

SUMMARY

Ambition

Internationally there is a huge desire to increase mobility by constructing new infrastructure. The European Union has an investment program of approximately € 600 billion up to 2020. At the same time we notice that while ambitions are high, the requirements put on new infrastructure have been rising over the years. This increase in demand is, for example, visible in the additional rules and legalisation that need to be complied with, such as those relating to flora & fauna, archaeology and soil decontamination. Additional pressure comes from the higher profile and more professional behaviour of stakeholders who are affected by Large Infrastructure Projects (LIPs) such as communities, pressure groups and environmental protection agencies. Apparently, in the implementation of LIPs 'good' is not 'good enough' anymore. Studies show that the results of LIPs are often regarded as disappointing in terms of money spent (cost overruns), late delivery and a general dissatisfaction from the stakeholders involved. On the basis of these facts, we can conclude that we are facing a potential deadlock between an enormous need for mobility on the one hand, and great difficulties in implementing LIPs to meet this need on the other. A possible solution to break this deadlock is by increasing fundamentally the quality of management of LIPs (figure 1).



Figure 1: Balancing requirement and the quality of management in LIPs

Based on this analysis we have formulated the following main research questions:

How does the implementation process of large infrastructure projects in Europe evolve, how are the characteristics of complexity visible in implementation of large infrastructure projects, how is this process managed and what are suitable ways to improve the management of the implementation process?

In order to answer these research questions, several choices needed to be made regarding the research approach. In our methodology we opted to investigate LIPs 'from the inside', which is not a coincidence, since we both are active practitioners

in the management of LIPs. In our approach we have tried to combine the worlds of science and practice: to develop theory based on empirical research. This study is an example of 'action based research'; since we were actively involved in the projects we have studied.

As can be read in the research questions, the main 'sensitising' concept used in this study is 'complexity'. During our first interviews with key players involved in the implementation of LIPs, this theme emerged quickly. Complexity is a term which is broadly used in practice to describe the management issues associated with LIPs. In addition the term is used in management theory and other fields of study, offering us access to a tremendous number of insights we feel can be potentially fruitful for managers active in these LIPs.

With this study we did not want to stick to national experiences – we wanted to meet the growing demand for more knowledge on an international scale and therefore we have researched projects in several European countries. So in order to answer our primary research question, the following six cases were studied, each of which are part of international transport networks:

- 1 Betuweroute
- 2 HSL-South
- 3 A73-South
- 4 Gotthard Tunnel
- 5 Lötschberg Tunnel
- 6 West Coast Mainline

The studied projects: characteristics and evolution of the implementation process

When performing an overall analysis we found that while there are many differences between the studied projects, it is clear that the characteristics of the projects studied and of their implementation processes also show some interesting similarities. Similarities can for example be found in:

- a Characteristics of the project
 - Tightly connected to their context
 - Multi player game
 - Implemented in a unique context
- b Evolution of the implementation processes
 - Non linear implementation process
 - Unique starting positions and events arising are of key importance
 - Complexity is visible in all 'rounds' of decision making

These similarities found in the cases studied are of high importance, because they mean that a comparison of complexity and management strategies is potentially fruitful. Even while the institutional context, which is of high importance, is different between countries, the analysis shows there are enough similarities to enable us to compare complexity and the management strategies to deal with that complexity.

The similarities found provide some first overall signs of complexity and provide a firm basis for the further build up of the study. But they are not exactly new findings: they have been illustrated by other authors in the field for these and for other projects. However one element emerged that has so far been largely been lacking description, or differently described in literature; namely that: “Complexity is visible in all rounds of decision making, and does not disappear or fade away towards the end of a project.” While it holds true that complexity is traditionally high during the early phases of the project, many of the elements of that complexity remain visible during the later stages of implementation. It seems that as soon as some important issues are solved, others will arise. And in addition: “Issues that appear to be solved often return to the centre of attention later on during the project. Clear examples of this were observed within the Highway A73-South project where important discussions regarding tunnel safety, location on the East or West bank and ecological compensation continued long after the ‘political agreement’ had been signed off. Another striking example are the discussions which continue within the Canton Uri associated with the Gotthard project which are unlikely to conclude soon since the ‘mountain alternative’, preferred by the citizens of Uri, is not to be constructed at any time in the near future.

