ONCE THE SHOVEL
HITS THE GROUND

evaluating the management of complex implementation processes of public-private partnership infrastructure projects with qualitative comparative analysis

STEFAN VERWEIJ

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ZODRA DE SCHOP DE GROND INGAAT

Het management van
complexe implementatieprocessen van
PPS infrastructuurprojecten evalueren
met kwalitatieve vergelijkende analyse

Thesis

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PART 1

Introduction

The first part of this thesis consists of one chapter: the introduction to this study. Chapter 1 provides a brief overview of the background of the study, presents the research questions and outline of the thesis, and explicates the practical and scientific relevance of the research.

1 | The Complexity of Public-Private Partnership Infrastructure Projects

1.1.   INTRODUCTION: IMPLEMENTING COMPLEX INFRASTRUCTURE PROJECTS

Every now and then you read or hear about some infrastructure project that (continues to) exceed(s) its budget and/or completion date. Famous examples are the Big Dig in Boston and the UK Channel Tunnel.[1] A well-known topical example from the Netherlands is the Amsterdam Metro North-South Line of which the costs have already increased from € 1.4 billion to € 3.1 billion and of which the completion date has been postponed to 2017.[2] Often we find somebody to blame for the situations that projects encounter in their implementation processes, such as decision-makers, policy-makers, planners, managers, the public procurer, or the private contractor. This is understandable. It is a comforting idea that dealing with the culprit, and devising measures to make sure that the situations never occur again, allows us to do better in other (future) projects. All that needs to be done is to sanction the people or public and private organizations in charge, and/or to change the rules of infrastructure project development. The North-South Line, for instance, has known many culprits, it is said (e.g., aldermen, project directors, and private contractors).[3] But things are not always this simple. Blaming and sanctioning those in charge, and changing the rules or implementing new rules, may help but not necessarily so.

Implementation processes of infrastructure projects are fundamentally complex endeavors.[4] When a project is implemented, i.e., when the project interacts with the existing socio-physical system, it would be naive to expect that system not to react in any way. When a bridge or tunnel is being produced along with the noise nuisance that often comes with it, neighboring citizens might complain. When a site is being excavated, some archeological treasures, or dangerous remnants from a wartime long gone, may be encountered. When plans are developed to change the layout of a highway network, stakeholders will have their favorite scenarios that they may pursue. And many more examples of such events can be imagined. The North-South Line project too has (had) its fair share of events.[5] There are also events that occur in implementation processes of infrastructure projects that are arguably not caused or triggered by the project itself. Examples are economic crises or changing laws and regulations.

It is unlikely that many of these situations would not occur after the people or public and private organizations in charge have been sanctioned, and/or after the rules of infrastructure development have been changed. Moreover, public and private managers of infrastructure projects are constrained in foreseeing the occurrence of many of these events. There are limits to their predictive capacities, no matter how much information is collected and analyzed in planning for the projects. Even if it is concluded that an event 'was bound to happen', these are often explanations in hindsight. Sure, 'if only

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1   See, e.g., Greiman (2013) and Anguera (2006).
2   Compare the quarterly project reports of, for example, Q1-2006 (Municipality of Amsterdam, 2006) and Q1-2013 (Municipality of Amsterdam, 2013). See also the report of the Committee Veerman (2009).
3   See Soetenhorst (2011).
4   Cf. Rittel and Webber (1973).
5   See Soetenhorst (2011).

we/they had known then that which we/they know now, then we/they would, could, or should have…' But the point is that often it was not known, or not completely known. In implementation processes – once the shovel hits the ground – of public-private partnership (PPP) infrastructure projects, many events occur that were, at least to some extent, unforeseen and unplanned. If we accept this, the focus shifts from 'who is to be blamed or sanctioned' to 'evaluating what can be learned from both better and worse experiences with responding to events in implementation', so as to improve other (future) projects. That is one of the aims of the present study. Given the fundamentally complex nature of implementing infrastructure projects, however, this imposes requirements on the evaluation methodology. These requirements are addressed in this study.

Before presenting the research question of this thesis, the next section first paints the contours of the background against which this study has been conducted (Section 1.2). The research question and outline of the thesis are then provided in Section 1.3. Section 1.4 continues by articulating the practical relevance of the research question, indicating what evaluators, implementation managers, and planners of infrastructure projects can take from this thesis. Thereafter, the thesis is positioned theoretically and methodologically, and the intended contributions to the theoretical and methodological fields are articulated (Section 1.5). The concluding section provides some final remarks (Section 1.6).

1.2. BACKGROUND: TRANSPORTATION INFRASTRUCTURE DEVELOPMENT IN THE NETHERLANDS

This study is about the management of implementation processes of PPP infrastructure projects. It has been conducted against the background of the wish of Dutch policy- and decision-makers to improve the development processes of transportation infrastructure projects. Numerous reports that appeared over the years are testimony to the fact that this wish is both longstanding and incompletely realized.

1.2.1. A history of time delays and cost overruns

Some twenty-five years ago, the Dutch government requested the Scientific Council for Government Policy (WRR)[6] to issue an advice on how decision-making concerning transportation infrastructure projects could be accelerated, as it observed that the lengthy decision-making procedures bore with them high administrative, social, and economic costs (WRR, 1994a). The WRR initiated a large study of twenty projects, and three years later it published its main findings (1994a) including several background studies (1994b; 1994c). Amongst other things, the study found, first, that the root causes for the lengthy processes were the legal and regulatory complexity combined with the involvement of

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6   The WRR – in Dutch: *Wetenschappelijke Raad voor het Regeringsbeleid* – is the independent advisory body for the Dutch government, which is tasked with identifying and advising on future trends and developments (see www.wrr.nl).

many public authorities. Second, projects were often managed as a technical challenge to be confronted (i.e., planned) in closed circles, which were subsequently and consequently subject to fierce sociopolitical opposition.[7] Six years later, a report published by the Netherlands Bureau for Economic Policy Analysis (CPB)[8] and the Netherlands Economic Institute (NEI)[9] also mentioned the problems of spatially integrating transportation infrastructure projects in the densely built and populated Netherlands, which complicates the government's balancing of the interests of different stakeholders (CPB & NEI, 2000c).

Three years later, in 2003, the Dutch House of Representatives decided to set up a Temporary Committee on Infrastructure Projects (TCI)[10] – also known as the Committee Duivesteijn – to investigate how the parliamentary oversight of transportation infrastructure projects could be improved. The immediate causes for creating the TCI were the increasing costs of the Dutch Betuweroute and HSL-South projects (TCI, 2004b): the budget of the former had risen from € 2.335 billion in 1992 to € 4.799 billion in 2004 (TCI, 2004c), and the HSL-South had experienced a budget increase from € 1.423 billion in 1991 to € 6.509 billion in 2004 (TCI, 2004d).[11] A year later, the Committee published its main report and accompanying background studies (2004a; 2004b). Interestingly, in its report the Committee indicated the persistent complexity of transportation infrastructure projects as subjacent to the budget overruns (2004b:15):[12]

> "[Another] constant factor in large infrastructure projects is the great dynamics and complexity. Their course is persistently unlike planned, they are influenced by many unpredictable trends and events, and the processes within which they are developed are extremely complex. […]. A symptom of this complexity is the systematic overrun of the budgets of infrastructure projects."

As will be argued later in this thesis, the Committee hit the nail on the head when it alluded to the 'dynamic' and 'complex' nature of transportation infrastructure projects, and to the occurrence of 'unplanned' and 'unpredicted' events throughout the projects' development processes.

The Dutch government studies cited above are concerned with the interrelated problems of time delays (in particular WRR, 1994a) and budget overruns (in particular TCI, 2004b) of transportation infrastructure projects. The studies were followed by develop-

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7   These were no new problems, though. De Hoo (1982) showed that conflicts of interest and governance problems also contributed to lengthy decision-making processes on infrastructure projects as early as the beginning of the 1960s.

8   The CPB – in Dutch: *Centraal Planbureau* – is charged with the analysis of the economic effects of current and future government policies. The CPB is part of the Ministry of Economic Affairs, but operates independently of it (see www.cpb.nl).

9   The NEI (currently ECORYS) – in Dutch: *Nederlands Economisch Instituut* – is a research and consultancy firm specialized in applied economic research (see http://english.ecorys.nl/NEI).

10   In Dutch: *Tijdelijke Commissie Infrastructuurprojecten.*

11   See, e.g., Metze (1997), Pestman (2001), and Nieuwenhuis (2008) for accounts of the Betuweroute project.

12   This quote is translated from Dutch.

ments in, inter alia, the ex-ante evaluation of transportation infrastructure projects (see De Jong & Geerlings, 2003; 2004; Geerlings & De Jong, 2004), such as new guidelines for cost-benefit analysis (CPB & NEI, 2000a; 2000b)[13] and parliamentary control (see Priemus, 2007a). Unfortunately, such developments have been too late in the day for the Betuweroute and HSL-South projects. They took many years to be completed, and they went down in history with price tags of approximately € 4.7 billion and € 7.2 billion, respectively (Cantarelli, Flyvbjerg, Van Wee, & Molin, 2010; Cantarelli, 2011). Real progress in the development processes of transportation infrastructure projects seemed yet a wish unfulfilled.

This phenomenon of poor project performance is not limited to the Netherlands though. A large international comparative study that was conducted by Bent Flyvbjerg and his colleagues around the turn of the millennium, probably the best-known study on the subject, revealed that infrastructure projects suffer from budget overruns, worldwide and throughout the decades (Flyvbjerg, Skamris Holm, & Buhl, 2002; 2003; Flyvbjerg, 2007a; 2008; Skamris Holm & Flyvbjerg, 1997).[14] Research also points to the lengthy completion times of projects as an international problem (Short & Kopp, 2005). At this point, studies could be cited here ad nauseam (some references can be found in Chapter 3 of this thesis) that tantamount to the same findings as those of Flyvbjerg and colleagues, but such is not the purpose here. The point is that there was still progress to be made in the development processes of infrastructure projects. This did not go unnoticed by policy- and decision-makers in the Netherlands.[15] Several roads towards improvement were embarked on.

1.2.2. Embarking on roads towards improvement

In 2007, the Dutch Minister of Transport, Public Works, and Water Management (V&W)[16] set up the Committee Acceleration Decision-Making on Infrastructure Projects (VBI)[17] – also known as the Committee Elverding. With the installation of this committee, attention shifted back again to the problem of time delays (cf. Priemus, 2010). The issue, addressed with the large study of the WRR over a decade earlier (WRR, 1994a), resurfaced as the Committee VBI was asked to analyze the delays of transportation infrastructure projects and to investigate the possibilities to accelerate the decision-making on them (Advisory Committee VBI, 2008). The Committee's final report (2008) pointed to, inter alia, administrative red tape, insufficient management knowledge and capacity, and complex and sectoral laws and regulations as causes for the delays. The similarities between

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13   See Annema, Koopmans, and Van Wee (2007) for a reflection on this guideline.

14   See the work by Cantarelli and others for the Netherlands' situation (Cantarelli, 2011; Cantarelli, Flyvbjerg, & Buhl, 2012; Cantarelli, Molin, Van Wee, & Flyvbjerg, 2012; Cantarelli, Van Wee, Molin, & Flyvbjerg, 2012).

15   In fact, Bent Flyvbjerg was also heard by the TCI as part of the investigation (TCI, 2004a).

16   In 2010, the Ministry of V&W was merged with the Ministry of Housing, Spatial Planning, and the Environment (VROM), resulting in the current Ministry of Infrastructure and the Environment (I&M).

17   In Dutch: *Commissie Versnelling Besluitvorming Infrastructurele Projecten.*

these findings and those of the WRR (see Section 1.2.1) are striking. Apparently, not much had improved in fourteen years. The problems with the development of transportation infrastructure projects were persistent and still very much on the political agenda.

One road of improvement that was embarked was that of the private financing of public transportation infrastructure projects. Already in 1994, the WRR observed that "the central government attempts to get certain projects off the ground more rapidly" with private financing (1994b:208), although the WRR itself was skeptical about it: "whether time is always gained with this is questionable" (1994b:208). Nevertheless, the issue of PPP caught the attention of Dutch policy- and decision-makers from the late 1980s onwards (Dewulf & Castaño, 2013; Eversdijk, 2013; Klijn, 2009),[18] although the associated high expectations contrasted sharply with the difficulties experienced in the actual formation (i.e., contracting and procurement) of PPPs (e.g., Klijn & Teisman, 2003; Koppenjan, 2005; Van Ham & Koppenjan, 2002). Also, the aforementioned Betuweroute and HSL-South projects are testimony to the fact that involving the private sector does not automatically yield better results (Gerrits & Marks, 2014; Koppenjan & Leijten, 2005a; 2005b; 2007). Despite such bitter pills, PPPs continued to receive the interest of policy- and decision-makers (Dewulf & Castaño, 2013; Eversdijk, 2013; Klijn, 2009). In 2008, the subject was again put to the fore with the publication of the report of the Committee for Private Financing of Infrastructure (PFI),[19] also known as the Committee Ruding (Committee PFI, 2008). In its report, "the Committee advocate[d] a more active use of private financing for road and rail infrastructure" (2008:6) for it can lead to, inter alia, "better value-for-money" and "acceleration of the realization of infrastructure" (2008:9). As the Netherlands were strongly influenced by the policies and discussions in the United Kingdom about the Private Finance Initiative (Klijn & Van Twist, 2007; Klijn, Edelenbos, & Hughes, 2007), the Committee PFI specifically advocated that PPPs would have a DBFM (i.e., Design, Build, Finance, and Maintain) format. In DBFM, the private contractor is not only concerned with designing and building the transportation infrastructure, but also with maintaining and (partly) financing it.[20] However, only few DBFM transportation infrastructure projects have been realized in the Netherlands (e.g., Eversdijk, Nagelkerke, Sewbalak, Van den Blink, & Rodenburg, 2011): four years after the publication of the report of the Committee PFI, the Ministry of Finance (2012) reported nine DBFM transportation infrastructure projects that were in the procurement, realization, or exploitation phase (cf.

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18   This is not to say that PPPs are a new phenomenon. Grimsey and Lewis (2004), for instance, provide historical examples of toll concessions – in Greece in the 1st century BC/AD, and in Britain during the Middle Ages – by public bodies to private parties, in return for which the private parties would maintain the roads. Also, the interest in PPPs in the Netherlands was not restricted to the development of transport infrastructure projects (see, e.g., Kreukels & Spit, 1990).

19   In Dutch: *Meerjarenprogramma Infrastructuur en Transport*.

20   See, e.g., Eversdijk and Korsten (2009) for an elaborate account of the characteristics of, motivations for, and developments of DBFM in the Netherlands. See also the *DBFM Handbook* that was published by the Knowledge Centre PPP (2008). As relatively few DBFM projects have been delivered, the jury is still out as to whether DBFM lives up to its promises.

Rijkswaterstaat, 2013b). One of these projects, the A15 Maasvlakte-Vaanplein (A15 MaVa), will be analyzed in the fifth chapter of this thesis (see also Chapters 6 and 7).

Another development that materialized in 2008 was the replacement of the Multi-Year Program for Infrastructure and Transport (MIT)[21] with the Multi-Year Program for Infrastructure, Space, and Transport (MIRT)[22] (Ministries of V&W, VROM, EZ, & LNV, 2007). Basically, the MIRT is the state government's spatial investment program that provides a framework for the decision-making and planning of projects. The development from MIT to MIRT is indicative for the emergence of a more area-oriented approach to spatial planning in the Netherlands (Heeres, Tillema, & Arts, 2012; Tillema & Arts, 2009). The coherence between different policy fields (e.g., mobility, housing, and nature), spatial scales, (local, regional, and national) and governments (local, regional, and national) is at the center of the MIRT (Verweij & Gerrits, 2011). By increasing the coherence, it is expected that projects are not in each other's hair (which could lead to project delays and budget overruns) in the already densely built and populated Netherlands. Rather, by involving more policy fields, spatial scales, and government layers, spatial planning – which includes transportation infrastructure – can be better coordinated, resulting in an optimized use of financial means and physical space (Ministries of I&M, EL&I, & BZK, 2011; Ministries of V&W, VROM, EZ, LNV, & WWI, 2010; Ministry of I&M, 2013). The A2 Maastricht project, which is analyzed in the fourth chapter of this thesis (see also Chapters 6 and 7), is a good example of a project in which this coherence seems to be realized (Van Gils, Verweij, & Gerrits, 2011; Verhees, 2013).

A third pathway of improvement concerns evaluation. The Netherlands Institute for Transport Policy Analysis (KiM)[23] published several reports from 2008 onwards that are concerned with the ex-ante evaluation of transportation infrastructure projects including cost-benefit analysis (KiM, 2008a; 2008b; 2010), and their ex-post evaluation (KiM, 2009; PBL & KiM, 2010). In its reports about ex-post evaluation, the KiM stresses the importance of evaluation as a means of learning in addition to evaluation as an accountability mechanism (see also, e.g., Van der Meer & Edelenbos, 2006). However, it recognizes that, inter alia, methodological problems hamper this learning potential. One of the problems is the difficulty of isolating *the* cause of an outcome. Given this difficulty, a related problem is how lessons from evaluations can be transferred to other (future) projects. One promising methodological approach for dealing with these problems is qualitative comparative analysis or QCA (cf. Stern et al., 2012). This is addressed in the second and third chapters of this thesis.

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21 In Dutch: *Meerjarenprogramma Infrastructuur en Transport.*

22 In Dutch: *Meerjarenprogramma Infrastructuur, Ruimte en Transport.*

23 In Dutch: *Kennisinstituut voor Mobiliteitsbeleid.* The KiM is an autonomous part of the Ministry of I&M. It is responsible for analyzing developments in the field of mobility so as to improve Dutch transport policies. In its organizational work program, the KiM explicitly positions itself as an embodiment of evidence-based policy (KiM, 2013). Basically, this is the idea that policy should be based on evidence produced by (evaluation) research (e.g., Bakker, 2012). Hence, the KiM also concerns itself with the evaluation of transportation infrastructure projects.

