of the network via rules, an insight may be gained into this grimmer side of network institutions (Knight, 1992).

Trust and trust relations: the rationale of networks?

If we assume that every action an actor undertakes is only based on opportunistic motives, like some economists as Williamson (1996) does, cooperation would almost be impossible. This is especially the case in highly complex interaction settings where innovative solutions have to be developed (Nooteboom, 2002).

If actors would solely rely on rational opportunistic behaviour they would never cooperate in these situations. Cooperation would simply not survive because the outcomes are too uncertain and the chances of opportunistic behaviour of other actors too great. Williamson tells us however that trust is a confusing concept because it amounts to nothing more than risk-taking. Or as he concludes in his essay on trust: "calculative relations should be described in calculative terms, to which the language of risk is exactly suited" (Williamson, 1996, pp: 275). In his view, the notion of trust blurs the argument, because one party takes the risk that the other party may be acting opportunistically, and the notion of trust as acting in good faith (without calculation) does not add anything useful to the analysis of the situation.[8]

Despite what Williamsons tells us strategic choices of actors in complex situations cannot be reduced to risk taking. Risk taking assumes that a calculation (or at least a prediction, how incomplete that may be) can be made on the basis of which a rational decision can be made. The assumption of calculation however does not fit the assumption of bounded rationality, which is the anchor stone of neo-institutionalism. If possibilities of information gathering are limited, then this certainly holds true for opportunities to assess strategic behaviour of other actors. It is therefore impossible to base all decisions on a rational calculation of costs and revenues only. This is because the institutional rules are not enough to reduce these uncertainties in contacts between actors. With this assumption of risk taking and calculation the neo-institutionalism of Williamson returns to the same kind of hyper rationalism that she apparently rejected in the classical economic approach.

Not surprisingly there is growing literature on trust in economic theory of contracting and business that points out that trust can facilitate decisions to cooperate. Some of this literature

stresses that trust relations are an asset which give firms an extra strong position on the market because they are able to exchange information and create innovative products which firms who lack these trust relation cannot (see Ring/van der Ven, 1992; Lane/Bachman, 1998; Sako, 1998; Deakin/Wilkinson, 1998).

In complex interaction decisions, such as those in the Delft case, trust is important for cooperative strategies of actors.[9] Trust will encourage actors to exchange information, to engage in interaction and take risk and trust is a positive factor for engaging in innovations (Ring/Van der Ven, 1992; Parker/Vaidya, 2001; Nooteboom, 2002, Edelenbos/Klijn, 2007). Trust reduces the uncertainty about possible strategic reactions of other actors and thus reduces transaction costs. It cannot always improve and enhance performance of cooperation but does facilitate cooperation and solidify it (Edelenbos/Klijn, 2007).

If it is such a miracle instrument why isn't it present all the time? There are several reasons for this but an important one is that trust has to be created and sustained by interactions and thus brings about interaction costs (other reasons: trust can be broken easily, takes a lot of time to establish and is difficult to enforce). Table 6 gives an overview of the trust relations of the main actors in the Delft case (identified by questionaires and interviews) and the interaction frequency between actors.

Table 6:
Trust relations and interaction frequencies in the Delft case

Trust relation / Interaction frequency	High trust	Moderate trust	Low trust
High	- Local actors and municipality - Ballast Nedam and municipality - Chamber of commerce and private actors	- Municipality-Pro Rail	
Moderate		- Municipality- ministry of housing (VROM) - Municipality- ministry of Finance - Municipality- ministry of inner affairs (BIZA)	- Municipality- ministry of transport (V&W)
Low			- Ministries-private actors - Inhabitants-ministries

As we can see in table 6 there is was a clear connection between the frequency of interactions and the level of the trust relation in the Delft case. This is not surprising since trust relations have to be built up and it is unlikely that strong trust relations will exist between actors who do not interact. This is probably *a key logic to the existence and maintenance of network*s, besides the dependency relations. Engaging in networks and interaction with other actors, allows actor to build trust relations, which they can use to achieve better products, policy or performances, acquire (new) information or solidify cooperation!