Practitioners’ perceptions of complexity

The analysis of the storylines provided us with first indications on the occurrence of complexity and of its management. But these indications are mainly built on ‘outside observations’ resulting from a description of the case history. To put it differently: in this first analysis the complexity has been defined by the researchers and not by the key participants involved in LIPs. This is a fairly common approach found in the field, since the specific literature on complexity is for the most part fairly new, not tied to LIPs and has a dominant theoretical base. The views of practitioners are largely lacking in the task of defining complexity even while these participants need to deal with the challenges of complexity on a daily basis. For this reason we decided to dig deeper into the practitioners’ perceptions of complexity.

The word ‘complexity’ is often used by practitioners — mostly without explaining the meaning. A situation ‘complex’ for one manager can be seen as ‘simple’ by another. We have opted to start on by asking project managers and other stakeholders in LIPs the question: “What makes this project complex to you?”. This has resulted in what we call a ‘practitioners’ view’ on complexity. Based on our interviews, our experience and on discussions with practitioners we developed a view in which we distinguish six types of complexity within LIPs: technical, social, financial, legal, organisational and time complexity (figure 2).

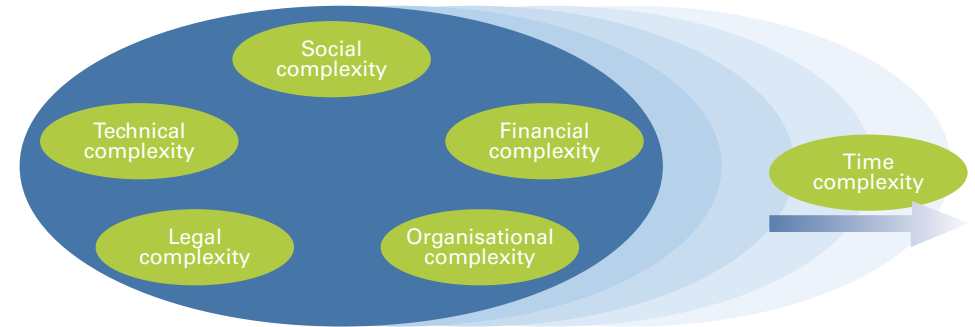


Figure 2: Six complexities within LIPs

The dominant form of complexity experienced by practitioners is social. On the other hand legal complexity proved to be of less importance. This is interesting because many recent initiatives trying to stimulate the successful implementation of LIPs have had an emphasis on legal aspects. The core of ‘social complexity’ lies in the different interests of the involved stakeholders. These different interests are mainly apparent as between NGO’s and local stakeholders on the one hand, and the principal, users and parent organisations on the other. The principal, users and parent invest in the project and have a need for its final product. In order to control their investment, resources they apply, are often rigidly defined in terms of scope, schedule and budget constraints. External stakeholders such as NGO’s and local interest groups do not have these constraints and are mainly interested in protecting or serving their own interest in the project; time and budget constraints are, in essence, not their concern. The project delivery organisation serves as an intermediary between these two interest groups, which makes it likely that it is here that conflicts of interest will manifest themselves.

Organisational complexity was mainly visible in our cases in the relationship between the project delivery organisation and its parent and sponsor organisation. Project delivery organisations seem to experience just as many challenges in dealing with these stakeholders as they do in dealing with, for example, NGO’s and local stakeholders. And this is notable since in current literature on LIPs, the challenges in dealing with NGO’s and local stakeholders are often highlighted while the management issues regarding parent and sponsor are largely overlooked.

Technical complexity and financial complexity were both demonstrated to be closely related to social complexity. Technical and financial complexity start to cause challenges when they influence the arena of stakeholders who are involved in LIPs. In this sense ‘technical’ and ‘financial’ complexity trigger ‘social’ complexity. Two main examples of technical complexity observed in practice are: dealing with new innovative technology; and technological uncertainty. Financial complexity can be

related to the distribution of costs and benefits; the perception of cost developments; different perceptions about definitions and agreements; strategic misinterpretation; optimism bias and the 'cascade of distortion'.

The practitioners' framework of complexity demonstrates that complexity, as a sensitising concept, is recognised broadly by practitioners as a key element in the successful implementation of their projects. The six types of complexity matter to practitioners in the implementation of LIPs. These are the elements they worry about in project implementation, requiring a great deal of management attention and, in this sense, representing key themes to address in the quest for the success. It is interesting to note in this respect that these types and issues deviate from the traditional aspects – time, money, quality, organisation, information and risk – used dogmatically in a large part of the literature on project management.