This succinct background overview was not intended as a full-fledged, all-encompassing account of the policy debate in the Netherlands regarding the development of infrastructure projects. If that would have been the intention, the overview presented here would fall short. Rather, the intent of Section 1.2 was to provide the background against which the present research was conducted and which motivated this thesis. Improving the development processes of transportation infrastructure projects is a persistent and pressing topic. The Betuweroute and HSL-South projects are closed chapters,[24] but the transportation infrastructure story continues as new projects are writing history and, by the looks of it, on rather black pages. A project that currently exercises many minds is, for example, the abovementioned Amsterdam Metro North-South Line (e.g., Badcock, 2009), of which the costs have already increased from € 1.4 billion to € 3.1 billion and of which the completion time has been postponed from 2011 to 2017 (Soetenhorst, 2011). But it is no use crying over spilled milk, and solutions are sought by policy- and decision-makers to improve the development processes of transportation infrastructure projects (e.g., Arts, Dicke, & Hancher, 2010). This brings us to the question of how this thesis contributes to that hankering (Sections 1.3 to 1.5).

1.3.   RESEARCH QUESTION AND OUTLINE OF THE THESIS

This thesis aims to contribute to improving the management of implementation processes of PPP infrastructure projects by evaluating these processes.

To this aim, it examines how qualitative comparative analysis (QCA) facilitates learning from evaluation. This examination consists of assessing QCA as a complexity-informed evaluation approach, and applying it to the study of the management of implementation processes of PPP infrastructure projects.

Given the background of this thesis as articulated in the previous section, it studies the management of the implementations of PPP transportation infrastructure projects in the Netherlands as a specific case of such processes. The main research question is as follows.

How can the implementation and management of PPP infrastructure projects be understood and evaluated from a complexity perspective using QCA, what management responses in project implementation yield (un)satisfactory outcomes, and how can this be explained?

This research question is broken down into a number of steps, formulated as sub-questions (SQ). The building blocks to answering the questions are provided throughout this thesis, as can be seen in Table 1.1.

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24   As far as construction is concerned (see Gerrits & Marks, 2014).

Table 1.1 Outline of the Ph.D. thesis

Chapter		Article	SQ1	SQ2	SQ3	SQ4	SQ5	
1		Introduction						Part 1
2	1st part	Journal of Critical Realism	■					Part 2
	2nd part				■			
3	1st part	Evaluation	■					
	2nd part			■				
	3rd part				■			
4	1st part	Public Works Management & Policy	■					Part 3
	2nd part					■		
	3rd part						■	
5	1st part	International Journal of Project Management	■					
	2nd part					■		
	3rd part						■	
6	1st part	Submitted	■					
	2nd part					■		
	3rd part						■	
7		Submitted				■	■	Part 4
8		Conclusions	■	■	■	■	■	Part 5

> 1. *How can the implementation and management of implementation of PPP infrastructure projects be understood from a complexity perspective?*
> 2. *What then are the consequent methodological requisites for evaluating PPP infrastructure projects?*
> 3. *How and to what extent does qualitative comparative analysis fulfill these requisites?*
> 4. *How are PPP infrastructure project implementations managed empirically, and what management responses yield (un)satisfactory outcomes?*
> 5. *How can these outcomes be explained?*

This thesis consists of five parts. Part 1 is this introductory chapter. Part 2 is about ontology, epistemology, and methodology. It is concentrated on the first three sub-questions. Parts 3 and 4 are primarily empirical; they address the fourth and fifth sub-questions. Part 5 concerns the conclusions and discussion of the study.

The *first sub-question* considers how implementation processes of infrastructure projects, and their management, can be understood from a complexity perspective. The answer to this question is constructed in three 'steps' with an increasing focus. At the basis lies, first, a philosophical examination of the very nature of reality and how it can be understood, including questions of epistemology. This is addressed in the first part of Chapter 2 (Gerrits & Verweij, 2013). Second, this understanding of reality is focused on infrastructure project development specifically. This is done in the first part of Chapter 3

(Verweij & Gerrits, 2013).[25] Third, it is further focused on the management of the implementation processes of PPP infrastructure projects. This means that the focus is on public and private management as responding to unforeseen events. This is done in the first parts of the empirical chapters of this thesis (Chapters 4, 5, and 6).

With the *second sub-question*, the focus shifts from ontology and epistemology to methodology. It considers how the complexity perspective developed with the first sub-question translates into methodological requisites. These requisites are established in the second part of Chapter 3.

With the *third sub-question*, it is assessed to what extent QCA meets these requisites. This is done in the final parts of Chapters 2 and 3, but especially Chapter 3. In effect, this establishes QCA as a complexity-informed evaluation approach.

The chapters in Part 2 about the first three sub-questions are formative for the ensuing empirical chapters: QCA as a complexity-informed evaluation approach is applied in empirical studies. These empirical studies comprise Parts 3 and 4 of this thesis, and they address the last two sub-questions.

The *fourth sub-question* addresses how implementation processes of PPP infrastructure projects are managed empirically, and what management responses yield (un)satisfactory outcomes. To answer this question, two project implementation processes are studied. The first one is the A2 Maastricht, which is analyzed in Chapter 4 (Verweij & Gerrits, 2015).[26] A total of eighteen unforeseen events are identified and comparatively analyzed with QCA. The analysis is structured in three steps: it shows the implementation of the infrastructure project (i.e., the occurrence of unforeseen events), how it is managed (i.e., how the events are responded to), and it evaluates what management responses yield satisfactory outcomes.[27] The second project implementation is the A15 MaVa, which is analyzed in Chapter 5 (Verweij, 2015a).[28] A total of twenty events are identified and comparatively analyzed with QCA. The structure of the chapter is similar to the previous one.[29]

The comparative analyses with QCA in Chapters 4 and 5 produce patterns of management responses to events in implementation processes associated with (un)satisfactory outcomes. The *fifth sub-question* addresses how these patterns associated with outcomes can be explained. The answer to this question is constructed in two steps. First, the patterns within the two project implementations are explained by reference to the underlying empirical data, for each project respectively. This is done in the final parts of Chapters 4

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25   An earlier version of the article was published as a book chapter in Gerrits and Marks (2012); see Verweij and Gerrits (2012a). To cater to practitioners, an introduction to QCA is published in Dutch (Verweij & Gerrits, 2012b).

26   A previous version of the article was published as a book chapter in Meek and Marshall (2014); see Verweij and Gerrits (2014). A preliminary analysis of the project without QCA was published elsewhere (Verweij, 2012a; 2012b).

27   The results of the A2 Maastricht analysis have also been made available to practitioners (Verweij, 2013).

28   See also Verweij, Van Meerkerk, Koppenjan, and Geerlings (2014).

29   The results of the A15 MaVa analysis have also been made available to practitioners (Reynaers & Verweij, 2014; Verweij, 2015b).

and 5. Second, the patterns are explained by comparing the two project implementations with each other. This is done in Chapter 6.

Chapter 7 is the empirical capstone of this thesis.[30] It comprises Part 4 and it addresses both the fourth and fifth sub-questions. It is a comparison of the implementations of a medium number of infrastructure projects. The chapter is an attempt to evaluate to what extent the patterns and explanations found in Chapters 4 to 6 are generalizable to a larger set of implementations. The shift from the studies of the two project implementations, via a comparison of them, towards a comparison of a medium number of implementations, can be imagined as a T-structure: the 'leg' of the T represents the two implementation studies and the 'roof' represents the comparison of multiple implementations (cf. Buijs et al., 2009). In the final chapter (Chapter 8), the research questions are answered. The outline of the thesis is summarized in Table 1.1.[31]

Now that the research questions and thesis outline have been presented, the next sections articulate the relevance of the questions and position the thesis in the literature.

1.4. PRACTICAL RELEVANCE TO THE FIELD

This doctoral thesis intends, first, to cater to the people who are in the business of actually implementing PPP infrastructure projects: the project managers (see also Sections 1.5.3 and 1.5.4).[32] Public procurers of infrastructure projects devote a lot of attention and resources to planning the projects: the pre-contract phase. The *planning phase* usually includes the legal planning procedures (i.e., Route Decision and zoning plan procedures)[33] and the procurement and contracting of the project. Subsequently, in contemporary projects, the private contractors design, build – and in the case of DBFM, also maintain and (partly) finance – the infrastructure. Rijkswaterstaat, the major public procurer of transportation infrastructure in the Netherlands,[34] is a case in point: it aspires to be a professional public principal that leaves the actual design and construction of projects to the market (Rijkswaterstaat, 2004; 2008) and, to an increasing degree, also their finance and maintenance (e.g., Eversdijk et al., 2011). Hence, quite a few Ph.D. theses have been concluded recently that focus on the planning phases – i.e., legal planning, procurement, and contracting – of

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30 A first version of this chapter was presented as a paper at the Netherlands Institute of Government Annual Work Conference. It received the 'Graduate School Award for Ph.D. Excellence 2014', for the best paper of the year, from the Erasmus Graduate School of Social Sciences and the Humanities.

31 The article titles, section numberings, the numberings of tables and figures, and the reference styles of the articles have been changed upon inclusion in the present thesis as chapters, for purposes of structure and coherence. The abstracts, subsection titles, and texts of the articles have not been changed upon inclusion in this thesis.

32 Cf. Hertogh and Westerveld (2010).

33 In Dutch: *Tracéwetprocedure* and *bestemmingsplanprocedure*.

34 Rijkswaterstaat is the executive agency of the Dutch Ministry of Infrastructure and the Environment that is responsible for the main transportation network. Rijkswaterstaat employs around 9,000 people and has an annual turnover of approximately € 5 billion. It manages over 4,500 km of highways, nearly 2,800 viaducts, 23 tunnels, and nearly 750 bridges (Rijkswaterstaat, 2012; 2013a).

Dutch infrastructure projects, and how these project phases can be improved and utilized for improving the end results of projects (e.g., Busscher, 2014; Giezen, 2012; Hoezen, 2012; Lenferink, 2013; Lousberg, 2012; Verhees, 2013). What happens in the subsequent *implementation phase* of construction and delivery – 'when the shovel hits the ground', so to say – of infrastructure projects is, however, less researched. Importantly though, it is not less important (e.g., Smits, 2013). Events occur in the implementation processes of projects, many of which are unforeseen and unplanned, that do have an influence on the development and outcomes in/of projects. Recall that this was also recognized by the Temporary Committee on Infrastructure Projects (2004b). Importantly, if these events are not managed properly, the obtained or anticipated gains in the legal planning, procurement, and contracting phases might be lost in the implementation phase (Mistarihi, Al Refai, Al Qaid, & Qeed, 2012).[35] Pressman and Wildavsky ([1973]1984) already showed some forty years ago that expectations and intentions in planning can easily fail in subsequent implementation processes.

Importantly, such unforeseen events are not necessarily due to ignorance on the part of some manager or organization bearing responsibility. Project implementation processes are 'wicked': their systemic complexity means that causes of and solutions for outcomes in/of projects cannot be predicted and identified unambiguously (Rittel & Webber, 1973). Assuming otherwise would probably facilitate blaming: 'you should have known then that…' (cf. McDaniel, Jordan, & Fleeman, 2003). In the context of infrastructure project implementation specifically, 'blaming' translates into public principals and private contractors arguing over who bears responsibility, and the costs that come with this responsibility. Rather, as is explained later in this thesis, unforeseen events are also fundamental to the nature of implementing infrastructure projects, and to reality in general (e.g., McDaniel & Driebe, 2005a). If we accept this, the focus shifts to how events in project implementation are best responded to by their managers, and what can be learned from this (cf. McDaniel et al., 2003), or perhaps even how they can be seized as opportunities (cf. Ward & Chapman, 2003). This concerns, or should concern, public managers (and policy- and decision-makers) who – although many risks in project construction and delivery are transferred to their private partner, and although such events cannot always be prevented – bear some responsibility for the public funds spent on infrastructure projects (cf. Miller & Lambert, 2014). This thesis contributes in showing how unforeseen events are best responded to (Piperca & Floricel, 2012) in the implementation of PPP infrastructure projects (see Chapters 4, 5, and 6).

Second, this thesis intends to cater to evaluators (see also Sections 1.5.1 and 1.5.2) of infrastructure projects. Evaluation is important: "the promise that comes from determining what works and what does not prompts you to continuously improve" (Kaufman, Keller, & Watkins, 1996:8). It is important to stress this promise, because the threat of evaluation, "which flows from misuse, comes from the fear that [evaluation] will be used for blaming and not for fixing or learning" (Kaufman et al., 1996:8). This thesis wants to emphasize the

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35   Somewhat related to this, note that the WRR and the Advisory Committee VBI also pointed to problematic management issues (see Sections 1.2.1 and 1.2.2).

promise and not the threat of evaluating projects (cf. Lehtonen, 2014): learning and not blaming. Fortunately, this awareness seems to gain a foothold in the Netherlands. Evaluation practice in the Netherlands appears to be increasing (Leeuw, 2009) and there is a growing awareness of the importance of evidence (produced by, inter alia, evaluations) based policy (e.g., Bakker, 2012; Hoorens & Oortwijn, 2005). However, concerns are expressed with regard to the extent to which results of evaluations actually are, and can be, harnessed (Kerseboom, 2008). One of the reasons for this concern, it is argued in the present thesis (see especially Chapter 3), is that the results of evaluations hardly reflect the complex nature of the object of the evaluation (in this thesis: the management of PPP infrastructure project implementation processes). The object of evaluation is also coined the evaluand (Davidson, 2005). The problem, or at least part of it (cf. Kerseboom, 2008), is in the methodology used for the evaluation (Pattyn & Verweij, 2014). In its report (2009), the KiM indeed recognized that causality in the real world of transport infrastructure is more complex than is usually assumed with conventional evaluation methods. This is correct.

Obviously, it is not possible to provide a complete description of reality: any research works with compressions or models of reality (Cilliers, 2000a; 2000b; 2001; 2002; 2005b). However, when evaluations compress the complex reality to the point that we are fooled by ostensibly clear-cut relations between cause and outcome, it may be disappointing to find out that when such 'causes' are applied in or to other (future) projects to achieve certain outcomes (learning), the outcomes that are actually produced are not those that were expected based on the results of the evaluations. The reason, of course, is that the actual causal relations are more complex than was assumed with the methods used in the evaluation (cf. Rogers, 2011). Byrne (1998:37; Byrne & Callaghan, 2013:58) has eloquently and trenchantly stated that "positivism is dead. By now it has gone off and is beginning to smell." The implication of this observation could be that as much of the complexity of the evaluand needs to be preserved as possible. However, in extremis, this would result in some postmodernist evaluative account (cf. Abma, 1996) that cannot be used in other (future) projects because generalization is not allowed. Both alternatives, i.e., excessive compression and generalization versus the excessive absence of it, are problematic for learning from evaluations (cf. Marsden & Stead, 2011). Excessive compression results in oversimplified evaluation results that may not work in other (future) projects, and the absence of compression forbids generalization, which forecloses in advance the option of cross-project learning. There is a need for broadening the range of evaluation methods in the toolbox (Stern et al., 2012). This thesis establishes and applies QCA as a complexity-informed evaluation approach that overcomes the flaws of both extreme positions by striking a balance between them (see Chapters 2 and 3), so that learning from evaluation is facilitated.

This thesis' envisaged contribution to evaluators is combined with the intention to cater to the project managers. This is done by applying QCA to the evaluation of how unforeseen events in implementation processes of PPP infrastructure projects are best responded to by managers (see Chapters 4 and 5). Having articulated the practical relevance of this thesis to the field, the next section is concerned with how it caters to the academic enterprise.

1.5.   SCIENTIFIC POSITIONING AND RELEVANCE TO THE LITERATURE

This thesis is imbued with complexity theory, or rather (see Byrne & Callaghan, 2013) 'complexity', 'complexity science', or 'complexity thinking'. The purpose of this thesis is not to provide a comprehensive overview of the origins and strands of complexity. Such overviews have already been produced by others (see, e.g., Castellani, 2014). Very briefly, complexity has been strongly influenced by developments in the natural sciences (i.e., biology, physics, and chemistry), often in interplay with mathematics and informatics (see, e.g., Mitchell, 2009), it is trans-disciplinary (Simon, 1962), and applications and developments are widespread throughout the sciences of both the physical and the social (see, e.g., Castellani, 2014). The latter includes the fields of Public Administration,[36] Public Policy, and Public Management, which have seen many complexity-informed scientific articles (too many to list here), books (Colander & Kupers, 2014; Dennard, Richardson, & Morçöl, 2008; Gerrits & Marks, 2012; Gerrits, 2012; Geyer & Rihani, 2010; Haynes, 2003; Meek & Marshall, 2014; Morçöl, 2012; Rhodes, Murphy, Muir, & Murray, 2011; Room, 2011; Teisman, 2005; Teisman, Van Buuren, & Gerrits, 2009), special issues (Dennard, Richardson, & Morçöl, 2005; Landini & Occelli, 2012; Meek, 2010; 2014; Morçöl, 2008; Teisman & Klijn, 2008), and recently even dedicated journals (Hadžikadić, 2014; Morçöl, Teisman, & Gerrits, 2014).[37] Given the breadth of the disciplines in which it occurs, it can hardly be maintained that complexity is a coherent agreed upon causal framework of propositions across (and even within) the academic disciplines in which it is being applied and developed. Hence, following Byrne and Callaghan, in this thesis the position is taken that complexity "is an ontologically founded framework for understanding and not a theory of causation" (2013:8). This said, the present thesis has been shaped by complexity's understanding of reality and the epistemological derivatives thereof.

This section positions the thesis briefly in the scientific fields of complexity (Section 1.5.1), evaluation (Section 1.5.2), project management (Section 1.5.3), and PPP infrastructure projects (Section 1.5.4), and it articulates the contributions it intends to make to those fields.

1.5.1.   Complexity and qualitative comparative analysis

Buijs, Eshuis, and Byrne (2009), amongst many, explain that complex systems have unique aspects but, because systems are open and therefore interact with each other, that they also share characteristics with other complex systems. Another way to put this is that reality is complex and rich in detail, but that general patterns can be found in it as well. This observation can be traced back to complexity's hallmark that life/reality/a phenomenon emerges from the interactions between a seemingly infinite number of elements (Gribbin,

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36   In Dutch: *Bestuurskunde.*
37   Complexity is also being taken up in the public domain beyond academia (e.g., OECD Global Science Forum, 2009).