Focal points: the strength of path dependency

If we look at the discussed focal points they have at least one thing in common. All are the result of past history and have been formed during interactions between actors. One can say that all were created consciously or unconsciously by human interactions during past interactions, or as a result of those interactions. In that sense order in the chaos is a matter of path dependency, or rather of meaningful social constructions that actors have created in the past. Inevitable this has the consequence that focal points are changing because what is man made, man can also change.

Managing the chaos: recommendations for successful management

Despite the hopeful text about that focal points that can create some stability in the flow of interactions and decisions, one may still get a little depressed when it comes to offering sensible advice about how to manage these interactions.

On the other hand the Delft story despite its possibly negative outcome does give hope for the achievement of successful management. Despite the lack of interest after the initial NS proposal in 1988 the municipality succeeded in putting the project back on the agenda, on achieving large support for the plan from almost all the ministries, local and regional actors and in achieving a content of the plan! It even managed the process, according to its greatest critic the Ministry of Transports, in a far better way than is average in such situations. Therefore it is useful to look at the management activities of the municipality and connect them to the three sources for complexity we addressed in section 2: negotiations about problems and knowledge, the myriad of decisions and the institutional variety. Rather than discussing all the possible strategies for each of the causes of complexity (for that see: Koppenjan/Klijn, 2004), we focus on the success factors of the case.

Managing the content: the power of a good idea

When addressing the content of the tunnel project the Municipality of Delft operated along two principle lines of strategy. On the one hand they were thoroughly dedicated to the idea that a tunnel must be achieved and were willing to invest a lot of time and money to attain that ambition. But on the other hand they were constantly exploring new ideas, information and additional solutions, which could improve the original plan

While the municipality firmly rejected the first solution of Dutch Railways (NS) and has remained determined about that, she explores various possibilities to realise a tunnel and to connect other aspects/solutions to the development of the plan that would convince other actors to support or to enter the process. A few examples of such strategies included:

- In 1998 the municipality applied for subsidy by the Ministry of Housing, which had a stimulation program for multiple land use. Subsidy could be received for research and development to improve the multiple land use character of plans. The plan was accepted and Delft used the money to let a Catalonian architect (Busquets) draw a development plan for the arena above the tunnel. This sketch helped to elaborate the plan, receive

support from the Ministry of Housing and to visualise the spatial possibilities for local actors. In this strategy one can observe several management strategies for network management like the promotion of more variety and the promoting of cognitive reflection (by introducing new actors)

- In the most recent years a safety plan was constructed and a safety impact assessment (Veiligheids Effect rapportage) was made because Delft volunteered as pilot municipality with the Ministry of Home Affairs to make such a Safety Impact Assessment. This had several effects. First of all safety problems were identified (together with local and other actors involved in safety problems) and successively implemented in the draft plan for the tunnel, which was made by the municipality and Pro Rail. This draft was one of the first to correspond with the safety regulations for transporting dangerous goods. Since these provisions were incorporated in an early stage of the plan and because the municipality kept a strong communication line between the group that had drawn the safety plan and the group that was busy designing the plan for the tunnel, the extra provisions for safety were incorporated at relatively low costs. In addition it enabled the municipality to obtain strong support from the Ministry of Home Affairs. Through being pro-active, and managing both the content and the interaction process, the municipality succeeded in improving the content quality of the plan, as well as raising additional support at relatively low costs.
- In arranging its relations with private actors (mainly Ballast Nedam and Dutch railways) the municipality tried to use some of the innovating contracting initiatives that the Knowledge Centre for Public Private Partnerships of the Ministry of Finance advocates. The assistance of the Knowledge Centre was also used to organise and draft the contracts. This not only achieved clarity between the municipality and the private actors, but also generated the support of the Ministry of Finance who was keen to promote PPP (and preferable through innovative forms of contract). In this way the plan was enriched and updated with the latest ideas on partnership, while at the same time more support was created.