Scientific perceptions of complexity

Now we have illustrated how complexity is perceived by practitioners it is interesting to investigate how complexity is perceived in theory and how this compares to practice. In order to answer this question we studied the literature on complexity. Based on this review and looking at our case material we distinguish two types of complexity:

- 1 Detail complexity
 - Many components with a high degree of interrelatedness.
- 2 Dynamic complexity
 - The potential to evolve over time: self organisation and co-evolution.
 - Limited understanding and predictability.

This classification is certainly not the only possible one. The decisive reason to pick this classification is that it enabled us to link complexity to distinctive management strategies. The framework is aimed to form a natural bridge between labelling complexity on the one hand, and identifying suitable management strategies to deal with this complexity on the other.

'Detail complexity' is the view that defines complexity as 'many components with a high degree of interrelatedness'. This type of complexity is clearly present in our cases, as can be witnessed by the overwhelming list of facts and figures of our studies. Detail complexity is visible in three main subsystems within LIPs: the stakeholder sub-system, the product sub-system (infrastructure facility), and the activity sub-system.

Of the three sub-systems in LIPs, that of the stakeholders illustrates the presence of dynamic complexity. 'Dynamic complexity' refers to situations where cause and effect are subtle, and where the effects of interventions over time are not obvious. The stakeholder sub-system evolves with the passage of time and produces variety,

novelty and can show improvement. It has the characteristics of a complex adaptive system. Dynamic complexity is related to the social complexity in our practitioners' framework. Social complexity is connected to the concept of ambiguity: the lack of shared meaning. This lack of shared meaning is prominently visible in LIPs when conflicts of interest arise between stakeholders. Within LIPs we see that stakeholders tend to interpret reality in line with their own interests, especially when the stakes are high. This in itself is interesting but key to the dynamic complexity in LIPs is that not only do the interests and preferences of players diverge; they can undergo a major revision over the course of the project. These changing preferences of stakeholders are predominantly driven by 'dissatisfaction' resulting from both external factors and internal developments. External factors can be external events or independent changes in context such as policy changes or socio-economical changes. Internal developments are changes driven by evaluation of the effects of past decisions.

Change in LIPs can be described in terms of a shift in system state. A dissatisfied key player will initiate actions to change the system state to fit his interests in a better way. As a result of the interaction with other stakeholders, a new equilibrium will be formed as the result of a series of change events. This new equilibrium, or system state, is defined by a new stakeholder constellation, often accompanied by changed product and activity sub-systems. So changes in the stakeholder sub-system lead to actions that may lead to changes in product and activity sub-systems. This means that the three sub-systems in LIPs are dynamically connected. These dynamic relationships result in the non-linear implementation process of LIPs over time.

One of the effects of the dynamic complexity in LIPs is that decision makers have to decide under circumstances of 'limited understanding and predictability'. These decision makers have to deal with uncertainty. Because of this uncertainty the outcome of decisions and actions can be highly difficult to predict. During the deployment of LIPs we can gain more knowledge on both the desired end product and of the implementation process. These new insights can trigger changes. For example we can discover that a new technology delivers the promised results but that it also has some additional other unforeseen benefits. Or we can discover that a previously developed contracting model is no longer appropriate. Uncertainty in decision making is not only connected to the observation that we do not have access to all available information, which has been the dominant definition in previous literature on this subject. Uncertainty is also connected to the fact that minor or major change events greatly impact results of decisions *previously taken*. These uncertain conditions mean that decision makers have 'to decide' without knowing the final infrastructure product or knowing the preferred implementation process.

Framework for the management of complexity

Now how do the involved stakeholders handle the detail and dynamic complexity within LIPs? Based on the characteristics of complexity we can outline two main demands for management approaches:

- 1 Detail complexity Need for control
- 2 Dynamic complexity Need for interaction

The volume of activities and the large number of relationships with stakeholders means that project managers cannot rely solely on their own overview to make arrangements: a more structured approach is needed to coordinate our efforts. In order to manage these large numbers we need to split up tasks and monitor progress closely. If this were not done we would quickly loose our grip on the project to be delivered. We refer to this need, originating in the main from detail complexity, as the need for ‘control’.