2004; Mitchell, 2009; Waldrop, 1992). A necessary precondition for understanding social phenomena, such as the implementation processes of PPP infrastructure projects that are studied in this thesis, thus is studying the details (Hertogh & Westerveld, 2010). Case studies are an appropriate means to study cases in detail – to study how elements interact in complex ways – to produce the outcome of interest (Anderson, Crabtree, Steele, & McDaniel, 2005; Buijs et al., 2009). Case studies focus on in-depth causal explanation of cases by using qualitative methods and techniques. The limitation is, however, that patterns found are unlikely to be representative or generalizable (Sayer, 1992).[38] This was also observed by Pollitt (2009) who argued, in response to a collection of complexity-informed case studies of infrastructure projects (Teisman et al., 2009), that "it is questionable whether even a substantial number of individual case studies can convincingly be used to derive general patterns" (2009:224), and who hence suggested to "explore more fully methodologies beyond that of case studies" (2009:230). This exploration is initiated in this thesis.

QCA is put forward as a promising approach that allows the derivation of general patterns from case studies in a systematic and transparent way. Merely introducing QCA is not the intended contribution of this thesis. The approach has been around for a while (Ragin, 1987; 2000; 2008a), textbooks have been written about it (Rihoux & Ragin, 2009a; Schneider & Wagemann, 2007; 2012),[39] and it has been applied many times already (Marx, Rihoux, & Ragin, 2014; Rihoux, Álamos-Concha, Bol, Marx, & Rezsöhazy, 2013). Rather, this thesis' intention is to – building on the work of most notably David Byrne (2002; 2005; 2009; 2011a; 2011b) – assess, establish, and apply QCA as a complexity-informed research approach. The links between complexity as an ontological and epistemological frame of reference, and QCA as its methodological 'corollary', will be explicated. This is at the center stage of Chapters 2 and 3. The perspective established in those chapters is formative for the subsequent empirical research that is reported in this thesis.

1.5.2. Evaluation and qualitative comparative analysis

QCA is rapidly gaining in popularity in the disciplines of Public Administration and Policy Analysis (Rihoux, Rezsöhazy, & Bol, 2011; Rihoux et al., 2013). The same applies to the Evaluation discipline.[40] Using the bibliographical database Scopus to conduct an exploratory survey in evaluation journals,[41] it was found that the recent years have seen

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38　In contrast to intensive research approaches such as case studies, 'extensive' approaches focus on descriptive, representative generalizations by applying quantitative methods and techniques, with the limitation, though, that the explanatory power of the results is limited (Sayer, 1992).

39　Other QCA-related books are: Rihoux and Grimm (2006b), Fiss, Cambré, and Marx (2013), and Thiem and Duşa (2013c).

40　See for a criticism: Tanner (2014).

41　The Scopus Journal Analyzer was used to select the relevant evaluation journals, using the query 'evaluation'. The resultant selection of 19 evaluation journals was searched with the queries 'ALL(*qca)' or 'ALL("qualitative comparative analysis")' to ensure that all articles that mentioned QCA were found. This resulted in a total number of 26 articles of which 19 actually mentioned QCA (in other articles, QCA was

a strong increase of QCA-related publications (see also Gerrits & Verweij, Accepted). An increasing number of conceptual pieces is being published (Byrne, 2013; Verweij & Gerrits, 2013), often including empirical applications as well (Balthasar, 2006; Befani et al., 2007; Befani, 2013; Blackman, Wistow, & Byrne, 2013; Holvoet & Dewachter, 2013; Ledermann, 2012; Pattyn, 2014; Sager & Andereggen, 2012; Thiem, 2014).[42] QCA has also been recognized as a relevant evaluation approach outside the evaluation journals (e.g., Befani & Sager, 2006; Hudson & Kühner, 2013; Marx, 2005; Pattyn & Verweij, 2014; Varone, Rihoux, & Marx, 2006; Verweij & Gerrits, 2012a).[43] This raises the question: what is the contribution of the present thesis to the evaluation literature?

First, QCA is introduced as a complexity-informed approach – i.e., a method explicitly rooted in the ontology and epistemology of complexity – into the evaluation discipline (Chapter 3). As Walton's (2014) lately published literature review shows, complexity is increasingly discussed and applied in the evaluation literature. The attention given to complexity in the journal *Evaluation*, for instance, has grown in recent years (e.g., Barnes, Matka, & Sullivan, 2003; Byrne, 2013; Callaghan, 2008; Davies, 2004; Mowles, 2014; Rogers, 2008; Sanderson, 2000; Verweij & Gerrits, 2013; Westhorp, 2012). There are also an increasing number of books available about complexity and evaluation (e.g., Forss, Marra, & Schwartz, 2011; Patton, 2011; Wolf-Branigin, 2013). To this field of complexity and evaluation, the present thesis adds QCA (cf. Blackman et al., 2013; Byrne, 2013), stressing in particular how QCA can also be deployed in a grounded manner. QCA is often said to be theory-driven (cf. Amenta & Poulsen, 1994; Befani et al., 2007; Yamasaki & Rihoux, 2009). In this thesis it is argued that, and explained how, QCA – consistent with complexity and specifically the notion that the subjectivity of agents in systems is formative to the evaluand, i.e., that managers' experiences have a key-role in understanding infrastructure project implementation processes (cf. Verweij, 2012a) – is to be applied in a more grounded fashion (cf. Hicks, 1994; Rantala & Hellström, 2001).[44]

Second, as explained by Lehtonen (2014), the evaluation of infrastructure projects has gained attention, but mainly for reasons of improving accountability and not for learning. The reason is that it mainly focuses on the 'pathologies' – i.e., outcomes – of, inter alia, costs overruns, time delays, and infrastructure quality (cf. Atkinson, 1999). It has been preoccupied with comparing 'before and after' situations. Although important

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an abbreviation for something else). This exploratory survey was last conducted on the 20th of October 2014 and includes all articles up to that date.

42 Other articles referenced to QCA, recognizing its relevance for evaluation, but did not pursue a detailed discussion of QCA (Da Costa, Pegado, Ávila, & Coelho, 2013; Jackson & Kolla, 2012; Pattyn & Brans, 2013; Ton, 2012; Walton, 2014; Yin, 2013).

43 See also www.compasss.org.

44 This does not mean that theory has no role to play. Rather, induction – understood as "the process of using evidence to formulate or reformulate a general idea" – and deduction – understood as "the process of deriving more specific ideas or propositions from general ideas" – are in interplay with each other (Ragin & Amoroso, 2011:76). They often blend in the research process, although this is often hard to exhibit in the reporting of the research. Cases are constructed in the research process, where data as well as theory (evidence as well as ideas) are used in a dialogical, iterative fashion for the purpose of achieving closure between them (Ragin, 1992).

(cf. Short & Kopp, 2005), the drawback of this is that less insight is gained in how the 'after' was produced in-between, in the implementation processes of the projects (cf. Love, Smith, Simpson, Regan, & Olatunji, OnlineFirst). This gap between implementation and evaluation limits the contribution of evaluations for learning (see, e.g., Patton, 2011). Alternatively, this thesis intends to show that QCA, when applied as a complexity-informed evaluation approach, focuses attention on learning from evaluations, because it gives attention to human experiences in understanding outcomes and the ways in which these are produced in projects. Specifically, it recognizes, first, the importance of context and the existence of multiple perspectives and rationalities (cf. Lehtonen, 2014), such as those of public managers, private managers, and local stakeholders. Second, it recognizes the importance of the day-to-day, the real-life, and the here-and-now practice of managing the projects in their uncertain and unpredictable environments (cf. Lehtonen, 2014; Sanderson, 2012). By evaluating the 'in-between' instead of the 'before and after' of projects, this thesis intends to contribute to closing the gap between the evaluation and the implementation (cf. Pressman & Wildavsky, [1973]1984) of infrastructure projects (Lehtonen, 2014). It is argued that, and showed how, QCA as a complexity-informed and systematic evaluation approach can be used to this purpose (Chapters 3, 4, 5, and 7). In doing so, QCA is also introduced in the field of (PPP) infrastructure project research (cf. Jordan, Gross, Javernick-Will, & Garvin, 2011), a domain rather unfamiliar with QCA (Jordan et al., 2011) with the exception of a few applications (e.g., Chan & Levitt, 2011; Delhi, Mahalingam, & Palukuri, 2012; Gross & Garvin, 2011).

1.5.3.   Project management and infrastructure projects

Complexity science understands that reality is composed of open systems that are nested and interrelated (Byrne, 2005). Hence, project implementations are open systems embedded in open socio-physical systems (i.e., environments) with which they interact (Engwall, 2003). The complex nature of the system creates uncertainties and it gives rise to unforeseen events (cf. Söderholm, 2008). Although it is still insufficiently appreciated, this requires project management research to adopt a situational, contextual approach (Blomquist, Hällgren, Nilsson, & Söderholm, 2010; Hertogh & Westerveld, 2010). As Sanderson expresses it (2012:441):

> "If we admit the view that the future unfolds in unknowable ways through myriad decisions and interactions between autonomous actors, then we must give proper attention to the ways in which project governing happens in a situated, relational sense, rather than focusing solely on governance as a set of pre-designed objects."

This thesis follows that view by focusing on how implementation managers of PPP infrastructure projects respond to situated unforeseen events (Chapters 4, 5, and 6).

The difference between risk and uncertainty is important here. As Sanderson (2012) explains, if managers adopt a risk-perspective then they assign probabilities – based on

either mathematical chance, or past empirical/statistical data – to events. If they adopt an uncertainty-perspective, then they accept that no objective probabilities can be assigned to a known range of possible future events, or that the range of possible future events is unknowable in the first place (cf. Flood, 1999a; 1999b). The risk-perspective dominates the literature on, and the practice of, the management of infrastructure projects (see, e.g., Akintoye & MacLeod, 1997; Smith, Merna, & Jobling, 2014). Importantly, as Sanderson (2012) clarifies, a focus on the risk-perspective seeks explanations for the outcomes in/of projects in the strategic rent-seeking behavior of project stakeholders, because the perspective assumes a worldview where the implementation paths of infrastructure projects can be calculated and that, therefore, actors can choose to miscalculate. This view is adopted in, inter alia, the work of Flyvbjerg and colleagues (e.g., Flyvbjerg et al., 2002; Flyvbjerg et al., 2003; Flyvbjerg, Skamris Holm, & Buhl, 2005; Flyvbjerg, 2009a). It focuses on identifying culprits and holding them accountable. This is not a perspective that promotes learning from evaluating the implementation of infrastructure projects (cf. Lehtonen, 2014; Love et al., OnlineFirst; Van der Meer & Edelenbos, 2006). The uncertainty perspective, on the other hand, accepts that events can be unforeseen (Sanderson, 2012). The occurrence of such events directly derives from reality composed of complex systems (McDaniel et al., 2003; McDaniel & Driebe, 2005b). March mentions "inherently unpredictable worlds" (1994:36), and McDaniel and colleagues refer to, inter alia, "the basic dynamics of complex adaptive systems" (2003:267), and the "fundamental unpredictability for the trajectory of the system and, therefore, fundamental unknowability of future system states" (2003:269). Adopting this view means dismissing the view that unforeseen events are due to ignorance or rent-seeking behavior (cf. Verweij, Van Meerkerk, & Korthagen, 2015), and accepting that unforeseen events inevitably occur. This shifts the focus to learning from both better and worse experiences with responding to events in implementation (McDaniel et al., 2003). In fact, as the review by Müller-Seitz and Schüßler (2013) indicates, the literature on unexpected events focuses on learning from events (e.g., McDaniel et al., 2003; Weick & Sutcliffe, 2001; 2007). This thesis investigates how these events are best responded to and, in doing so, contributes to the need to develop more complexity-informed, 'bottom-up' understandings of, and approaches to, the research and practice of managing projects (Blomquist et al., 2010; Winter, Smith, Morris, & Cicmil, 2006).

1.5.4. Public-private partnerships and infrastructure projects

The fourth and final field to which this thesis intends to contribute is PPPs in infrastructure projects. Cross-sector partnerships in projects have become more prominent from the 1980s onwards, as it was increasingly recognized that organizations have by themselves insufficient capacities to deal with increasingly uncertain environments (Selsky & Parker, 2005). Business-government partnerships, i.e., public-private partnerships, constitute one arena (Selsky & Parker, 2005). PPPs have been contested ever since they became fashionable some thirty-five years ago (Bovaird, 2004) – inter alia because of their questionable performance (e.g., Hodge & Greve, 2007; 2009) – but they have become a prevalent

practice nonetheless (Bovaird, 2004), as they are expected to have many advantages over classical ways of public infrastructure procurement (see, e.g., Section 1.2.2). PPP popularity also increased in the field of delivering (transportation) infrastructure projects (Kwak, Chih, & Ibbs, 2009), including in the Netherlands (Klijn, 2009) (see Section 1.2.2). This growing popularity is also reflected in the increasing number of PPP articles published in this field (Ke, Wang, Chan, & Cheung, 2009; Tang, Shen, & Cheng, 2010).

Literature reviews of infrastructure project PPP studies indicate that PPP risks is one of the dominant topics in the academic literature (Ke et al., 2009; Kwak et al., 2009; Tang et al., 2010). Many studies have been conducted, for instance, into the preferred allocation of risks and responsibilities between the public and private partners (e.g., Bing, Akintoye, Edwards, & Hardcastle, 2005; Chung, Hensher, & Rose, 2010; Hwang, Zhao, & Gay, 2013; Ibrahim, Price, & Dainty, 2006; Ke, Wang, Chan, & Lam, 2010; Ng & Loosemore, 2007; Roumboutsos & Anagnostopoulos, 2008). A topic that has received less attention is the management in PPP infrastructure projects (cf. Ismail, 2011; Ke et al., 2009). Research that has been performed into the management in and of PPPs (e.g., Edelenbos & Teisman, 2008; Edelenbos & Klijn, 2009; Klijn, Edelenbos, Kort, & Van Twist, 2006; 2008), however, has not (always) specifically focused on the implementation processes of the projects. What happens in the implementation of a PPP project – i.e., the construction and delivery which start after the phases of legal planning, procurement, and contracting have been concluded – is generally little studied (Jones & Noble, 2008; Mistarihi et al., 2012; Mistarihi, Hutchings, & Shacklock, 2013; Weihe, 2008b; 2009) (see also Section 1.4).

PPP implementation is an important topic because, if not managed correctly, the obtained or anticipated gains in the formation of PPPs might be lost in the implementation phase (cf. Verweij et al., 2015). The literature about PPP risks focuses on 'designing' PPPs and allocating risks to partners based thereon (e.g., Reijniers, 1994). However, when the implementation starts, unforeseen events can still occur (see Section 1.5.3) and both the public and the private partners have a vested interest in an effective management of these events. The market needs to make a profit and the government serves to protect a wide variety of public interests. It is argued however, referring to the work of Jacobs (1992), that the fundamental differences between the public and private domains – in terms of these interests, but also with respect to perspectives, management practices, etcetera – poses great difficulties in the planning and in the implementation processes of PPP projects (Klijn & Teisman, 2000b; 2003; 2005; Koppenjan, 2005; Reynaers, 2014; Teisman, 2010; Van Ham & Koppenjan, 2001; Verweij, 2012a). A focus on risks means trying to solve implementation problems by reference to the risk allocations stipulated in the PPP contract. Although contracts are of great importance to successful PPP project implementation, a too strict focus on them could result in disputes about who is to be held accountable ('blaming'), which, as studies (Kumaraswamy & Zhang, 2001 cited in: Tang, Shen, & Cheng 2010) and recent experiences (e.g., Koppenjan & Leijten, 2005a; 2005b; 2007) suggest, often results in the government bearing the costs. Rather, this thesis (Chapters 4, 5, 6, and 7) contributes by focusing on how public and private managers need

to work in partnership to achieve satisfactory outcomes in implementation processes, a topic that is yet rather understudied (Weihe, 2009).

In summation, establishing (Chapters 2 and 3) and applying (Chapters 4, 5, 6, and 7) QCA as a complexity-informed evaluation approach, this thesis thus combines the PPP and project management research fields with that of the evaluation of infrastructure projects, by evaluating how implementation processes of PPP infrastructure projects can be managed satisfactorily, and explicating what can be learnt from this (Chapter 8).

1.6.   FINAL REMARKS

Qualitative, case-based research is often not a purely inductive or deductive process. The same applies to the present thesis, which is best characterized as iterative (cf. Dubois & Gadde, 2002; Ragin, 1992; Ragin & Amoroso, 2011; Schwartz-Shea & Yanow, 2012). The arguments introduced above, the research questions, the conduct of the research, the report of the research in this book, the conclusions – these have all been shaped throughout the research process. It is important to stress this because this thesis is article-based. This means that some of the articles (i.e., Chapters 2 to 7) were published or accepted for publication – 'cast in stone', so to speak – after which (further) empirical research was conducted, resulting in new ideas and insights. Although they were 'cast in stone', the articles should not be understood as rigid frameworks for the subsequent steps in the research (cf. Robson, 2002). This thesis represents the ongoing development of the thinking about the topics introduced above, to date, and an attempt to report on the research into these topics.

PART 2
Ontology, Epistemology, and Methodology

This part of the thesis focuses on the first three sub-questions. It examines how implementation processes and their management of PPP infrastructure projects can be understood from a complexity perspective (i.e., the first sub-question), what this implies for evaluating these processes in terms of methodological requisites (i.e., the second sub-question), and to what extent qualitative comparative analysis (QCA) meets these requisites (i.e., the third sub-question).

QCA is first established as a complexity-informed approach. This is done in Chapter 2 by making the connection between complexity as an "ontologically founded framework for understanding" (Byrne & Callaghan, 2013:8) and QCA. It is important to explicitly consider this relationship:

> "'Method' suggests a carefully considered way of approaching the world so that we may understand it better. To make judgments about method it helps considerably if we have some idea of the nature of the relationship between ourselves and that which we seek to understand. Yet it is at this fundamental level that many arguments about method go wrong, for they fail to consider knowledge in its context" (Sayer, 1992:12).

The connection between complexity and QCA is established by using critical realism as a meta-framework. The chapter is published as an article in the *Journal of Critical Realism* (Gerrits & Verweij, 2013).