On the one hand, the complexity of perceptions and content were managed by varying the content and exploring new additional ideas to the core idea of the tunnel, while on the other hand also pursuing a strategy of enriching solutions and enlarging support. This was done by activating new actors that could bring in (new) ideas, promote goal intertwinement and substantive variety, as well as contribute to joint research.

Managing strategies and arenas: organising participation and connections

As the examples in the previous section have already shown Delft did a lot to guide interactions. Not only did the municipality set up various organisational arrangements to coordinate local interactions and keep the local coalition firmly together, but she was also very active in participating and lobbying in all relevant arenas.

- The municipality was very active in the central political arena. Connections with politicians in parliament were well developed and sustained. With every new elections the municipality took great effort in establishing new relations if sector MP's were replaced. The municipality also provided the MP's with (additional) information, which counterbalanced the information of the Ministry of Transport. Ever since 1998 when parliament set money aside for the project, parliament has continued to support it. This has provided an important driving force to keep the process going. The connections and managerial activities in this arena were also very important because the municipality had no other access to the MIT arena. On several occasions parliament forced or urged the Ministry of Transport to reserve money or to maintain the reservation.
- The municipality was also very active in connecting other actors to the project such as the Ministries of Home Affairs and Finance. As has been explained this was done by making a content connection through firstly making the project a pilot in the newly established policy initiatives of various ministries (such as multiple land use in the Ministry of Housing, safety assessment in the Ministry of Home Affairs and PPP and contracting of the Ministry of Finance). At the same time attempts were made in most cases to also manage the interactions and keep actors attached to the project. This proved to be very useful on other occasions (for instance deliberations in the ministry council about the project).
- In 2002 a covenant was drafted between the public actors to structure the process, evaluate the various possibilities, and make a final plan for the tunnel. This process covenant, which also laid down the positions and ambitions of various actors including the activities they were obliged to contribute, played an important role in the final stage of the process. The drafting of the covenant was also initiated by the
- municipality and again tied the various actors to each other.

Essentially managing the uncertainty in the variety of strategies and arenas came down to arranging interactions, choosing participation and termination in arenas, making agreements on how the process should be organised, agreements on participation and exit options, organising daily interactions and so on (See Koppenjan/Klijn, 2004)

Institutional variety: coping by means of a process design

For a municipality it is very difficult to change anything about the institutional variety. A large proportion of it has its sources at higher levels of the public organisation and cannot, or can hardly be influenced by a municipality. The possibilities for institutional design, and consciously influencing and changing institutional characteristics of networks (see Koppenjan/Klijn, 2004; Klijn/Koppenjan 2004), is hardly possible for a municipality.[10]

Therefore the municipality tried to cope with the institutional variety in every way it could. One of the most important ways was the process covenant, which has already been mentioned above. This document enabled the municipality to try to arrange not only the interactions between various actors in different networks, but also to commit these actors to the process,

thereby diminishing the possibilities of clashes between the 'logics' of different networks. The fact that all actors expressed their dedication to the project should be a slight guarantee that they also will do their best to solve institutional problems such as different procedures, different demands on subsidy and so on.

Conclusions: laborious process management or strong leadership?

In this article we have analysed the sources of complexity in modern decision-making by using concepts from a network perspective on decision-making and public policy, and applying these to an empirical case. We have identified stabilising factors in the chaos of modern decision-making and looked at ways to manage these.

The managing strategies that have been elaborated and the ideas from which they are inspired are far from uncontroversial. Actually the political and media attention seems to be moving away from accepting and dealing with complexity as is done in the Delft case. Recent discussion stresses the undesirability of long decision-making processes and advocates strong leaders who can make decisive statements and clear decisions without indulging themselves in all these complex networks of actors. This discourse is accompanied by a focus on leadership, the primacy of politics and a strong focus on clear and strong words that accompany the deeds. It is however very questionable if these advocacies for decisive leadership will bring us much further in solving societies complex problems. It does not solve the emerging complexity of society, the need for innovative solutions and the problems of the role of politics in society.

If we accept that society is changing and most products, services and policies are being realised in networks of actors, or that knowledge is dispersed, rapidly aging and becoming obsolete fast, then we have no alternative than to go to the path described through the Delft case.