Dynamic complexity within LIPs has significant management implications on their management since it highlights the importance of factors outside the control of project managers. Political changes, policy changes, economic changes, incidents and accidents greatly influence the results that an infrastructure project produces. Often project managers are assigned to deliver projects within the constraints of budget, schedule and quality (scope). The application of these strict constraints in judging project management performance however does not fit well with the conclusion that many factors outside the project manager’s control can influence project results. An important implication of the management of complexity is related to the uncertain conditions for decision making in LIPs noted earlier. Decisions can have a different impact in the short run then in the long run which makes evaluation necessary to assess the impact of past decisions in considering future actions. Based on this we can identify a second need in the management of complexity, especially to deal with the impact of external influences such stakeholder behaviour and uncertainty in decision making. We labelled this need: ‘The need for interaction’.

So the management of complexity in LIPs provides a need for control – to address detail complexity – and a need for interaction – to address dynamic complexity (table 1).


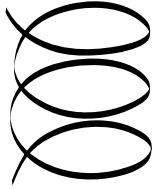
Strategy	Control	Interaction
Illustration		
		
Basis		
Fit for	Detail complexity	Dynamic complexity
Problems are	Unambiguous, fixed and independent of stakeholders	Ambiguous, changing, determined by stakeholders
Problem solving	Linear	Iterative
Theoretical basis	Organisational design Systems management	Interactive management Complexity management
Management strategies		
	1 Break down in terms of <ul style="list-style-type: none"> • in time • in end product • organisation 	1 Alignment 2 Redefinition of the problem and change of scope
	2 Management processes <ul style="list-style-type: none"> • schedule • costs • quality • risks 	3 Using short term predictability <ul style="list-style-type: none"> • systematic evaluation • selection of successful strategies
		4 Variation <ul style="list-style-type: none"> • in strategies • scenario building & pattern analysis

Table 1: Strategies of control and interaction

Based on the need for control and interaction we have constructed a framework in the management of complexity (figure 3).

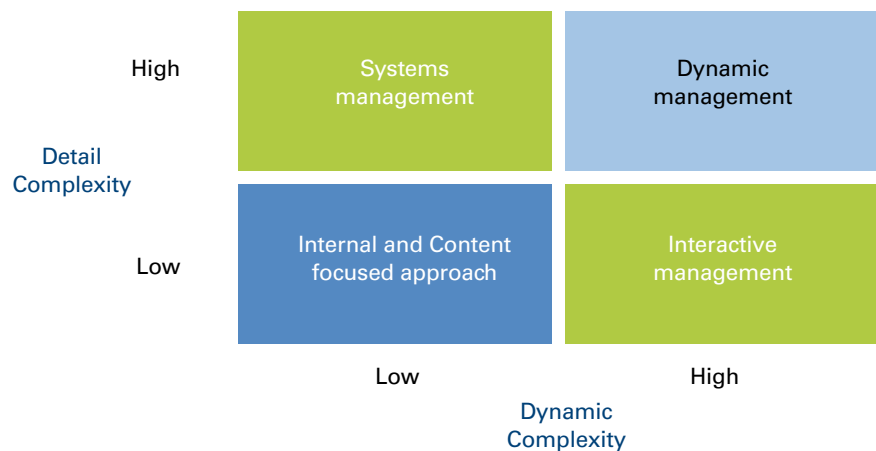


Figure 3: Four approaches on the management of complexity

Internal & Content focused approach

The first approach is labelled the ‘the internal and content focused approach’ because it involves a lack of clear management strategies. The responsible project delivery organisation treats the project as a technological or financial challenge whilst paying minimal attention to the interests of stakeholders or the strategies of project control. In our overall scheme we classified this as an approach fitting contexts with both low detail and low dynamic complexity. This might seem strange because our research is especially aimed at situations with high complexity. This should, as a result, mean that this approach would be less suited for the specific situations we have studied. But while this argument is supported by our findings, it is surprising that the internal and content focused approach is the approach most often used from those observed in our cases!

When looking at management theory, there have been descriptions found of management strategies that at a first glance appear to be similar to the content focused approach like the “Muddling Through” approach of Lindblom (1959). However there is a major difference since ‘muddling through’ is an approach which is characterised by small incremental steps in progress with a strong focus on bargaining and interaction between the various involved participants. This element is lacking within the content focused approach where the problem solvers operate largely in isolation and later find out that their proposed solution does not meet the requirements of stakeholders involved. So while the content focused approach is not well described in theory, it is amazingly often used in practice. Various factors can be a stimulus for the content focused approach to occur – for example: lack of management attention; specialist managers, financial tensions; organisations that are unfamiliar with each other; and a project team showing the characteristics of ‘groupthink’. The content focused approach leads to ‘premature convergence of solutions’.