In Chapter 3 the relationship between complexity and QCA is also established, but now with a specific focus on the evaluation of infrastructure project development processes. It is argued that project implementation is complex, which imposes requirements on the methodology that can be used for evaluating infrastructure projects (see, e.g., Smyth & Morris, 2007), and that QCA is a suitable approach for evaluating infrastructure project development processes. The chapter also provides a first explanation of how QCA works. The chapter is published as an article in the journal *Evaluation* (Verweij & Gerrits, 2013).

Synchronously with the development of these two chapters, QCA was applied in an empirical study of network management in Dutch spatial planning governance networks. This resulted in an article publication in the journal *Public Administration* (Verweij et al., 2013). Although that study is not part of this thesis, the experiences gained with it greatly contributed to the development of Chapters 2 and 3.

2 | Complex Reality: Understanding and Researching with Qualitative Comparative Analysis

Lasse M. Gerrits
Stefan Verweij

ABSTRACT

Many methods are used in research on complexity. One of these is qualitative comparative analysis (QCA). Although many authors allude to the relationships between complexity and QCA, these links are rarely made explicit. We propose that one way of doing so is by using critical realism as a meta-framework. This article discusses the viability of this approach by examining the extent to which QCA is a complexity-informed method. This question is answered in three steps. First, we discuss the nature of complexity and its epistemological implications. Second, we focus on Bhaskar's perspective on critical realism and show how it can be used as a framework for understanding social complexity. Third, we examine the ontological and epistemological assumptions underlying QCA and synthesize these with our critical realist approach to complexity. We argue that complex reality is non-decomposable, contingent, non-compressible, and time-asymmetric. We conclude that, although QCA is inevitably reductive (i.e., it compresses reality) and partial (i.e., it decomposes reality), its core premises are built upon the notions of contingency and time-asymmetry. Therefore, it is not only a powerful method for doing complexity-informed research, but is also a complexity-informed method by itself.

2.1. INTRODUCTION

Many different methods and tools are being used to carry out social-scientific inquiry that is informed by the complexity sciences (Byrne, 1998). Agent-based modelling (e.g., Koliba, Zia, & Lee, 2011) and action research-based theory (e.g., Wagenaar, 2006) are just two of the many methods of inquiry that are informed by theories and concepts from the complexity sciences. Each method or analytical tool used in the complexity sciences has a number of implicit or explicit ontological and epistemological assumptions, and these assumptions differ greatly across methods. Each method brings with it different assumptions about the nature of complexity, differing levels of access to reality, and differing explanations for observed phenomena. These differences have led many to ask whether there is a method in the mix that is not only helpful in analyzing complexity, but that is itself informed by complexity, i.e., a native method or tool.

One such method that has received much attention, most notably from David Byrne (Buijs et al., 2009; Byrne, 2005; 2009; 2011a), as being particularly suitable for analyzing the complexity of reality, is Charles Ragin's qualitative comparative analysis or QCA (1987; 2000; 2008a). The main feature of this case-based method is that it is able to account for the contingency of a social phenomenon. In addition (and not instead of doing so), it allows for an exploration of causal patterns. As such, it is a viable means by which to understand the systemic nature of case studies *and* to identify recurring patterns across such cases (cf. Gerrits, 2012). However, although many authors allude to the relationship between complexity and QCA, the logic underlying this relationship is rarely made explicit. This article aims to map that relationship using critical realism as a meta-framework.

We argue here that any effort to research social complexity is implicitly or explicitly informed by Roy Bhaskar's critical realism (cf. Reed & Harvey, 1992). We posit that Bhaskar's view of the world as complex is not simply a truism, but provides a meta-framework for understanding reality as complex and systemic. Our discussion on complexity and critical realism translates into a specific take on complexity, summarized in four properties, which can also be found in QCA, if it is carried out following Byrne and Ragin's guidelines.

This article is structured as follows. We start with the understanding that complexity is a real, non-constructed, property of the world. This leads to a number of epistemological consequences (Section 2.2.1). We then discuss critical realism as a framework for articulating this complex reality (Section 2.2.2). Next, we discuss the basic ontological and epistemological assumptions behind QCA (Section 2.3) before relating them to Bhaskar's critical realism. In doing so, we assess the extent to which QCA is complexity-informed (Section 2.4). The argument is summarized in the final section (Section 2.5).

2.2. COMPLEXITY

2.2.1. Complex reality

According to many authors on the subject, ontologies in the realm of complexity sciences are different from the classical Newtonian worldview. A non-Newtonian worldview holds that reality is characterized by wholes rather than discrete entities and events; non-linear causality instead of linear causality; uncertainty about the future instead of total predictability; and partial truths rather than final truths (Morçöl, 2001). Although these statements describe the nature of complexity, they do not specifically answer the question: what exactly is complexity? Although there have been many attempts to answer this question, complexity has proven to be elusive to define unambiguously (Rescher, 1998). A tentative answer could be that complexity is the opposite of simplicity, i.e., complexity focuses on intricate causal patterns that progress non-linearly, making for a poorly predictable reality. But this answer is as vague as it is specific. While it points out that complexity is recursive, as each closer look reveals even more intricate details that mirror the larger whole, complexity is not exactly recursive in the sense that the whole can be fully known or understood by looking at the discrete details (Cilliers, 2002; 2005b; Rescher, 1998). It implies that a truly accurate description of a phenomenon's complexity would be of the same extent as the phenomenon itself (Rescher, 1998). This is impossible for two reasons. First, complexity is not static but dynamic; thus, an exhaustive description would be temporally limited. Second, there are practical limitations in generating complete and dynamic descriptions of reality. Any description or model of complexity is incomplete by definition, as pointed out by Paul Cilliers, among others (1998; 2005a). Hence, the question becomes: what characteristics of reality impede our understanding and generation of knowledge about the real world?

Perhaps the most fundamental statement about complexity that can be made is that the world is composed of open systems that are nested within, and have nested within themselves, other open systems (Byrne, 2005). This openness means that systems, although bounded, interact with other open systems in their environment (Cilliers, 2001). This interaction results in changes to the systems, as environmental influences become part of the system's structure. However, such environmental influences are not magically transferred to the system; the components that form the structure of the system interact and it is through this interaction that environmental influences become internalized. The process by which this happens is referred to as emergence: structure is formed through the interaction of components, and the resulting structures are not linearly traceable to their roots. Without interaction, there is no structure, only a sum of components. Thus, complex reality consists of open systems that are emergently structured (Reed & Harvey, 1992). Note, however, that emergence does not mean that a discrete entity or phenomenon, that can be investigated under controlled conditions in the real world, exists (Elder-Vass, 2005). Instead, emergence serves as an ontological vehicle for thinking about the nature of causation.

Thinking through emergence points towards another important characteristic of complexity: time-asymmetry, which implies time-irreversibility. If social reality is a non-linear *emergent* result of interacting components, then the future is not a mirror of the past. Although the situation at a given time may appear to be the logical consequence of the sequence of prior events, that logic is not as easily apparent when predicting the future (Byrne, 1998). This is because systems do not follow fixed trajectories. The occurrence of non-ergodic chance events means that reality is developmentally open: "causally undetermined or underdetermined by the existing realities of the present and open to the contingencies of chance or choice" (Rescher, 1995:41). Thus, the future consists of a number of possible future states, some more likely than others. Which one of those future states becomes the actual state depends on the past, and the occurrence of random or chance events. These chance events introduce a level of instability into the trajectories of phenomena, and explain why the future is probabilistic even though the past often (falsely) appears as a fixed sequence (Prigogine, 1997). In an indeterministic or developmentally open world, certain events may or may not happen – depending on the conjunction of conditions. Some configurations may bring forth a future more probable than others (Gerrits, 2012).

These ontological points of departure highlight four properties of reality (Byrne, 2011a). First, since reality is non-decomposable, simply describing components of reality as discrete entities is insufficient, because real structures and processes come about through the internal and external interactions between these components. Second, reality is contingent. This means that any explanation is temporal in time and local in place. Since systems are nested within their systemic environments, there is mutual influence between different systems. This property also implies that some mechanisms are in operation at given points in time, while others are not, which we expand on in Section 2.2.2. Third, the previous two properties mean that reality cannot be compressed without losing some of its aspects. In other words, while reduction or compression may be inevitable given the limits of human cognition, and for practical research purposes, such a reduction or compression implies the loss of some of reality's properties, such that any explanation is reductionist, i.e., an explanation can never fully contain the complexity it describes. This is also indicative of the role of semiotics in defining the world in terms of systems. Finally, time is understood to be asymmetric, which means that the trajectory of all systems is unidirectional. An event may appear in hindsight to be the result of a logical sequence of events, but, as mentioned earlier, this logic is not as easily apparent when looking into the future. Epistemologically, this constrains the extent to which meaningful predictions can be made.

In the next section, we argue that critical realism functions as a meta-framework for understanding this complex reality. We also look at the implications of critical realism for the type of statements that science can substantiate, and the methods that can be deployed to substantiate them.

2.2.2. Real complexity

The common theme in arguments about the complexity of social reality is that this reality is real. Many authors in the field of complexity science maintain that attempts can be made to understand this reality. A realist stance is implied in social complexity that is explicitly not postmodernist, but also not modernist, because it argues that reality can be understood through the deployment of research tools (Cilliers, 1998). It echoes Kant's stance on empirical realism in holding that there is a reality that exists independently of our knowledge and perception (Losch, 2009), but goes beyond Kant in assuming that research allows us to approach reality, and that the tools of research actually allow us to come closer to reality (Sayer, 1992). This way of thinking is propagated in critical realism, and it is often thought of as the way to navigate between empiricism and the interpretive sciences (Wuisman, 2005).

There are a number of different and disconnected strands under the heading of critical realism (Losch, 2009) which may cause some confusion about what critical realism actually means. Still, variants have been adopted in many scientific domains (Easton, 2010). We do not intend to comment directly on that diversity, but to build more specifically on the early work of Bhaskar ([1975]2008) who is credited with the philosophical elaboration of the first wave of critical realism, as well as two subsequent waves (Bhaskar & Hartwig, 2010). While we acknowledge that Bhaskar himself, at first, used the term 'transcendental' and not 'critical' realism (Losch, 2009), we conform to the nomenclature that has developed over time and use the latter as shorthand for Bhaskar's philosophy and strongly related accounts.

Bhaskar's work indicates the existence of a reality independent from human observation. In contrast to others who have a similar view, he believes that we can in fact research, observe the effects of, and analyze the mechanisms underlying, the occurrence of events. Thus, he moves beyond the idea that humans can only describe what they think they perceive without claiming to gain better access to the causal mechanisms that are behind events, processes, or behavior. In this way, Bhaskar presents a stratified perspective on social reality that gives meaning to how one can understand the world. As Andrew Sayer puts it, "critical realism distinguishes not only between the world and our experience of it, but between the real, the actual and the empirical" (2000:11). The empirical is the domain of personal experiences. These are accompanied by the realities of actual events, processes, and behavior, and the mechanisms underlying these events and processes of structure and power. It is important to note that while these mechanisms exist a priori, particular configurations can bring the mechanisms into action, or fail to do so. A well-known example of this is labor power. The power to perform labor is very real, but becomes actualized when labor is actually performed (Sayer, 2000). This position has implications for the type of statements that science can substantiate, and the methods that can be deployed to substantiate them.

In relation to the first point, Bhaskar posits that causality is real and can be researched. External events, processes, or behaviors (Bhaskar's second dimension of stratification), and

the effects of underlying mechanisms (the third dimension), can be observed (the first dimension) as they unfold (Easton, 2010). Critical realism favors the language of causality to describe the world, even though it accepts that any analysis of causality is partial at best. Therefore, critical realism advocates that it can generate provisional explanation of how events follow from previous events, what drives processes, and the mechanisms by which human behavior transpires. In the words of Sayer: "To ask for the cause of something is to ask 'what makes it happen', what 'produces', 'generates', 'creates' or 'determines' it, or, more weakly, what 'enables' or 'leads to' it" (Sayer, 1992:104).

Bhaskar accepts that, while the world ticks because of certain mechanisms, it is not possible to uncover these mechanisms unambiguously or comprehensively (Cilliers, 2001; 2002; 2005b). Following Malcolm Williams (2009; 2011), it is on this point that we feel that Bhaskar's critical realism needs to be amended. Critical realism argues that "there are often sufficient conditions for something to occur, but they are not necessary ones, except under specific circumstances whereby the 'natural necessity' is actualized" (Williams, 2009:3). We follow Sayer in saying that, although "in the 'open systems' of the social world, the same causal power can produce different outcomes, according to how the conditions for closure are broken" and "sometimes, different causal mechanisms can produce the same result" (Sayer, 2000:15), this critical realist view of causation is still open to natural or nomic necessity (Williams, 2009). However, critical realism in Bhaskar's view holds that it is impossible to know this necessity up to the moment that it is actualized (the dimension of the actual): structures and powers are considered dispositional.

Again, labor power provides a striking example. We agree with Bhaskar that recursive complexity impairs complete knowledge of the world, but we add that this recursive property is not the sole reason for partial knowledge. Indeed, reality is itself contingent, and, for that reason, any explanation is partial and contingent. As stated before, some mechanisms operate while others do not, and this marks the difference between potential and achieved influence. However, it does not mark an apparent difference between real influence (realized, therefore observed and appearing to be present) and influence that is not real (unrealized, therefore unobserved, and appearing to be absent). This difference between potential and realized influence can differ between events, processes, systems, or cases (cf. Bhaskar & Hartwig, 2010:109-110). Whether certain mechanisms are in operation or not is a question that can only be answered empirically. We want to emphasize that this does not imply total unpredictability. We learn from past research and experience that, given a certain configuration of conditions, some future states are more probable than others (Byrne, 2011a). However, this is true only in so far as such estimations are not built on the homogenizing assumptions of time symmetry (Prigogine, 1997; Ragin, 2000). To us, this implies that contingency is both epistemological *and* ontological in nature.

Although it is not possible to fully know reality because of the reasons given above, people act upon their interpretations of reality nonetheless. Their interpretations of a situation causally affect their actions, and so interpretations must be considered real, as implied by the Thomas theorem. In other words, people accept in their actions that the world as interpreted by them is real (Easton, 2010). This extends to the researcher who attempts

to discover the causal mechanisms, but who has to understand that his interpretation can only gain meaning through comparison with other interpretations as every interpretation carries with it normative judgments. This observation makes a strong case for negotiated subjectivism (Byrne, 2003; Haynes, 2001; Uprichard & Byrne, 2006), which is the main point of departure in critical realism (Guba & Lincoln, 1989).

Critical realism may accept the notion of causality, yet Bhaskar takes issue with grand narratives about how positivism and its methods, especially the golden standard of the double-blind experiment, can uncover truth. Bhaskar holds that reality is an open system and that causality is systemic by definition. Inevitably, each research attempt draws artificial boundaries around its subject. Those boundaries may be negotiated, perhaps based on common sense in the most literal sense of the word, but they are boundaries nevertheless (Cilliers, 2005b). The real world, however, is unbounded. The choice to focus on certain variables invariably brings with it the choice to ignore others. Unavoidably, it also means that the observer's normative stances are (implicitly or explicitly) embedded in the research, thus translating into what is being researched. Therefore, under the complexity sciences, the positivist claim to true, objective knowledge is unsupported.

These premises lead to the second point, namely that Bhaskar moves away from the positivist orientation and methods that are built on the premise of controlled conditions and stability in the system (e.g., Callaghan, 2008). The absence of control over the conditions in the real world (as opposed to enclosed laboratories) means that it is impossible to establish a definitive causal account because one does not know how the conditions, in which a certain event or process takes place, impact causality, i.e., whether they promote or dampen the occurrence. This perspective has consequences for the way reality is assumed to unfold. Stable systems promote predictability because the same incentives lead to the same result when repeated. But Bhaskar's premise of open systems means that the events, processes, or behaviors that are witnessed are not caused by a supposedly fixed set of variables, but rather by a conjunction of variables at a certain point in time. This can be explained (provisionally) but not predicted (Williams, 2009).

The argument above can be summarized in a description of the nature of complex causality, following Byrne (2011a; 2011b). Complex causality is an interaction of generative mechanisms in specific contexts, resulting in unidirectional outcomes, meaning that the outcomes are subject to time-asymmetry. In addition to Byrne's description, we argue for the plural form of mechanisms because multiple mechanisms produce an outcome in conjunction with context. In other words, a space of possible combinations exists, from which a specific configuration is triggered at a given point in time. Thus, causality is both real and complex, and, importantly, its contingency also applies to those studying it, implying that causality is, by definition, interpreted.

2.3.   PRINCIPLES OF QUALITATIVE COMPARATIVE ANALYSIS

In this section, we discuss the main principles of QCA and its ontological and epistemological assumptions before connecting the dots. QCA is an umbrella term that captures different types of case-based, comparative methods (Rihoux & Ragin, 2009a). The method was developed in 1987 by Ragin as a way of integrating the case-oriented and variable-oriented approaches so as to exploit the strengths of both (Ragin, 1987). Ragin argues that scientists using QCA do not have to choose between the "understanding of complexity and knowledge of generality" (Ragin, Shulman, Weinberg, & Gran, 2003:324). QCA can be used to "achieve a systematic comparison across a smaller number of individual cases (…) in order to preserve complexity, and yet being as parsimonious as possible and illuminating otherwise often hidden causal paths on a micro level" (Rihoux & Lobe, 2009:228).

   It is a comparative case-based approach that allows for the examination of multiple causal configurations. The configurational approach implies that combinations of conditions (i.e., configurations) produce certain outcomes, different combinations may produce the outcome, and certain conditions can have different effects in different contexts. These characteristics are referred to, respectively, as conjunctural causation, equifinality, and multifinality (Grofman & Schneider, 2009; Schneider & Wagemann, 2010), and summarized collectively as causal complexity or complex causation.

   QCA relies on set theory; variables are conceived as conditions, and collections of conditions make up sets. Sets can be, and most often are, conceptualized and defined using existing theories. Cases can have different degrees of membership in a certain set. Different set relations or logical operators (Smithson & Verkuilen, 2006) express the characteristics of causal complexity. 'Logical and' expresses conjunctural causation (i.e., configurations as sets) and 'logical or' expresses equifinality and multifinality. All the logically possible configurations are listed in a truth table (Ragin, 2008a). This truth table is the key tool for the analysis. It sorts the cases across the various configurations and, based on measures of consistency and sufficiency, allows the researcher to examine the set relations between conditions and outcomes.