Indeed, if performed properly it works! Just before the end of 2004 the municipality of Delft received with great pleasure the news of the Ministry of Transport: the Ministry will once again reserve money to realise the tunnel in Delft. At last the project can really be implemented and it would seem that all the long and hard management efforts have paid off. This was a consequence of the Municipality having a strong plan that was supported by a number of various actors at just the right moment when there were additional funds to acquire through the Ministry of Finance.

The proposal as it now has been developed is a superior proposal compared to the initial proposals for a tunnel. That is probably the other side of the story. Complexity and mutual dependencies forces the initiator to make the utmost of the proposal and search for an optimal combination of values and interests, otherwise the proposal doesn't stand a chance.
Seen from another perspective complexity and interdependence functions as a check and balance to search for strong support and look for innovative ideas for complex problems. In that sense complexity has yet another interesting aspect besides the fact that it presents managers and policy makers with challenges.

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Notes

[1] Delft is a medium sized city in the western part of the Netherlands near Rotterdam
[2] The city of Delft has research done. In 1993 it appears that the noise has risen far above the level of 45 db (85-95 db). This problem in general is acknowledged by NS.

Endnotes

[i] The research was done and made possible within a large external funded research (BSIK) on Innovative Land Use (BSIK-VRG).
[ii] These concepts are elaborated more extensively in J.F.M. Koppenjan, E.H. Klijn, Managing uncertainties in complex networks 2004 but are strongly rooted in a wider literature on networks and decision-making.
[iii] Recently there is more attention to complexity theory as a perspective on public policy. This perspective that originally comes out of the natural science, stresses complex and non-linear behaviour in systems and focuses on It uses ideas like co-evolution, feedback mechanisms and self organisation end emergent properties of systems (see Macintosh et all, 2006). Although there are certainly resemblances to the way complex decision-making from a network perspective is analysed it is not possible to deal with that resemblances in this article.
[iv] The case was studied in several ways. First a reconstruction was made on basis of a large amount of documents (policy documents, minutes of meeting and so on). This preliminary process description was then tested against interviews with all the main stakeholders. Some

of them were interviewed twice (a second time at a later period). The results on trust were acquired by using a questionnaire (which was also part of another research). The resulting case description and analysis was then presented to some of the key stakeholders for comments. It is not possible to present the whole case description in this article. A full (but Dutch!) case description is given in klijn 2004.

[v] Note that networks can overlap each other. If we use the definition of a network as "a more or less stable patterns of social relations between mutually dependent actors, which form around policy problems and/or cluster of means and which are formed, maintained and changed through a series of game"(Klijn, 1996; Koppenjan/Klijn, 2004 pp 69-70)) the important aspect is the stability. Actors of course can and will be members of more than one network (and thus are multiple included, see Weick, 1979). In this case it seems sensible to make a distinction between different types of networks. Besides networks with a sector character, which have mostly a rather stable and long lasting character (sector networks) one can find more fluent networks around specific policy problems (governance networks) or around specific implementation tasks (implementation networks)

[vi] Williamson explicitly rejects the value of trust. He tells us: "I argue that it is redundant at best and can be misleading to use the term trust" (see Willamson 1996: 256). Trust is only reserved for very personal relations (like marriage) and for institutions but not suited for relation between actors (Williamson, 1996: 273).

[vii] Trust is here defined as "a stable perception of actor A about the intentions of actor B in the sense that B will refrain from opportunistic behaviour even if the opportunity braises". Trust is considered as a perception and clearly separated from actions (although trust will lead to certain actions) and institutional characteristics like rules (although certain rules can support and enhance trust) (see Klijn, 2002; Edelenbos/Klijn, 2006 forthcoming).

[viii] Because of lack of space we won't discuss the variety of institutional design strategies (see Koppenjan/Klijn, 2006). There is however an interesting paradox. Although the general opinion among scientist and practitioners is that institutional changes are hard to achieve and require a lot of effort, one can see a wide variety of attempts at institutional change initiated by politicians.