Possibly interesting alternative solutions are disregarded too early in the process of implementation – and this is not the only downside of the approach. In general the content focused approach does not yield positive results in situations of high detail and dynamic complexity since it often produces dissatisfaction amongst all stakeholders. Because of this dissatisfaction, organisations that use the content focused approach sooner or later are forced to change their attitude. In addition, the dissatisfaction resulting from the use of the content focused approach will influence the attitude of stakeholders in a negative manner, long after the approach has been abandoned. So the long term effects of the content focused approach in the management of complexity can be (and normally are) devastating.

Systems management (strategies of control)

The second approach is that of ‘systems management’. Here strategies are focused on control. In many of our observed cases, strategies of break down and control management processes were successfully used – especially for the management of detail complexity. Strategies of control originate from the field of systems management theory and can be linked to the field of organisational design.

There are various benefits attached to the use of systems management, in particular in the many situations where it is necessary to shield part of the organisation from the ‘dynamic complexity’ so as to facilitate progress and maintain control. We identify two main systems management strategies: (1) decomposition in time, end product and organisation, and (2) management processes for schedule, costs, quality and risks. Although systems management is often regarded a ‘hygiene factor’ in the management of LIPs, in practice its application is certainly not a ‘given’. Systems management within LIPs is a time consuming task – often supported by sophisticated tools – that requires continuous attention in the set-up and in the use of appropriate instruments of project control. Systems management helps to define responsibilities as between players, to regulate and document changes, and to improve accountability for decisions taken.

On the other hand systems management is an inflexible approach to the management of complexity. Because of the need for decomposition and control management processes it encourages a basic reflex ‘to stick to outdated solutions’. It is a rigid approach based on the assumptions of a fixed project goal and that the project is to be executed in linear fashion in a stable environment. But LIPs are characterised by the occurrence of new developments and new insights, or ‘dynamic complexity’ as we labelled it earlier. So, while the use of systems management can certainly be beneficial, we need something more to address dynamic complexity. This ‘something more’ is the interactive management approach.

Interactive management (strategies of interaction)

'Interactive management' as an approach, was originally developed as an alternative or supplement to 'systems management'. Traditional systems management strategies turned out to be inadequate to deal with the dynamics of stakeholders associated with LIPs.

The traditional literature on interactive management has a heavy focus on the 'interaction with stakeholders'. We have added an additional element to this theory which we have borrowed from the theory of complexity management: a focus on flexibility. This focus is needed to deal with the many changes that occur within LIPs. Combined, this makes interactive management suitable to address the social complexity which characterises the stakeholder network together with the dynamic development of stakeholder preferences over time.

Strategies of interaction assume that problems are ambiguous and that goals are related to the players, and are not fixed – in fact, changing as the context changes. It is a 'development approach'. Management focuses on satisfying needs through interaction in the network of stakeholders, and from focusing on flexibility – so as to have the ability to act (favourably by anticipation) in the face of changing circumstances or specific outcomes of management strategies. In the sub-cases studied we saw that the most dominantly visible strategy within interactive management is 'alignment'. This approach can be very beneficial, since our cases support the view that using a strategy of cooperation has a much greater chance of success than an 'internal' approach. The use of other strategies, such as using short term predictability and variation, were not as prominent. We found few examples in our sub cases. But, when used, these strategies seem to offer added value.

Our analysis shows that the strategies based on interaction are mainly suitable for dealing with dynamic complexity. The use of scenario analysis is an example of this. By predicting possible future scenarios, the development of the stakeholder 'world' over time can be discussed and made visible – it is directly linked to the dynamics of the stakeholder network.

Even though there is still limited empirical evidence to evaluate its effectiveness, we believe that strategies of interaction have the potential to provide added value in the management of complexity within LIPs. Project managers and other stakeholders can benefit much more from practical application of these strategies than they already have done. But managers also need to be aware of the potential pitfalls of the strategies of interaction – the most important pitfall of which is that pure and unique focus on stakeholder demands may seriously limit project progress, or lead to over expensive solutions emerging. This is because of the risk that difficult decisions are avoided in a desire to satisfy stakeholder demands and are thereby not confronted.