   Next, the truth table can be minimized, using Boolean algebra, to produce general statements of the necessity and/or sufficiency of (combinations of) conditions for the outcomes to emerge. A condition is necessary if it has to be present for the outcome to occur, and sufficient if it can produce the outcome by itself. However, most often conditions are not individually necessary or sufficient for phenomena to occur, but they can be in the context of certain other conditions (i.e., within a configuration). Such conditions are called INUS conditions: *i*nsufficient but *n*on-redundant parts of a condition which is itself *u*nnecessary but *s*ufficient for the occurrence of the effect (Mackie, 1980). The minimization process leads to a summarized statement or solution formula about the patterns and conditions that lead to certain outcomes observed across the cases. However, the formula only makes sense if its constitutive conditions are theoretically related, and if it is reinterpreted in the light of the individual cases. Boolean minimization is only one part of the cycle of scientific discovery, and the researcher should return to the in-depth

case studies, and perhaps even add new ones, to understand the *meaning* of the solution formula. Adding new cases or new conditions, or re-conceptualizing sets, may cause the solution formula to shift.

QCA is used in a number of different ways for social science research. Some authors, including Ragin himself, regard it as an approach that brings to the forefront the iterative movements between induction and deduction that are part of the social sciences but often remain implicit in research reports. This relates well to Jan Wuisman's argument that, for critical realism to show its potential when examining complex systems, it is necessary that both induction and deduction be included in a single research cycle. He argues that, when the lens of critical realism is adopted by a researcher, the "process of social research is reconceptualized as a process of discovery in which two distinct elements as integral parts are incorporated" (2005:393). Using QCA to conduct research in this way means exposing and mapping the steps back and forth between induction and deduction.

Moreover, this approach allows qualitative and quantitative data to be combined and related to each other (Byrne, 2011a; Ragin, 2000). For example, a qualitative in-depth analysis of a limited set of cases could lay the foundations for a quantitative large-n study. The results from that large-n study could be fed back to the in-depth case analysis. While QCA perceives complexity as real, it can be used to compress large amounts of qualitative data, without losing the essential qualitative nature of the data, to facilitate comparison across cases so as to render patterns of complex causality apparent.

QCA can also be used as an alternative tool for analyzing quantitative data when the sample is too large to allow in-depth analysis, but too small to allow conventional regression analysis. Such studies, and variations on those approaches, use QCA as a frugal way to compress data and to arrive at meaningful results.

A somewhat similar application is when QCA is used to describe systems' trajectories (Byrne, 2011b). This approach uses QCA as a descriptive tool and addresses the configurations of components characterizing the state of a certain system at different moments in time (e.g., Vis, 2007). This configurational approach means that systems are considered conjunctural, and that cases or (sub-)systems are heterogeneous wholes made up of different parts or conditions. At the explanatory level (or Bhaskar's third dimension), their heterogeneous context is assumed to influence their development and structure. Thus, social phenomena are considered emergent (Ragin, 1987): they result from the interactions between different parts or conditions. Hence, their explanation requires a consideration of the interactions of different conditions in relation to the phenomenon, event, or process. Contextual heterogeneity also implies that reality is contingent. Social phenomena operate in context, but this context is not similar for all social phenomena. Nevertheless, a certain phenomenon, event, or process can occur in a similar vein despite being embedded in a different context. This also means that the effects of specific conditions in this heterogeneous contextual configuration depend on other conditions in the configuration. Hence, causality in QCA is conjunctural, equifinal, and multifinal, as mentioned before, and characterized by INUS conditions. This is important, not because social phenomena are multivariate, but because "different causally relevant conditions can combine in a variety

of ways to produce a given outcome" (Ragin, 1987:26). In this way, QCA can be used to elucidate contrary or combined causal mechanisms that lead to certain system states in particular contexts.

2.4.   CONNECTING THE DOTS

We set out to map the connections between complexity, critical realism, and qualitative comparative analysis, connections that are often alluded to but seldom explicitly explained. We began by explicating four ontological statements about the complexity of open social systems: reality is non-decomposable (emergence: the whole is more than the sum of the parts), contingent (systems are located in systems), non-compressible (complexity is recursive), and time-asymmetric (emergence: the future is developmentally open). We then described the usefulness of Bhaskar's approach to critical realism as a meta-framework for understanding how these four statements impact the type of statements social research can substantiate, and the methods that can be deployed to substantiate such statements.

In short, we postulate that a reality exists outside human perception and that this reality is driven by causality. The term 'causality' does not imply universal laws or necessity. Rather, it concerns specific configurations that are temporal in time and local in place, which activate certain mechanisms that bring about that specific reality. Research can aid in describing and understanding how these configurations operate. However, critical realists understand that social reality is too complex to be fully understood, and that there is a difference between achieved and potential influence, and that the absence of a certain effect does not mean that its mechanisms are also absent.

Critical realism appears to have much in common with the ontological statements about complexity. Its focus is on contingency, i.e., how particular configurations activate certain mechanisms and how these configurations shift in time and place. This focus on contingency has implications for the extent to which patterns are said to reoccur over time. As such, it addresses the issue of time-asymmetry. Its position on reality aligns with complexity's properties of non-decomposability and non-compressibility. It implies that both complexity and critical realism offer an anti-reductionist take on social reality (Sibeon, 1999).

This anti-reductionist approach is evident in QCA. It accepts that, while reality is real, we perceive and reconstruct it. To study this complex reality and find causal patterns that may explain the emergence of events, processes, or other kinds of social phenomena, we need to make choices, as with any study. We need to choose the descriptive and explanatory conditions to include in the analysis, and how to define and operationalize (i.e., perceive and reconstruct) these conditions. QCA provides a dialogical research framework in which the researcher moves iteratively – based on actualized events (i.e., cases) – between observations and the discovery of mechanisms, thereby covering Bhaskar's three dimensions. In this way, the operations of QCA articulate the iterative nature of complexity research as a critical realist cycle of scientific discovery (Wuisman, 2005). In line with

Byrne's view of cases as configurations of conditions (Byrne, 2005), and as argued by Ragin, the researcher constructs sets of conditions that constitute the case. As implied in the literature, these conditions can be descriptive (Berg-Schlosser, De Meur, Rihoux, & Ragin, 2009), in which case the comparative analysis – conducted at different times of the cases' development – can point at patterns across cases "as variate traces of the character of open systems" (Byrne, 2005:107). Another use can be to construct different (competing) mechanisms as sets, whereby these are comparatively analyzed to see which combinations yield certain outcomes. Taken together and referring to Byrne's causal critical realist formula of complex causality (Byrne, 2011a), cases can be reconstructed as instances of 'mechanism*s* and context', and subsequently analyzed to find patterns of causal complexity. Any analytically produced complex pattern is derived from the complexity of in-depth case studies, and has to be interpreted as such. This makes QCA a powerful methodology for analyzing complexity.

Although QCA is reductive (i.e., compresses reality), as with any type of research, and partial (i.e., decomposes reality), it is built on the notion of a contingent reality, which is at the core of complexity. This is evident in its notion of causal complexity or chemical causation (Ragin, 1987), as pointed out in the previous section. Furthermore, it adheres to the premise of time-asymmetry. Statements of complex causality are derived in hindsight. The cases that form the basis for these statements are actualized instances. This does not imply total unpredictability since we can learn from past research and experiences that certain patterns have a higher probability than others. This is evident in QCA's identification of limited diversity or logical remainders, and its suggestion that we use counterfactual analysis (Ragin, 2008a) to cope with this.

2.5.   CONCLUSION

We have argued that critical realism provides a meta-framework for understanding the relationship between the complexity of the real world and qualitative comparative analysis as a complexity-informed method. We explored how complexity impacts the extent to which we can generate pertinent knowledge of social reality, and discussed the extent to which QCA can be used to generate provisional explanations of emergent social phenomena across multiple cases – provisional because the explanations are temporal in time and local in place. Using critical realism as a meta-framework for understanding social complexity enables us to position the research in this field within the debates in the philosophy of science. While methodological issues related to QCA's atemporal conception of cases, and the deductive logic that is currently dominant in its application, are yet to be resolved, and although its use as a critical or complex realist method of scientific discovery is still limited, QCA is at its core a contingent and time-asymmetric method of social inquiry. QCA is not only a helpful method for analyzing complexity, as seen in its increasing use in the realm of complexity science, but is also complexity-informed in itself.

3 | Complex Infrastructure Projects: Understanding and Evaluating with Qualitative Comparative Analysis

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Lasse M. Gerrits

ABSTRACT

This article proposes a complexity-informed framework for evaluating transportation infrastructure projects. The article does this through four steps. First, the properties of infrastructure development projects are discussed. This leads to the conclusion that the specific locality or contextualization of a given project is important for explaining the outcome. Hence, there is a need for an ontology and epistemology that addresses the importance of this contextualization. The second step concerns the development of the prerequisites for a methodological framework that follows from this epistemology and ontology. The third step is the assessment of common infrastructure evaluation methods against these prerequisites. This leads to the conclusion that a comparative case-based approach is the most suitable way to study the relationship between context and outcomes in projects. A framework based on qualitative comparative analysis (QCA) is presented in the fourth step. The article concludes with a discussion of the further development of QCA.

3.1.   INTRODUCTION

Transportation infrastructure projects are characterized by budget overruns, time delays, and public resistance. For example, the decision-making process for infrastructure development in the Netherlands takes about 11 years on average (Advisory Committee VBI, 2008). Despite this, cost overruns above 40 percent occur frequently, and sometimes exceed 80 percent (Flyvbjerg et al., 2003). This is not a new finding: a European study from a decade before had similar results (WRR, 1994a), and the effectiveness, efficiency, and legitimacy of infrastructure development have been debated in the Netherlands since the 1970s (De Hoo, 1982). The long-running discussion highlights the persistence of the complexity underlying infrastructure development and the lack of any quick fixes.

The poor performance of such projects has led to various attempts to better understand infrastructure development, and the causes of and solutions to the problems the sector faces. For instance, the Netherlands Institute for Transport Policy Analysis (KiM) strongly advocates more and better infrastructure development evaluation, emphasizing the need to improve our understanding of why projects perform the way they do (KiM, 2009). However, it is more difficult to assess 'what' causes than 'that' causes (Flyvbjerg et al., 2003): it is relatively easier to identify patterns of cost overruns and time delays, for example, than the underlying reasons why they occurred. Project evaluation has tended to focus on the comparison of 'before and after' situations, and has not adequately incorporated the influence of contextual local conditions on infrastructure project development (Sanderson, 2000). The dominant evaluation methodologies impede policy learning since they do not account sufficiently for the complex nature of policy systems (Sanderson, 2000). KiM also similarly commented that, in addition to ex-post evaluations being carried out on a marginal basis, current evaluations also suffered from methodological deficiencies (KiM, 2009; PBL & KiM, 2010), which are related to the misfit between the way infrastructure development projects are understood and the methodologies used to evaluate them. Hence, there is a need for evaluation methodologies that do justice to the complex nature of infrastructure projects.

Although evaluation methodologies should pay attention to the contextual nature of projects to account for the influence of idiosyncratic events, this does not imply an exclusive focus on single-n in-depth evaluations. After all, evaluation aims to improve infrastructure development practice, which requires some degree of generalization (see Sanderson, 2000), and solely focusing on one particular context of one particular case does not allow recurring patterns to be analyzed. At this point, as will be shown in the following section, the requirements of contextualization and generalization seem to be in conflict with each other. On the one hand, the dominant methods used today are often inadequate because they discount local conditions in cross-case comparative studies. On the other hand, generalization from in-depth case studies is difficult.

This article aims to reconcile this dilemma. It presents a complexity-informed evaluation framework based on qualitative comparative analysis (QCA) (Ragin, 1987; 2000; 2008a) for evaluating complex infrastructure development projects. This method integrates

the generic patterns of variable-oriented studies with the idiosyncratic events of case-based studies. Before presenting this method, we clarify what complex infrastructure projects are so as to establish their fit with the method(s) used to evaluate them (see Sanderson, 2000). This article aims to answer the following question: *what are the ontological, epistemological, and methodological components of a method for assessing the influence of idiosyncratic events and recurring patterns on infrastructure development projects, and what should a coherent evaluation method based on these components consist of?*

3.2. GENERALIZATION VERSUS CONTEXTUALIZATION

Flyvbjerg and colleagues (Flyvbjerg et al., 2002; 2003; Flyvbjerg et al., 2003; Flyvbjerg, Skamris Holm, & Buhl, 2004; 2005; Flyvbjerg, 2007b; 2009b; Næss, Flyvbjerg, & Buhl, 2006) compared 258 large infrastructure projects in 20 different countries, and found a number of patterns. For instance, actual costs are on average 45 percent higher than estimates, cost overruns are a global phenomenon, and cost performance has not improved over the past 70 years. Although this study and its findings are of indisputable importance in accounting for the 'that' of infrastructure development performance, it cannot explain the 'why' of cost overrun (see Flyvbjerg et al., 2003). That is, while their study finds some differences between rail, road, and fixed link projects, and between project types within these categories, this large-sample study, by its very nature, cannot explain the influence of local conditions on cost performance. For example, Flyvbjerg and colleagues (2003:19) state that:

> "For the Channel Tunnel, changed safety requirements were a main cause of overrun. For the Great Belt link, environmental concerns and accidents with flooding and a devastating fire made the budget balloon. For the Øresund link, it proved more costly than estimated to carve major new transport infrastructure into densely populated Copenhagen, and so on."

In general, the study points to many similarities amongst projects in terms of their performance. For instance, the Øresund link and Channel Tunnel are reasonably similar regarding the percentage of cost overrun (i.e., respectively 70 and 80%) (Flyvbjerg et al., 2003). However, the causal paths leading to those results are different. An ex-post evaluation into the cost performance of the Channel Tunnel revealed that, in addition to the findings of Flyvbjerg and colleagues, other factors also led to cost overruns (Anguera, 2006). These included the absence of a clear project owner from the outset, the unforeseen advent of low cost airlines leading to reduced train ridership, political events involving the French and British governments, difficult ground conditions, and transport-related incidents such as the Pan Am crash at Lockerbie. Although the Øresund link project is similar in some of these aspects, these specific conditions do not account for its cost overruns.

This brief example points to the tension between generic patterns and factors that are specific to a certain situation. On the one hand, large-n quantitative studies, such as those performed by Flyvbjerg and colleagues, provide lasting insights into generic patterns such as cost overruns and their causes. However, these studies do not allow a detailed analysis of the idiosyncratic nature of such projects, even though specific events may have significantly contributed to the project outcomes. On the other hand, studies such as Anguera's (2006) provide important insights into the unique and idiosyncratic nature of individual projects. However, such case-oriented studies have little to contribute to the development of patterns from different cases. By their very nature, both types have their advantages and disadvantages. Table 3.1 provides an illustrative list of both types of infrastructure development studies (excluding the studies by Flyvbjerg and colleagues mentioned above).

Table 3.1 Variable- and case-oriented studies in transport infrastructure development

Variable-oriented	Focus on generic patterns	Hecht and Niemeier (2002); Hsieh, Lu, and Wu (2004); Irfan, Khursid, Anastasopoulos, Labi, and Moavenzadeh (2011); Kaliba, Muya, and Mumba (2009); Lee (2008); Magnussen and Olsson (2006); Manavazhi and Adhikari (2002); Odeck (2004); Polydoropoulou and Roumboutsos (2009); Welde and Odeck (2011); Yang (2007)
Case-oriented	More attention to idiosyncratic events	Anguera (2006); Cantarelli, Flyvbjerg, Van Wee, and Molin (2010); Han, Yun, Kim, Kwak, Park, and Lee (2009); Peters (2010); Priemus (2007b); Rigden (1983); Van Marrewijk, Clegg, Pitsis, and Veenswijk (2008); Walter and Scholz (2007)

3.3. MATCHING ONTOLOGY AND EPISTEMOLOGY WITH METHODOLOGY

3.3.1. Understanding complex infrastructure projects

If an infrastructure project is said to be complex, it usually means that it is perceived to be difficult. However, complexity is not just a generic statement about the effort necessary to complete a project, nor is it a truism. Instead, it is a multi-layered concept. In abstract terms, developing infrastructure means modifying an existing system. An example of a system is a built area, which consists of interacting three-dimensional units (e.g., rooms, buildings, and assemblages of buildings), two-dimensional units (i.e., the layout or distribution of the three-dimensional units across a given space), and linear units or transport networks linking the three-dimensional units, thereby largely determining the area's layout (Marshall, 2009). Together, these form a built syntax specific to a given area. While some patterns of activity can be found in various examples of infrastructure development (e.g., suburbanization and subsequent commuter travel patterns), other properties are specific to a local situation (e.g., particular difficult ground conditions that would make the construction of a road to a future suburb prohibitively expensive). Therefore, an infrastructure

developer wishing to change something in a specific situation deals with a specific built syntax that is a mixture of generic elements and local conditions.

Over time, the interaction of generic and specific elements leads to a local built environment that is unique in its particularity, even though it still has recognizable elements (Byrne, 1998; 2001; 2003; 2005; Marshall, 2009). A built area becomes even more complex if its social fabric is taken into account – individuals and social groups living, working, traveling, and recreating in any given area – since it directly influences the existing and future infrastructure requirements. This syntax of built and social components is nested in the way that properties of a subunit (e.g., a street) reflect the properties of its whole (e.g., a district), but not to the extent that both levels are exact copies (Marshall, 2009). Thus, the local built order emerges from the interaction between generic and specific physical and social elements (Allen, 1998). Hence, infrastructure developers have to deal with a unique local area that nonetheless exhibits similarities with other areas. Developing infrastructure in built areas is, therefore, not just a matter of applying generic planning, building, or managerial rules to a certain area; these need to be adapted to fit the local conditions. It is pivotal for the development of infrastructure in built areas that this specific pattern of local conditions and generic developments is researched, to understand ex-ante how a project should be executed, and to understand ex-post what leads to certain outcomes.

This perspective focuses on a number of dimensions. First, infrastructure development takes place within a specific interacting mix of local conditions and generic patterns that occurs in any given location. Second, this points to the fact that the causal relationships between site-specific conditions and generic developments are poorly known and, if known, only for that specific time and place. Thus, known causal relationships specific to a certain area are by definition case-specific. Indeed, the unique nature of built systems implies that other systems are constituted differently, although the emerging order can be quite similar. Third, this emergent nature of any built area implies that it is the result of longitudinal development. That is, it is the result of past changes and events that are to some extent path-dependent. Taking these three points together, this article understands built areas as complex systems (e.g., Batty, 2010). The next question then is: how should this complexity as such be named, understood, and researched? This three-part question is answered in the following section, resulting in the formulation of requisites for complexity-informed evaluation.

3.3.2. Foundations for understanding and researching situated complexity

The complexity described above can be characterized in two ways: simplistic or generic complexity, and complex or situated complexity (Byrne, 2005; Cilliers, 2001). Generic complexity focuses on the emergence of complex processes and structures from a limited set of variables. It assumes a general set of rules from which emergent complexity flows (Buijs et al., 2009). Although elegant, this approach is only part of the issue since, as we noted in the previous section, the emergent nature of infrastructure projects is partly determined by local conditions. Built areas are open systems (see De Roo, 2010), mean-

ing that their composition and behavior are constituted through interaction with their environment, resulting, as stated above, in a specific locally-situated mix of generic and specific elements. Considering built areas as open systems assumes that an explanation for the development (or lack thereof) of a project can be found in its contextualization (i.e., that local conditions contain explanatory variables – see Mjøset, 2009).

Buijs, Eshuis, and Byrne (2009) use 'situated complexity' to focus on the explanatory value of the contextualization of a phenomenon. Although some argue that a research methodology should start from either the generic or situated approach (e.g., Bar-Yam, 1997), Buijs, Eshuis, and Byrne (2009) state that a case can and should be made for systematic in-depth comparison across systems. They argue that, while open systems "do not operate according to general rules applied in all contexts" (2009:37), a systematic comparison can reveal differences and similarities between the operations of different systems. This approach to situated complexity focuses both on recurring patterns over multiple systems and on the idiosyncratic events in particular systems, since both determine how systems develop over time. The research methodology presented in this article starts from that premise.

The second part of the question concerns the way complexity is understood, which is basically a question of how reality can be understood. The classical divide is between positivism and postpositivism. To some extent, this divide coincides with the difference between generic and situated complexity. Positivism is primarily concerned with determining general rules by taking reality apart in discrete components, which matches the aims of studies of generic complexity. However, postpositivism has many different substrands that range from the extreme relativism of social constructivism to the more realist thesis of negotiated subjectivism (Byrne, 2003; Haynes, 2001; Uprichard & Byrne, 2006) or critical realism (Guba & Lincoln, 1989). The common theme within those strands is that the contextualization is explanatory for what is being observed, which coincides with situated complexity.

The fact-value dichotomy that underlies the positivist stance has been thoroughly undermined (Bateson, 1984; Byrne, 2002; Fischer & Forester, 1987; 1993). Complex and systemic causality is always subject to interpretation and, consequently, debatable as every interpretation carries with it normative judgments (Williams, 2009). If systems are said to be open, then it follows that their boundaries do not exist a priori, and any individual will develop a particular demarcation or set of boundary judgments about the system which includes and excludes variables (i.e., a reduction of real complexity), that may be connected but not perceived as such by the observer (Checkland, 1981; Cilliers, 2001). Thus, there is no unambiguous separation between systems and their context, and the observer is as much part of the complexity as the system or agents that are observed. Situated complexity is, therefore, not confined to the presupposed demarcations of systems but intersects all system representations by respondents.

This reduction of real complexity both compromises the research, as well as keeps it manageable (Cilliers, 2001; 2005a). It requires that multiple perspectives on a particular system are taken into account. If a multitude of observers can develop a multitude of

boundary judgments about what is taken into account or not with a multitude of perspectives about how something is being perceived, chances are that a larger part of the complexity of the system is captured (Cilliers, 1998; 2005a). This type of thinking implies a convergence of the fact-value dichotomy, but not a postmodern stance where subjective storytelling is all that remains. It means that, although temporal in time and place (i.e., specific to a given locality), cause and effect relations do exist and can be known through respondents' perceptions (i.e., it is agent-bound) (Byrne, 2001; 2003; 2005; Morçöl, 2001). Causality can still be determined in terms of change and response relationships that lead to certain observable effects (see Bryman, 2004; Hammersley, 2008; 2009). The ontological point of departure in this article is, therefore, complex realism (see Byrne, 2002; Harvey, 2009; Reed & Harvey, 1992).

Researching situated complexity from the perspective of complex realism requires a methodology that focuses both on recurring patterns over multiple systems as cases and on systemic peculiarities, that acknowledges that these patterns and peculiarities are interpretations but point to real causalities nevertheless. Taking these points together, the first criterion for a complexity-informed methodological framework is (1) that it balances between in-depth understanding and reductionist generalization. Second, since studying situated complexity requires an in-depth understanding of cases, (2) the method has to be case-based. Moreover, since single case studies cannot be employed for explanatory purposes in other cases and, therefore, do not allow statements about patterns across systems, a comparative case study approach is required. Third, as stated above, situated complexity focuses on the explanatory value of contextualization. This contextualization emerges from the interaction of generic patterns and specific events, and therefore it can be inferred that, in methodological terms, (3) the method should allow the observation and analysis of complex interaction between the variables. This is discussed in the following sections. Finally, since complex systems, such as built areas, are the result of longitudinal development, (4) the method has to consider how situated complexity came into being over time (i.e., complex dynamics).

3.3.3. Towards a complexity-informed case-comparative framework

These four requirements are only partly fulfilled by the two general evaluation approaches presented above. Variable-oriented studies, such as those conducted by Flyvbjerg and colleagues (2003), examine relationships between general features of infrastructure projects. These features are conceived as variables (e.g., project type, topography, and cost overrun) and are then correlated with each other. This makes it possible to deduce empirical generalizations about structural processes relevant to a larger number of cases (Ragin, 1987). For instance, cost underestimation and overruns occur more often in rail projects and, within rail projects, overruns are higher in developing nations than in North America and Europe (Flyvbjerg, 2007a).

However, "the simplifying assumptions that make this approach possible often violate commonsense notions of causation and sometimes pose serious obstacles to making

interpretative statements about specific cases or even about categories of cases" (Ragin, 1987:xiii). In essence, Flyvbjerg's studies cannot account for the idiosyncratic nature of specific cases as the study of Anguera (2006) can, because variable-oriented studies are, by their nature, not case-oriented. Furthermore, correlational methods cannot deal with contextualization; they do not allow for complex causality (see next section). For example, in the work of Flyvbjerg and colleagues, the importance of the context is recognized by pointing to the fact that cost overruns are due to different circumstances. However, this is not reflected in the generic patterns that appear in the research. Finally, variable-oriented studies can account for time. For instance, Flyvbjerg and colleagues (2003) conclude that infrastructure development performance has not improved in the past 70 years. However, such studies have a hard time including complex dynamics, such as the influence of particular events (e.g., the crash at Lockerbie) on the course of the development of a specific case.

Case-based methods are, by their nature, sensitive to the complexity, diversity, and (historical) uniqueness of cases (Ragin, 1987). Projects are treated holistically and not as collections of parts; case studies are sensitive to contextualization and temporality. For instance, Anguera (2006) is able to discuss in detail the Channel Tunnel project, its performance, and the key factors that influenced the latter. However, in the words of Aus (2009:175), "most case studies (…) could maliciously be qualified as theoretical 'data dumps'. One of the methodological reasons for this rather unfortunate state-of-the-art is that single case studies can hardly be employed for explanatory purposes." Hence, the methodology needs to be case-comparative to allow for causal inference (Aus, 2009) – for studying patterns across cases.

However, when case study material is analyzed and compared in case-comparative studies, this often happens rather loosely and in a non-formalized manner (Rihoux, 2006). Often, qualitative comparative studies, necessarily limited in the number of cases, result in an overview of the most important similarities and differences (Rihoux & De Meur, 2009). This comparative process is often not formalized, in the sense that little insight is and can be provided into the way it was performed, including identifying the decisions that influenced the outcomes of the comparative process. In addition, the rich data represents many possible causal conditions that are often hard to disentangle. Consequently, the scientific value of these studies is often questioned (Ragin, 1987). Table 3.2 summarizes the strengths and weaknesses of both approaches, and compares them with QCA as a hybrid alternative research approach that integrates the strengths of both approaches, thereby mitigating their weaknesses.

Table 3.2 Variable-oriented versus case-oriented approach

	Requirements			
Approach	In-depth vs. generalization	Case-based vs. comparative	Attention to context	Attention to time
Variable-oriented	Generic patterns	Comparative, not case-based	Limited	Limited
Case-oriented	In-depth, focus on idiosyncrasies	Not comparative, case-based	Yes	Yes
QCA	Iterations between generic patterns and idiosyncrasies	Case-based comparison as main feature	Yes	Yes, but weak

3.4. QUALITATIVE COMPARATIVE ANALYSIS

3.4.1. A hybrid alternative

QCA is an umbrella term for three comparative methods: crisp set QCA (csQCA), multi-value QCA (mvQCA), and fuzzy set QCA (fsQCA) (Rihoux & Ragin, 2009b). It aims to integrate the case-oriented and variable-oriented approaches so that scientists do not have to choose between an "understanding of complexity and knowledge of generality" (Ragin et al., 2003:324). QCA can be used to "achieve a systematic comparison across a smaller number of individual cases (e.g., a sample of between 10 and 30 cases) in order to preserve complexity, and yet being as parsimonious as possible and illuminating otherwise often hidden causal paths on a micro level" (Rihoux & Lobe, 2009:228).

It is a comparative case-based approach that allows the examination of multiple causal configurations (Byrne, 2009). This approach aims to uncover the most frequent combinations of causal conditions (i.e., variables) that produce a certain outcome. For instance, Anguera (2006) presents several factors that affected cost overruns in the Channel Tunnel project. However, different configurations may produce the outcome. For instance, the Øresund link and the Channel Tunnel have similar outcomes, but their configurational paths towards that outcome are different. In addition, factors can have different effects in different contexts. For instance, the advent of low-cost airlines had different effects on the Channel Tunnel and the Øresund link because of their different contexts and natures. Grofman and Schneider (2009) and Schneider and Wagemann (2010) refer to these characteristics of complex causality as conjunctural causation, equifinality, and multifinality, respectively. They add to this the notion of asymmetric causality (i.e., that the presence and absence of outcomes require different explanations). In sum, the approach ticks all of the boxes in Table 3.2, excluding, as discussed later, the last one concerning temporality.

3.4.2. QCA as a complexity-informed research approach

It is important to clarify that QCA is not just a method; it is first of all a research approach (Rihoux, 2003). Central to this approach is the dialogue between theoretical ideas and

empirical evidence (Berg-Schlosser et al., 2009; Ragin, 1987; 2000; 2008a; Yamasaki & Rihoux, 2009), which is especially important in the selection and construction of cases and variables. In QCA, variables are conceptualized as causal conditions or sets. For instance, the Channel Tunnel, Øresund link, and Great Belt link cases are members of the 'transportation infrastructure projects' set.

What makes set theory interesting for case-comparative studies is that sets can be intersected (i.e., the set operator 'logical and' – referring to conjunctural causation) and unified (i.e., the set operator 'logical or' – referring to equifinality and multifinality). QCA is able to systematically compare and analyze these set conjunctions (i.e., configurations or causal recipes) (Ragin, 1987; 2000; 2008a; Smithson & Verkuilen, 2006).

However, social phenomena such as infrastructure development are often difficult to grasp in terms of sets. For instance, compare the relative ease of defining the set boundaries of concepts such as 'democracy' and 'legitimacy' with 'transport modes'. Producing a list of projects that fit a certain type of transport mode is probably easier than listing the legitimate public participation processes involved in infrastructure development projects (see Smithson & Verkuilen, 2006). Therefore, theoretical and substantive knowledge should be used to substantiate the construction (and membership) of sets.

3.4.3. Illustrating QCA for the evaluation of situated complexity

Using set theory implies a focus on set relations instead of correlations. Instead of studying the net-additive effects of variables, QCA studies the necessity and sufficiency of relations between (configurations of) sets and the outcome (Ragin, 1987; 1999; 2000; 2008a; Schneider & Wagemann, 2010). A condition is *necessary* if it has to be present for the outcome to occur, indicated by the outcome being a subset of the causal condition. Suppose condition B is the set 'cost overrun' and condition A is the set 'construction delay'. Then, Figure 3.1 shows that every case that exhibits cost overrun also exhibits construction delay.
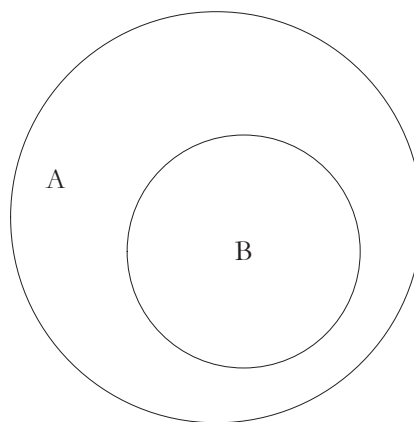
Figure 3.1 Set relations

If a case does not exhibit A, then it cannot be in set B. This would point to construction delay as a necessary condition for the outcome to occur.

A condition is *sufficient* if it can produce the outcome by itself, indicated by the condition being a subset of the outcome. Now suppose that B is the set 'construction delay' and A is 'cost overrun'. Then, Figure 3.1 shows that every case that exhibits construction delay also exhibits cost overrun. *If* construction delay is the only condition at play, then this figure indicates that it alone is sufficient to produce cost overrun.

However, necessary and sufficient conditions can, and most often are, combined within a causal recipe since causation is complex (Ragin, 2000). This means that there are usually no purely necessary or sufficient conditions for an outcome to occur (i.e., overlapping sets). Such a condition is called an INUS condition, which can be defined as an "*insufficient* but *non-redundant* part of an *unnecessary* but *sufficient* condition" (Mackie, 1980:62, original italics). For example, imagine that the Channel Tunnel, Great Belt link, and Øresund link have different 'scores' on three causal conditions A, B, and C. Suppose that the Channel Tunnel exhibits conditions A and B, the Great Belt link conditions B and C, and the Øresund link conditions A and C. Thus, there are three configurations: A*B, B*C, and A*C. The * sign indicates 'logical and'. These three different paths produce the outcome cost overrun. This implies 'logical or', indicated by a + sign. This can be written as a Boolean expression, namely:

$$A*B + B*C + A*C \rightarrow \text{cost overrun}$$

This means, first, that none of the three conditions is individually sufficient since in none of the three cases the outcome is produced by a single condition. Second, it means that none of the three conditions is necessary. For instance, condition A is not necessary for cost overrun to appear, since the outcome can also appear with the combination B*C. It does mean, however, that A is an INUS condition: it is an insufficient (i.e., it cannot produce the outcome by itself) but non-redundant (i.e., it is a necessary condition in both the combinations A*B and A*C) part of an unnecessary (i.e., A*B and A*C are not necessary since cost overrun also appears in B*C) but sufficient (i.e., A*B and A*C are sufficient for cost overrun to occur) condition. Finally, it is important to note that "neither necessity nor sufficiency exists independently of theories that propose causes" (Ragin, 2008b:42), because this distinction is only meaningful in the context of theoretical perspectives. In other words, the contextualization of the research method is confined to the included sets, whose construction is substantiated with theoretical and substantive knowledge.

When each case is assigned a set membership score for each of the conditions, the researcher can move from mere theoretical (i.e., set construction) and empirical (i.e., case scoring) description to comparative analysis. The first step is the construction of the truth table. The fundamental unit of analysis is the truth table row (Ragin, 1999). A truth table lists all of the logically possible configurations – expressed by the exponential formula 2^k (k being the number of conditions), since a condition can be both present and absent – and sorts (i.e., assesses the empirical presence of) the cases over to these configurations in the

'distribution of cases' column. Next, for each causal recipe the outcome value is defined. For illustrative purposes, a hypothetical truth table with three conditions is depicted as Table 3.3.

Table 3.3 Hypothetical truth table

Condition A	Condition B	Condition C	Outcome	Distribution of cases
1	1	1	1	
1	1	0	1	
1	0	1	1	
1	0	0	1	
0	1	1	1	
0	1	0	0	
0	0	1	0	
0	0	0	0	

Note that the process described so far has taken the researcher from qualitative thick-case descriptions of cases – which are preferably based upon multiple perspectives by (multiple) researchers – via the construction of sets and the assignment of set membership scores, towards the construction of the truth table. One might argue that this discounts the unique and complex nature of cases. However, the method actually facilitates the interpretive and iterative research process by formalizing the comparative procedures from an in-depth understanding of complex systems to the identification of recurring patterns over multiple systems, without undermining the essence of complex systems: their contextualization and complex causation.

Next, the truth table can be minimized to produce a so-called solution (i.e., a statement about patterns across the cases). Maximum complexity was assumed a priori, and this complexity is now brought back to its core. This minimization process is structured by using Boolean algebra. Its basic procedure can be summarized as follows: "if two Boolean expressions differ in only one causal condition yet produce the same outcome, then the causal condition that distinguishes the two expressions can be considered irrelevant and can be removed to create a simpler, combined expression" (Ragin, 1987:93). For example, the previous hypothetical truth table gives the following Boolean expressions:

$$A*B*C + A*B*{\sim}C + A*{\sim}B*C + A*{\sim}B*{\sim}C + {\sim}A*B*C \rightarrow \text{cost overrun}$$

The tilde sign (~) indicates the absence of a condition. This formula shows five empirically observed paths towards cost overrun. As a next step, it can be evaluated what the sufficient, necessary, and/or INUS conditions are in this expression.