Dynamic management (balancing control and interaction)

Our fourth and final approach is called 'dynamic management'. This approach is based on a synthesis of our findings in the successful management of complexity. It is our answer to the question: 'How to manage complexity in LIPs'. In our opinion this management approach offers the best chance of success in the management of complexity in LIPs.

Dynamic management is based on:

- a) Balancing control and interaction
- b) Doing the extraordinary

Balancing control and interaction is founded on theoretical building blocks drawn from the contingency approach, complexity management theory and recent adaptive governance theory. 'Balancing' means that project delivery organisations need to find a structure to fit the project context and to accommodate the need for both interaction and control. In addition, balancing also means the mixture of the two complementary and coherent clusters of management strategies: control and interaction. One is fit to deal with detail complexity (control) and one to deal with dynamic complexity (interaction). The mixture of strategies is likely to change over time since it needs, at least partially, to reflect changes in the project context (figure 4).

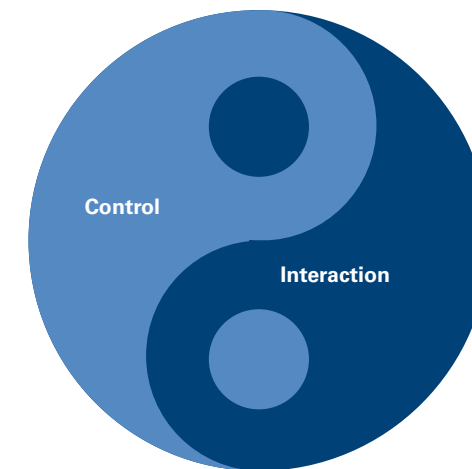



Figure 4: Balancing control and interaction

The strategies of control and interaction do not necessarily mix well so they cannot always be deployed in full harmony. Building in a new round of interaction might cause serious conflict with your project's time schedule. However both the strategies



of control and interaction are needed to offer the best chance of the successful management of complexity in LIPs. It is essential to look for a balance which fits the unique circumstances of the project with which you are working. 'Recipe book' approaches to the management of complexity will prove impossible because of the high importance of the 'unique context'.

Practical applications of the balancing strategy are still relatively scarce compared to applications of 'content focused & internal approach' and of 'systems management'. But first analysis shows the balancing strategy can greatly enhance the chance of success in the management of complexity. However many questions remain both on the theoretical foundations and on its use in practice. Future research will need to address this.

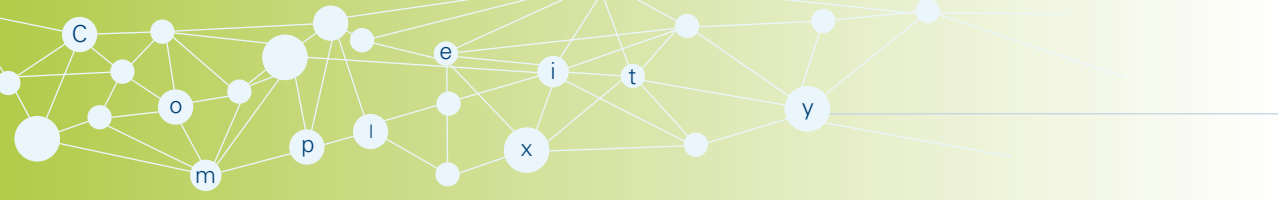
So, one key to the successful management in LIPs is clearly the effective combination of the strategies of control and of interaction. This approach has been touched on, however with only limited empirical evidence, by the literature in the field. But is that all there is? When looking at our case material we found that the answer to this question was clearly in the negative. In order to be truly successful in the management of complexity, we need what we refer to as 'extraordinary efforts'. This is the second element of our dynamic management approach and forms an insight into what has so far not surfaced in literature. In the successful management of complexity within LIPs, X-factors can make the difference. We observed the following 'extraordinary' solutions:

- 1 Stakeholders system – higher order of cooperation
- 2 Player level – project champions
- 3 Personal level – competent people making a difference
- 4 The capability of finding new management solutions
- 5 Using windows of opportunity

The first three X-factors consider the players within LIPs on three separate levels: system, project delivery organisation and individual. The stakeholder system within LIPs has a tendency to produce unwanted results when the participating stakeholders only look to serve their own interests. To avoid this, a broader systems view should be encouraged as the basis for their actions. This systems view would allow them to see their actions and their position in relation to that of other players and enable them to see the broader perspective. The project delivery organisation is the stakeholder that should be responsible for encouraging the adoption of this broad, system based, perspective by participants. In this sense the project delivery organisation is much more than an 'implementation agency': it is the stakeholder that should make sure that the entire stakeholders' system produces optimal benefits in terms of output of the project. This translates to the individual behavioural level where we see that competent individuals can make the difference

within LIPs by taking a system-wide view – which also facilitates the achievement of their own objectives.