The first two configurations can be minimized to A*B: whether condition C is present or not, cost overrun appears nonetheless. This pairwise minimization procedure is further displayed in Figure 3.2 and results in the following solution formula:

$$A + B*C \rightarrow \text{cost overrun}$$
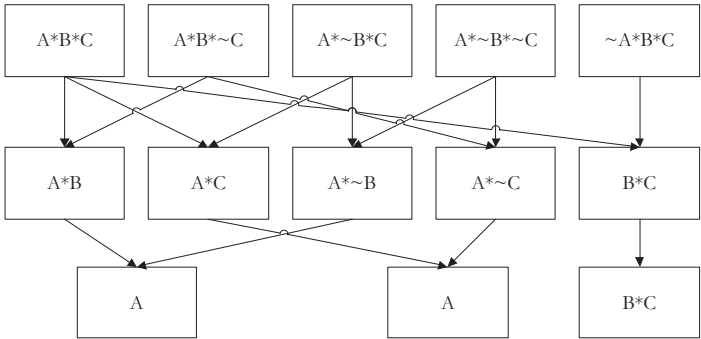
Figure 3.2 Boolean minimization

It is pivotal that the resulting formula is not applied mechanically in concluding the comparative analysis. As stated above, QCA is first of all a case-based qualitative approach. It involves the researcher interpreting the formula and critically assessing it in light of the individual cases: does it make sense? As a consequence, the comparative research process should consist of several iterations between data and concepts, generating increased un-derstanding/interpretation of the cases. Indeed, the researcher will often be forced to do so since contradictory configurations (i.e., a configuration that produces opposing outcomes across cases) require adapting the selection and conceptualization of conditions. As such, QCA allows a continuous search into the conditions under which infrastructure projects are being realized, and enables the researcher to find causal patterns that are deeply hidden in the appearances of the projects.

3.5.   DISCUSSION AND CONCLUSIONS

Rooted in the logic of situated complexity, we made the case for the use of QCA to evaluate infrastructure projects, thereby contributing to the discussion of complexity in evaluation (see Callaghan, 2008) and of QCA in evaluation (see Befani et al., 2007; Marx, 2005). We provided a brief overview of the logic and main procedures of QCA. Inevitably, some in-depth aspects were left out, such as limited diversity/logical remainders, contradictory rows, counterfactual analysis, and the consistency and coverage measures; unfortunately, it is not possible to discuss these due to the limited space available. However, it is necessary here to elaborate on a further development in QCA, namely fuzzy set QCA.

FsQCA was introduced by Ragin (2000). Although csQCA and fsQCA are equal in their set-theoretic and configurational rationale, a dichotomous distinction is made in csQCA (Ragin, 1987) between the absence and presence of causal conditions in a case (i.e., crisp sets). FsQCA, on the other hand, allows for finer gradients in the degree of set membership (i.e., a variable does not need to be fully present or absent in a case) (see Ragin, 2000; 2008a). For instance, with crisp set QCA, an infrastructure project can be fully in or fully out of the set 'cost overrun' (i.e., it can score 0 or 1). However, one might argue that a cost overrun of 70 percent in the Øresund link project is substantially different from a cost overrun of 110 percent in the Great Belt project (see Flyvbjerg et al., 2003). Therefore, the latter may have a stronger presence in the 'cost overrun' set than the former. This can be formalized by assigning different set memberships to these cases (e.g., 1.0 for the Great Belt project and 0.7 for the Øresund project). In this manner, fsQCA can be said to more accurately describe the complexity of infrastructure projects compared to QCA based on crisp sets.

We formulated four requirements for an evaluation approach that would match the complexity of infrastructure projects. While QCA fulfills three of the four requisites, it does less well on the fourth dimension (i.e., time). In essence, QCA is a static method (Rihoux, 2003) and does not fully capture the dynamics of complex systems (Gerrits, 2011). Some provisional workarounds, suggested by Rihoux (2003), De Meur, Rihoux, and Yamasaki (2009), and others, capture the time dimension by: using multiple iterations of the method (i.e., before, during, and after a certain intervention), interpreting the time dimension, conceptualizing time as (part of) a set, or complementing QCA with other methods. Attempts are also being made to develop a distinct time-inclusive type of QCA (Caren & Panofsky, 2005).

However, all options are compromises and researchers should be aware that, while QCA is useful for mapping the systemic complexity of infrastructure development, it is less useful for incorporating time dynamics. One could argue that this is not really a problem in the case of ex-post evaluation, which measures the static outcome of a project, but may be more of a concern in ex-durante evaluations, where time is an important part of the evaluation. However, we argue that one needs the time dimension to understand the emergence of outcomes, i.e., whether the observations at t_{n+1} are the result of the configurational changes that took place at t_n. Time matters in evaluation, and it is an unresolved issue with the QCA approach.

Another inherent limit of (fs)QCA is the number of conditions that can be taken into account, since the logically possible number of combinations increases exponentially. At the same time, the addition of a new case to the set of cases being compared can lead to a different solution formula. Although both issues are not unique to QCA – one could argue that such limitations are an innate part of research into social reality – they should not be ignored. Regarding the limited number of conditions being considered, Rihoux (2003) and De Meur, Rihoux, and Yamasaki (2009) suggest that a possible remedy is to carry out multiple routines, i.e., building an increasingly clearer set of conditions by going through the QCA process multiple times. This way, the researcher is able to find out, in a

very transparent way (Rihoux, Ragin, Yamasaki, & Bol, 2009), which conditions do not matter or yield the same or similar results. These conditions can then be excluded from the analysis or grouped together as macro variables. Schneider and Wagemann (2006) provide an alternative staged approach: first, remote (e.g., contextual) and proximate factors are analyzed separately, and in the second stage, the remote and proximate factors that have been found to be influential are analyzed together.

The second issue, the possibility of arriving at different conclusions after adding new cases, is actually part of the philosophy behind QCA and its roots in systemic thinking. With QCA, the researcher does not strive to identify a single central tendency that reflects reality as more cases are added (Rihoux, 2003). Rather, it helps researchers to examine the different causal pathways that lead to a particular outcome, and how such pathways are linked to individual cases. Adding a new case can lead to the discovery of a new pathway. More commonly deployed comparisons aim to find the variable that controls for differences and similarities in multiple cases. Following the discussion on generic and situated complexity, such a search is beside the point. Cases can have unique pathways and comparison should be used to highlight the particularities of the pathways. It is also through this perspective that thinking in terms of dependent or independent variables is replaced by thinking in configurations (Aus, 2009), which resembles social reality more closely.

In short, our argument is that QCA is a promising approach that largely meets the evaluation requirements set out at the start. Some issues will have to be dealt with, most prominently the issue of time. The next step is to use QCA in an evaluation study to evaluate its viability as a tool for analyzing complex infrastructure development projects.

PART 3

Analyses of Two Large Infrastructure Project Implementations

This part of the thesis focuses on the first, fourth, and fifth sub-questions. It explains how the management of the implementation processes of PPP infrastructure projects can be understood from a complexity perspective (i.e., the first sub-question), it examines how the implementations are managed empirically (i.e., the fourth sub-question), what management responses to unforeseen events yield (un)satisfactory outcomes (i.e., the fourth sub-question), and how these outcomes can be explained (i.e., the fifth sub-question). The chapters in Part 2 were formative for the chapters in this third part.

Marra makes the point that "evaluation should look not just at what the system is producing in terms of outcomes, but also 'into the system' at how the system is doing and what it is doing" (2011:322). In this vein, Chapter 4 studies how public and private managers in the A2 Maastricht project manage the complexity of project implementation, and what management responses are associated with (un)satisfactory outcomes. In Chapter 5, this is also done for the A15 Maasvlakte-Vaanplein (MaVa) project. Chapter 4 is published as an article in the journal *Public Works Management & Policy* (Verweij & Gerrits, 2015) and Chapter 5 is published as an article in the *International Journal of Project Management* (Verweij, 2015a).

Because PPP infrastructure project implementation processes are complex but patterns can be found in them and across them, the studies have a grounded approach. Complexity-informed analysis "assumes an exploratory or pattern recognition approach, rather than a traditional hypothesis-testing or confirmatory approach" (Wolf-Branigin, 2013:71). As such, within the two studies respectively, QCA is applied to study patterns of how managers respond (un)satisfactorily to different events occurring in project implementation processes.

Whereas many studies in the field of infrastructure development and public-private partnerships use quantitative measures of performance for evaluating projects, the outcome in this thesis is 'satisfaction'. In contrast to performance measures, satisfaction is better able to address the complex, heterogeneous, and subjective nature of outcomes in project implementation processes (Kärnä et al., 2013; Lehtiranta et al., 2012).

Chapter 6 takes stock of the two studies. It aims to further articulate what can explain the management patterns within the implementations of the two projects, and what can explain the different patterns across them. The chapter has been submitted to a journal.

4 | Management and Public-Private Cooperation in the A2 Maastricht Project

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Lasse M. Gerrits

ABSTRACT

In the implementation phase of transportation infrastructure projects, unplanned events will inevitably occur. Although this is increasingly acknowledged, little systematic research has been conducted into what management strategies are best for dealing with these unplanned events. This article investigates how managers respond to unplanned events that occur in the context of a project during implementation, and which management responses produce satisfactory outcomes. To evaluate what strategies work in what contexts, we introduce multi-value qualitative comparative analysis (mvQCA) and apply it to the Dutch A2 Maastricht transportation infrastructure project (the Netherlands). We produced systematic evidence that (a) internally-oriented private management is associated with low satisfaction; (b) externally-oriented management is associated with high satisfaction in responding to social, local unplanned events; and (c) that internally-oriented management is associated with high satisfaction depending, in particular, on the nature of the cooperation between principal and contractor in the project.

4.1.   INTRODUCTION

Generally speaking, transportation infrastructure projects are characterized by, inter alia, cost overruns (Flyvbjerg et al., 2003) and lingering implementation processes (Advisory Committee VBI, 2008; De Hoo, 1982). One family of explanatory factors of this undesirable state of affairs is the context in which projects are being implemented. In studying five large U.S. transportation infrastructure projects, Owens, Ahn, Shane, Strong, and Gransberg found that in addition to "factors found in the traditional management areas (cost, schedule, and design)" (2012:186), external forces or context were considered a primary source of complications in those projects. Other scholars (cf. Mistarihi et al., 2013) also demonstrate the importance of context for understanding complications in infrastructure development, especially in the implementation – that is, construction and delivery – phase of projects. For instance, Teisman, Westerveld, and Hertogh studied the Dutch Betuweline and the U.K. West Coast Main Line and demonstrated that implementation processes are compromised by unplanned events, and that "managers cannot know in advance what the relevant context will be and how contexts will interfere with implementation and with one another" (2009:72).

Although this uncertain and badly predictable context in the implementation of infrastructure projects is increasingly acknowledged (e.g., Atkinson, Crawford, & Ward, 2006), little systematic research has been conducted into which management strategies are best for dealing with (i.e., responding to) unforeseen and unplanned events in implementing projects (Mistarihi et al., 2013). A generic distinction is made in the management literature between two more or less opposite management strategies: (a) internally-oriented strategies that focus on the internal structures of project organization (e.g., Mantel, Meredith, Shafer, & Sutton, 2005) – for example, doubling shifts or changing construction modes in an attempt to control planning and budget – and (b) externally-oriented strategies that emphasize interaction with the social (stakeholder) environment in which the project is developed (e.g., Koppenjan & Klijn, 2004). Research suggests that the latter approach leads to more satisfactory outcomes (Edelenbos & Klijn, 2009; Klijn, Steijn, & Edelenbos, 2010) although, importantly, not necessarily always so (Verweij et al., 2013). The scientific literature is rather ambivalent about this relationship between management strategies and outcomes in project implementation (Edelenbos & Klijn, 2009). Consequently, proposals focus on a balance between the two strategies (e.g., Atkinson et al., 2006; Edelenbos & Teisman, 2008; Hertogh & Westerveld, 2010). But what does this 'balancing' entail? And perhaps more importantly, how is it that sometimes a certain management strategy results in satisfactory outcomes, and sometimes not? These are largely underexposed questions. Research into this can contribute to the successful management of transportation infrastructure projects in their implementation phases. Hence, the research question of this article is as follows: *how do managers in the implementation phase respond to unplanned events occurring in the context of the transportation infrastructure project, and which management responses produce satisfactory outcomes?*

Methodologies to systematically evaluate these issues seem to run behind (cf. Verweij & Gerrits, 2013). For one thing, little structural attention is given to actual day-to-day management actions in specific circumstances, that is, how managers respond to unforeseen and unplanned events, whilst these are pivotal to understanding how outcomes come about in projects (cf. Atkinson et al., 2006; Cicmil, Williams, Thomas, & Hodgson, 2006). Moreover, traditional evaluations of transportation projects tend to focus on comparing 'before and after', thereby often inadequately reckoning with context in their assessments. This significantly impedes learning from such evaluations because context is explanatory to how outcomes come about (Pawson & Tilley, 1997; Sanderson, 2000). Evaluation methodologies need to match the complex nature of transportation infrastructure development (Verweij & Gerrits, 2013). In short, we need a context-sensitive method that is empirically grounded so as to study management actions in response to unplanned events, and that is able to systematically evaluate when and why these produce certain outcomes and when they don't, such that learning is facilitated in a meaningful way.

In two previous articles, we have laid the groundwork for such a method, namely, qualitative comparative analysis (QCA). In this article, we apply one of the proposed versions, mvQCA, to the Dutch A2 Maastricht transportation infrastructure project. This is done in a number of steps. First, in Section 4.2, we will briefly explain the evaluation method and the perspective on the complexity of managing infrastructure projects that underlies it. In Section 4.3, we introduce the A2 Maastricht project and the data we collected. These data are stepwise analyzed in Section 4.4. Following the grounded approach, we first identify and define the conditions of our analysis: the nature of the unplanned event (physical – social), the management response (internally-oriented – externally-oriented), the interaction between principal and contractor (acting alone – cooperation), and the outcome (satisfaction with how the event was responded to). In Section 4.5, we conclude our article, and discuss implications for managers and evaluators of transportation infrastructure projects.

4.2. RESEARCHING COMPLEX TRANSPORTATION INFRASTRUCTURE PROJECTS

In Section 4.2.1, we briefly outline our understanding of 'complexity', that is, what it is about the projects that makes them complex. Following our understanding, we introduce the related methodology in Section 4.2.2. For a more elaborate discussion and explanation, we refer to Gerrits and Verweij (2013) and Verweij and Gerrits (2013).

4.2.1. Properties of complexity in infrastructure project management

An infrastructure project is implemented in a complex socio-physical context. Unplanned events (e.g., bad weather or stakeholder protests) may occur in this context. Naturally, these can impact the planning and aims of the project. Managers respond to such events in

an attempt to safeguard satisfactory outcomes (e.g., prevent time delays and budget over-runs – cf. Atkinson et al., 2006). Managers often have to respond to different and multiple such events, each of which may require various management strategies. Such instances are considered cases in this article; the project investigated here, the A2, can be considered a long-term spatial program that consists of series of cases. Thus, within a single infrastructure project there are multiple and different cases of 'responding to unplanned events'.

This also means that, contrary to the positivist take on reality, in different contexts the same management response can produce different outcomes, and different responses can produce similar outcomes (cf. Byrne, 2011a; 2011b; Pawson & Tilley, 1997; Sayer, 2000). For example, within a single infrastructure project, one and the same management response may result in preventing the project planning to get out of hand in the case of one unplanned event, but not in another; this depends on the nature of the event. Furthermore, there may be multiple conditions interacting with one another. That is, the effect of the management response is codetermined by other conditions, such as the cooperation between principal and contractor. This implies a research approach that can study the complex interaction between conditions (see Section 4.2.2).

In addition, knowledge about the management of such projects is situated and contextual. This applies to the evaluator and the managers working in the projects. In short, the actions of managers are context-dependent. A manager interprets an event and consequently acts on it with the intention to produce satisfactory outcomes. These actions, in turn, causally influence the project's development. This means that, to understand the ways in which the project develops, it is essential that the researcher looks at how the manager(s) interpret(s) the event. In other words, the interpretations of managers are the researcher's 'entrance' to understanding and evaluating transportation infrastructure development. This perspective favors a qualitative (interpretative) *grounded* research approach in which managers are studied in their contexts – what they do, why, and with what outcomes – on which causal explanation is grounded (cf. Cicmil et al., 2006; Verweij, 2012a).

Finally, in evaluating transportation infrastructure development, it may not be possible to define beforehand what aspects should be researched. Because managers act in an uncertain and badly predictable context (Atkinson et al., 2006; Teisman, Westerveld et al., 2009), and because their responses are informed by their interpretations of events and not by the theories proposed by evaluators (cf. Pawson & Tilley, 1997), what constitutes a case of 'management in response to an unplanned event' cannot and should not be predefined by the researcher. That is,

> "It is not possible to construct verbal formulations [i.e., theory, authors] that can embrace or contend with the complexity and diversity of the empirical world. For these and related reasons, *cases often must be delimited or found in the course of research*" (Ragin, 1992:220, emphasis added).

Discovering and studying cases is often a key object of the research (Sayer, 2000). Again, this favors a qualitative and grounded research approach.

4.2.2.   Researching complexity in infrastructure project management with mvQCA

Following these three properties, the first step of the method involves the grounded collection of data. Open, qualitative interviews are especially suitable for this purpose (e.g., Weiss, 1994) because this allows the researcher to fully grasp the managers' perspectives of the event (instead of testing those of the researcher), their consequent management responses, and the outcomes. The second step is to code the resulting data (e.g., Boeije, 2010) so as to facilitate the reconstruction of cases. Coding facilitates the synthesis of different manager perspectives into a single coherent reconstruction per case. By coding and memo-writing, ideas about the collected interview data are recorded, thus allowing for those ideas to be reinterpreted (Schwartz-Shea & Yanow, 2012). This interpretive process is influenced by existing ideas about complexity (theory) and managing infrastructure projects with which the researcher is familiarized. Ragin coins this quest 'casing' – which is best understood as a dialogue between ideas and evidence or theory and data – which can bring operational closure to the relationship between the empirical world and the way we reconstruct it (Ragin, 1992; Ragin & Amoroso, 2011). This second step results in the construction of conditions (see Section 4.4.1) that influence a case (cf. Byrne, 2005).

Qualitative comparative analysis – an umbrella term for several types of QCA (see Rihoux & Ragin, 2009a) – is deployed in the third step. In short technical terms, QCA allows for the *iterative* examination of patterns of complex causality through pairwise comparison of cases as combinations of conditions (i.e., configurations – Ragin, 1987; Schneider & Wagemann, 2012). Complex causality means that conditions combine in configurations; that there may be multiple, different, nonexclusive configurations for the outcome; and that the effect of a condition on the outcome depends on its interaction with other conditions in the configuration (see further Schneider & Wagemann, 2012). The specific type of QCA we use in this article is multi-value QCA (mvQCA – Cronqvist & Berg-Schlosser, 2009), in which conditions can have multiple values, for example, 0, 1, and 2. We demonstrate mvQCA in Section 4.4.2.