X-factor 4 focuses on management solutions. To align interests and create progress, unique management solutions are needed. New management solutions can create a breakthrough for participants. The dominance of dynamic complexity within LIPs means that creating and dealing and taking advantage of change becomes a subject of vital importance. Project managers and others should look for windows of opportunity to stimulate progress and align interests (X-factor 5). These windows often open as the result of external pressure from one of the main stakeholders. Change should not be regarded as a negative thing; it can offer new and unforeseen potential benefits to all involved.



ACKNOWLEDGEMENTS

Our thesis would not have been possible without the inspiring support of, and cooperation from, a great number of people.

First of all, it is a great pleasure to mention Professor Geert Teisman our promoter and teacher. Geert, it was a honour to work closely with you, and to enrich ourselves with your insights, which you were always able to explain very clearly in just a few words. Thank you for your feedback, your patience and your encouraging words when we needed it most. We will cherish the interesting discussions 'at some other' restaurant in Rotterdam, when Irene joined us many times. We hope we will continue this!

Of crucial importance for this study was the support of Leendert Bouter, former project director HSL-South and Betuweroute. Leendert, with a dream we started our international journey about seven years ago. During that trip you infected us with your enthusiasm of (international) knowledge exchange. Thank you for your wisdom, support and all the inspiring moments we had and still have in Utrecht, Zoetermeer and throughout Europe.

Professor Hansruedi Schalcher of ETH Zürich, we owe you many thanks. Because of you, our ambitions took on an international dimension. You introduced us to BAV in Bern and to the Gotthard and Lötschberg base tunnel projects, where we were able to meet Tony Eder, Frank Wadenpohl and all the others. Moreover you were also there to discuss the practical implications of theory, since theory is of no use unless it is anchored in practice. And last but not least: you taught us how 'to play with complexity'.

In this list Stuart Baker of Department Transport, UK, former project director West Coast Mainline, may not be excluded. Stuart, at first sight you were somewhat reserved about "Those chaps from Holland", but for half a decade you, and your colleague Tony Francis, have become 'best mates' in our search for 'the best training experiences' in Europe. We have been privileged to work closely with an inspiring person like you.

Rodney Turner, you have been involved since the start of this journey. We have stayed into touch over the years and you have given us the opportunity to enter an international network of expertise thanks to your great knowledge and overview of the field of project management. Many thanks for your ongoing support.

We really appreciate the fact that Transumo, a Dutch knowledge programme 'Transition sustainable mobility', supported our PhD. To Jan Klinkenberg, Jo van Nunen and Arjan van Binsbergen, we want to show our appreciation for your having given us this

opportunity and for the chance to exchange views in respect of other innovations within Transumo. Also thanks to Teije Gorris who has supported us so many times in the past. We are proud that we could be part of this programme.

We want to stress the importance for our thesis of some inspiring professionals who were able to share their knowledge. Patrick Buck and Joost Vinkenvleugel we owe you many thanks for your input in discussions and the fact you gave us the opportunity to do extensive research at the Betuweroute. At the HSL-South, Jaap Geluk and Frans de Mol thank you for encouraging us in collecting and building up knowledge on the management of large projects. At the A73-South we had a very fruitful contact with René Scholtes, who enthusiastically shared his experiences with us. We will cherish these discussions and we hope these will go on in future.

During the period this PhD has been completed, two enthusiastic supporters of our programme of knowledge building and exchange passed away – Rob Prins, former project director of Highway 73-South and Peter Testoni of BAV, former 'client' for both Swiss base tunnels. Our thoughts are with their families and friends.

To Dudley Taylor and Wim Demmers – thank you for your encouragement and support for the basic attitude that our international contacts will be of value in the development of our colleagues, the benefit of the professional growth of AT Osborne, and for continuity within our unique company. Thanks to colleagues who supported us: especially Mirjam Cauvern, Pau Lian Staal, Manon Elling, Marcel van Rosmalen and Franc Mouwen.

Lidwien, IJsbrand, Diederik, Timo and Véronique, I hope the PhD didn't influence our daily life too much, because that's too precious for us. Thank you for your support and continuous inspiration.

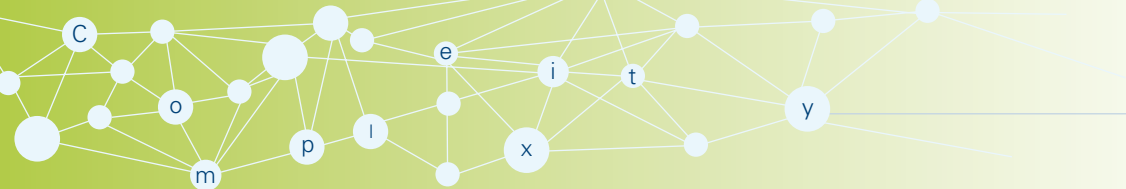
Chaja, Samuel and Raul. Thanks for being so supportive. Writing this PhD would still be a dream if it was not for your support.

Our appreciation also goes to all the people we interviewed for sharing your experiences and beliefs, your successes and disappointments. We were surprised by your openness and courtesy – in Switzerland, the UK and The Netherlands. By means of this publication, we hope to give you some insights in return.

We hope we will be able to continue our inspiring collaboration in future. *Panta rei!*

December 2009,

Marcel Hertogh
Eddy Westerveld



RESUMÉ - MARCEL HERTOIGH



Marcel Hertogh studied at the Delft University of Technology, Civil Engineering and at Erasmus University Rotterdam, Economics (obtaining Master's Degrees at both). He started his career at a contracting firm in 1988, where he worked on projects such as the 'Maeslantkering' storm-surge barrier and two tunnel projects for road traffic. In 1993 he joined Berenschot Osborne. Currently he is a member of the board of AT Osborne and responsible for one of the two business units: Infrastructure, Urban Planning and Environment. His main field of experience is management and organisation of complex projects.

He is the programme director of NETLIPSE 'Network for the dissemination of knowledge on the management and organisation of Large Infrastructure Projects in Europe' and one of the project's initiators. NETLIPSE started as a European Union '6th framework programme' and now has a follow up element in which the consortium will develop an 'Infrastructure Project Assessment Tool' and, in co-operation with the EU, will explore possible structures for a legal entity of the network after 2010.

He has been involved as a senior consultant with several very large infrastructure projects – he was Head of Department, Quality and Organisation of the Betuweroute project for ProRail, and also undertook a due diligence study on the Oosterweel Junction in Antwerp. For the Westerschelde Tunnel he studied the feasibility and opportunities for private financing. He set up the project organisation and project processes of several big water projects, a big transport corridor project and two storm surge barriers.

He is a professional trainer and a frequent speaker at congresses. He is the (co-) author of 8 books about organisation and contracting for big investment projects. He has written more than 30 articles and has been interviewed for magazines and for radio and TV.

RESUMÉ - EDDY WESTERVELD



Eddy Westerveld works as a consultant and project manager in projects for AT Osborne in The Netherlands. Over past years he has been active as project manager, researcher and consultant in large infrastructure and urban renewal projects both in The Netherlands and abroad. Projects he has worked on include: the Westerscheldetunnel, Rijnboog Arnhem, HSL-South and the Amsterdam North South Metro Line. Some of his main fields of interest relate to bridging the gap between science and practice in the management of large infrastructure and to the management of complexity in these projects.

Recently he has been involved as the 'knowledge team coordinator' in a European research initiative called NETLIPSE (www.netlipse.eu). NETLIPSE is a European Union '6th framework programme' project that was executed by 8 consortium members from 6 European countries. He is co-author of the book 'Managing large infrastructure projects' which was published in 2008 as a result of NETLIPSE research. Within this book the conclusions of research into best practices and lessons learnt from 15 large infrastructure projects are outlined. At present a new phase of research has been started, in co-operation with the EU, with the objective of setting up a 'European Foundation for the Management of Large Infrastructure Projects'.

Eddy specializes in project management which is demonstrated by his membership of the committee working on the new ISO guideline on project management, his work as a lead assessor for the IPMA excellence award, and his membership of IPMA in The Netherlands. In addition he is the lead author of the book on the 'Project Excellence Model' which was published in 2002. He is regularly involved in training and classes relating to project management for clients and for students.