The basic logic of the approach consists of several subroutines: (a) construct cases as configurations and put them in a 'data matrix', which includes assigning values to the conditions per case based on the coded data; (b) organize the cases over the logically possible configurations in a so-called 'truth table' (see Section 4.4.2); (c) assign values to the outcome condition *per configuration*; and (d) identify minimal (combinations of; necessary and) sufficient conditions through pairwise comparison of configurations that agree on the outcome and differ in but one other condition (i.e., 'minimization').

A condition is necessary if the outcome cannot be produced without it. A condition is sufficient if it can produce the outcome by itself. Complex causality, however, implies that necessary and sufficient conditions often combine. Within a combination, a condition is INUS, that is, an *insufficient* but *necessary* part of an *unnecessary* but *sufficient* condition (Mackie, 1980). This combining ('intersection') of conditions is expressed by the operator *logical and* (* sign); the existence of different and multiple combinations is expressed by the operator *logical or* (+ sign). The degree to which the empirical evidence supports

claiming necessity and/or sufficiency is expressed in terms of consistency. Basically, this "gauges the degree to which the cases sharing a given combination of conditions agree in displaying the outcome" (Ragin, 2008a:44). The empirical strength of a (combination of) condition(s) is expressed in terms of coverage (see Schneider & Wagemann, 2012).

Importantly, interpretation of patterns occurs throughout the iterative process and is of pivotal importance in concluding (see Section 4.5.2) the analysis. For a detailed explanation and overview, we refer to the large body of methodological literature on QCA (e.g., Ragin, 1987; Rihoux & Ragin, 2009a; Schneider & Wagemann, 2012) but, for methodological reasons, it is important (see Schneider & Wagemann, 2010) to explain here why we selected the specific type of mvQCA. The first reason is that the conditions we constructed do not represent interval or ratio scales. Second, prior to the mvQCA analysis presented in this article, we performed a crisp set QCA (Rihoux & De Meur, 2009) and a fuzzy set QCA (Ragin, 2009), but all these produced quite a few contradictions that could largely be resolved with mvQCA. The mvQCA was performed using Tosmana software (Cronqvist, 2011).

4.3. DATA COLLECTION ABOUT THE A2 MAASTRICHT PROJECT

The A2 passageway Maastricht project concerns the construction of a 2.3-km-long double-deck, double-tube tunnel running under the city of Maastricht. The tunnel is constructed using the cut and cover method. It is managed by a cooperation between four governments – Rijkswaterstaat (RWS),[45] the Province of Limburg, and the Municipalities of Maastricht and Meerssen – on the one hand ('the Project Agency'), and construction consortium 'Avenue2' on the other hand. The project replaces the former highway that divided the city. In addition, its construction is also used to instigate real estate development, landscaping, and the reconstruction of nearby highway junctions. The construction formally started in 2011 and the commissioning of the tunnel is planned for the end of 2016.

A total of eighteen open interviews with public and private managers of the A2 Maastricht project were conducted between September 13, 2011, and December 6, 2011, by the first author of this article. In addition, multiple site visits, observations of project meetings, project documents, and the website www.a2maastricht.nl facilitated interpreting the interview data. The interviews were transcribed and then coded and recoded in an iterative fashion (Boeije, 2010), using ATLASti coding software.

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45   Rijkswaterstaat is the executive arm of the Dutch Ministry of Infrastructure and the Environment. On behalf of the Minister and State Secretary, Rijkswaterstaat is responsible for the design, construction, management, and maintenance of the main infrastructure facilities in the Netherlands (see www.rijkswaterstaat. nl/en).

4.4.   ANALYSIS

The analysis proceeds in three steps. First, we construct eighteen cases of management responses to unplanned events in the A2 Maastricht project (Section 4.4.1). Note that a case does not equal an interview; their number both being eighteen is a mere coincidence. Second, we compare these using mvQCA so as to find out which configurations of management responses and events produce (un)satisfactory outcomes (Section 4.4.2). Third, we explain these results in Section 4.4.3.

4.4.1.   Case reconstructions of responding to unplanned events in the A2 Maastricht project

Several attempts (i.e., iterations) at bringing operational closure are reported elsewhere. In what follows, we report our latest effort. Table 4.1 describes eighteen unplanned events, stemming from the project's context during implementation, that we identified. As we focus in this article on how managers act, and because we focus on the implementation process, the table only concerns events after the contract closure – project construction – between principal and contractor in October 2009.

We constructed these cases as configurations of conditions. The first condition concerns the nature of the unplanned event. Contemplating Table 4.1, the nature of the events varies widely. In some cases, it originates from the physical situation (i.e., SOI

Table 4.1 Unplanned events in the A2 Maastricht project

ID	Label	Brief description of the unplanned event
TUN	Tunnel standard	Due to ambiguity and hence discussions about the safety standards for Dutch tunnels and delayed commissioning of tunnels resulting there from, RWS established a Tunnel Director to develop a general tunnel standard to be anchored in legislation. At the time of interviewing, this caused uncertainty about changes in the technical traffic and tunnel system requirements and related rising costs of the systems.
BI1	Bicycle bridge	The plan was to create a temporary bicycle bridge to compensate the closure of two bicycle tunnels. A subcontractor identified problems with the design (i.e., sheared risks) that caused discussion within Avenue2 about how to proceed.
BI2	Bicycle bridge	In the end, this bridge was cancelled by Avenue2 for technical and safety reasons not foreseen in the procurement of the plan. Consequently, the Cyclist Union objected. The Union mobilized politicians in the municipal council – who appeared not to be informed of the change – who called the alderman to account.
WAT	Waterboard[a]	The Waterboard needed to issue permits for parts of the project. It imposed additional requirements related to water retention and drainage when a permit was applied for by Avenue2. This affected the project scope. According to several managers, this was due to not involving the Waterboard in the planning of the project.
LAN	Land acquisition	Over 400 apartments had to be purchased by the Municipality of Maastricht (Project Agency) to be demolished. A small number of residents objected, and some even appealed at the Dutch Council of State.[b]

Table 4.1 Unplanned events in the A2 Maastricht project (continued)

ID	Label	Brief description of the unplanned event
ZON	Zoning plan	Leading up to the endorsement of the zoning plan by the Municipality of Maastricht, the content was agreed on by the responsible municipal manager and the manager planning of the Project Agency. However, as a consequence of internal municipal dynamics – inter alia, limited decision-making power of the municipal manager – the municipal manager reconsidered the agreements twice.
ENV	Environmentalists	Environmental interest group Kloar Loch appealed at the Council of State to enforce a higher air quality near the tunnel mouths in the final situation, and during project construction. Parallel to the legal procedure, the group also contacted the Project Agency to negotiate an agreement.
LEE	Leeuwenborgh	Vocational school Leeuwenborgh lodged an objection at the Project Agency to the phasing of a road bypass during construction for reasons of safety, health, and limited parking space.
WES	West8	In detailing the design of the project, the angle of a small tunnel relative to the highway was slightly altered by Avenue2 when they applied for the construction permit at the Municipality of Maastricht. Landscape architect West8 objected, mobilized inter alia the municipal Building and Housing Inspectorate, and demanded the undoing of the alteration.
RIJ	Rijkswaterstaat	RWS needed to verify the Route Decisions developed by the Project Agency.[c] Leading up to the endorsement, the content was agreed on between the Agency and RWS, but then RWS specialists demanded some changes in the design for reasons of air quality that would affect the project's budget.
TRA	Traffic audit	During construction, RWS performed an unannounced audit concerning traffic measures. The audit judged that the measures taken by Avenue2 were insufficient and that unsafe situations existed.
CR1	Crisis	Part and parcel of the plan and Avenue2's business case is the construction of 1,100 houses and 30,000 m^2 of commercial properties between 2016 and 2026. The financial and real estate crises caused uncertainty regarding the balance of the budget.
CR2	Crisis and Recovery Act	In the beginning of 2010, the Crisis and Recovery Act was enacted. This law aims to shorten procedures at the Council of State.
SOI	Soil contamination	During the reconstruction of the Geusseltvijver, soil contamination was discovered that was heavier than expected in the reports. By law, this contamination had to be removed.
BAD	Badger	Leading up to the contract closure, the local badger habitat was identified. After the contract closure, it appeared that the habitat had changed resulting in the need for scope changes (inter alia, badger tunnels).
PRO	ProRail	Decommissioning the railway near the project area is necessary for project construction purposes. When the Project Agency requested the decommissioning, ProRail acted obstructive as they felt passed over because they were not consulted about the issue during plan preparation.[d]
CIV	Civil initiative	In 2011, a city artist and an architect approached the Project Agency with an initiative to perk up the construction site with sunflowers.
THE	Theft	Construction materials were stolen from the Avenue2 site.

[a] Dutch waterboards are regional democratically elected governmental bodies charged with the management and mainance of water barriers, waterways, water levels, and water quality. The first waterboards date from the 13th century.

[b] The Council of State advices government and parliament on legislation and governance, and it is the country's highest administrative court (see www.raadvanstate.nl/the_council_of_state).

[c] The Route Decision is the national equivalent of a zoning plan for national infrastructures.

[d] ProRail is the organization responsible for the construction, maintenance, management, and safety of the Dutch railway network.

and BAD); in other cases, it primarily relates to the local social environment (i.e., BI2, LAN, ENV, LEE, and CIV), the project system (i.e., BI1 and WES), the local governance system including mother departments of the public partners (i.e., BI2, WAT, ZON, WES, RIJ, TRA, and PRO), or remote of the project (i.e., THE, TUN, CR1, and CR2). What sets the middle three categories apart is that these strongly relate to what Hertogh and Westerveld coin "social complexity" that is "prominently visible in the relationship between the project delivery organization and local stakeholders" and "between the project delivery organization and their principal and parent organizations" (2010:150). The first and latter categories could be said to be similar in that respect, but differ from one another in terms of their remoteness to the project. In sum, the first condition is broken down into five categories: physical, social, project, public, and remote (see Table 4.2).

The second condition concerns the way in which managers respond to the unplanned event. As can be seen from Table 4.2, they do so by focusing on their internal structures – for example, doubling the shifts, changing planning, and changing construction modes – or by (attempting to) engage with the social system, most prominently engaging with stakeholders, in which the project is embedded, or some combination of both. It is important to note here that not all the events are responded to by public and private managers; some are of concern to only one party. This is expressed in the third condition.

The third condition specifically concerns the relationship between the principal and contractor, which appeared to be a focal point in the interviews. This condition consists of two dimensions. First, an unplanned event may be responded to by either principal (public managers), or contractor (private managers), or both (i.e., interaction). This concerns the presence of public-private interaction. Second, if *inter*acted on, this may be characterized, to greater or lesser extent, by either cooperation or conflict between principal and contractor, that is, join forces or, inter alia, shear risks. This concerns the nature of the interaction. Hence, four basic categories of public-private interaction can be distinguished: autonomous public, autonomous private, conflict, and cooperation. The empirical manifestation of the interaction is at least partly determined by the contract between principal and contractor that provides directions for how they are to interact.

The fourth and final condition concerns the 'outcome'. In this, we follow Verweij, Klijn, Edelenbos, and Van Buuren (2013) to the extent that no unambiguous measure of 'good outcomes' can be used in projects with multiple actors and interests. Moreover, the project was at the moment of interviewing in construction; that implies that outcomes are provisional, that is, that the final effect on the project outcome as a whole could not be established. For these reasons, we take as an aggregate measure the satisfaction of managers "based on their realized preferences and goals, and the time and energy spent achieving those" (Verweij et al., 2013:1038) in a case as the outcome, which predominantly concerns time, budget, quality, and/or the public-private relationship (Verweij, 2012a). For instance, if goals are realized but with much energy spent, satisfaction is assessed as moderately high. In the next section, the qualitatively described data in Tables 4.1 and 4.2 are calibrated (see Table 4.3) and quantified in a data matrix (Table 4.4).

Table 4.2 Responding to unplanned events

ID	Event	Management	Interaction	Satisfaction	
TUN	Remote	Internal	Cooperation	High	
		Managers tried to anticipate the uncertainty, but no attempts were made to influence the tunnel discussion.	The Agency and Avenue2 explored the possibility of forming an alliance for the technical traffic and tunnel systems to share risks. The idea was abandoned when uncertainty decreased; the contract is amended and the partners will cooperate to implement design changes.		Public and private managers expected the standard to enhance clarity; additional costs will be paid by the Ministry; and going for contract amendment is preferred by both parties.
BI1	Project	Internal	Private	Low	
		In the end, Avenue2 changed the construction plan concerning the bridge.	Avenue2 individually made the decision without timely communicating it.		The result was societal unrest and a "political joust".
BI2	Social/Public	External (primarily)	Public (primarily)	Indifferent or moderate	
		A meeting was arranged with a delegation of the municipal council and the alderman promised better communication. Also, Avenue2 and the Agency took stock of improvement points.	The municipal-political manager of the Agency led the reconciliation process although Avenue2's director was also involved in meetings.		Although the issue was settled in the end, and although it was felt that it was an "unnecessary mistake" that could have been avoided, the manager conveyed a sense of events like this being the daily affairs in such a local and political environment.
WAT	Public	External	Cooperation	Indifferent or moderate	
		Managers arranged meetings with the Waterboard to negotiate a solution.	The Agency and Avenue2 went to the Waterboard together, cooperated on submitting a new permit application, and they agreed on some contract changes (i.e., additional work).		Although in the end construction activities could commence, it was felt that the ado could largely have been avoided if the Waterboard would have been involved from the outset.

Table 4.2 Responding to unplanned events (continued)

ID	Event	Management	Interaction	Satisfaction	
LAN	Social	External	Public	The acquisition of land is the sole risk and responsibility of the principal.	Managers negotiated with landowners about the price of the acquisition, sometimes accompanied by the alderman to soothe emotions. Also during the Council of State meeting, prices were informally negotiated between appellants and the Agency's director.	High	Although some properties have to be expropriated, appeals were withdrawn and nearly all the land was bought up. These results were contrasted by some managers with a nearby project and assessed positively.
ZON	Public	External	Public (primarily)	The negotiations were managed by the Agency as the zoning plans were its responsibility, but Avenue2 also filed a claim to exert pressure. Later, they helped with the solution.	Initially, the interaction with the Municipality was hardened as the Municipality was threatened with claims. Later, the interaction softened by negotiating a substantive solution.	Moderate to high	Although in the end the claims were withdrawn and the conflict between the Municipality and the project was settled, some plan changes had to be made and some frustrations with the situation remained.
ENV	Social	Internal	Public	The Agency was responsible for getting the zoning schemes declared irrevocably by the Council.	The strategy of the responsible manager was to maintain radio silence as long as the Council did not judge yet. There was invested in legal and air quality specialists.	High	The appeals were declared unfounded and the responsible manager expressed a great sense of accomplishment.

Table 4.2 Responding to unplanned events (continued)

ID	Event	Management	Interaction			Satisfaction	
LEE	Social	External (primarily)	Public (primarily)	Via an informal process, the manager tried to negotiate a solution with the school, at certain points aided by mobilizing the alderman. This also meant changing the planning and position of the road bypass.	The interaction and negotiation process was carried out by the Agency, but Avenue2 helped with the substantive solution (i.e., changing the planning).	High	The school's objection was waved aside, the Agency and school's rapport remained good, and the responsible manager was admired for his good performance.
WES	Project/Public	External (primarily)	Private	The involved manager tried to negotiate a solution with West8 and the Inspectorate, and in the end decided to satisfy West8's wishes to prevent a claim for damages.	Avenue2 acted alone on this issue.	Moderate to high	In the end, it appeared to be a communication problem and West8, the Inspectorate, and the Agency were satisfied, at the expense of some additional costs for Avenue2.
RIJ	Public	External	Cooperation	A persuasion process was initiated (e.g., by showing the financial consequences of demanding plan changes) to ensure that RWS would endorse the Route Decision.	Avenue2 was mobilized by the Agency's manager in the persuasion process to pressurize RWS to endorse the plan without expensive plan changes.	High	The Route Decision was endorsed, and about a year faster than average Dutch projects.
TRA	Public	Internal (primarily)	Private (primarily)	A meeting was organized to let the auditors present their findings, improvement points were identified and recorded, and physical measures were taken to enhance safety.	The meeting was organized by the Agency, but Avenue2 takes the organizational and physical measures.	Low	The involved manager expresses irritations regarding this case. It is a drain on his time and budget.

Table 4.2 Responding to unplanned events (continued)

ID	Event	Management		Interaction		Satisfaction	
CR1	Remote	Internal	The effects on the budget are calculated and monitored.	Private (primarily)	This is the contractor's risk although public managers express goodwill to jointly consider the issue once it becomes prominent.	Indifferent or moderate	This event is outside the sphere of influence and, at the time of interviewing, managers were yet mainly concerned with the tunnel construction.
CR2	Remote	Internal	The Act reduces the amount of required permits and shortens planning procedures.	Public	The planning process was the Agency's responsibility.	Moderate to high	The Act accelerated decision-making at the Council but, due to capacity shortage, the effect was partly nullified.
SOI	Physical	Internal	The contamination is responded to by taking physical measures.	Private (primarily)	The contamination is obviously dealt with by the contractor, but the principal decided how and changed the contract (i.e., additional work) accordingly.	Indifferent or moderate	Such unforeseen events are not exceptional, as is the way it was dealt with.
BAD	Physical	Internal	The scope was changed, i.e., additional badger tunnels were constructed.	Private	Avenue2 was charged with the construction and with the migration of the badgers.	Low	In hindsight, insufficient sagacity resulted in unnecessary costs.
PRO	Public	External	Managers negotiated a contract with ProRail for the decommissioning of the rail track.	Public	The negotiations were managed by the Agency as that is its responsibility.	Indifferent or moderate	The influence of this case on the course of the project is limited, but not involving ProRail from the outset of the project was a missed opportunity.
CIV	Social	External	The initiative was embraced.	Cooperation	The initiative was embraced by both parties.	High	The initiative benefits the project image and enhances societal support for the project.
THE	Remote	Internal	Insurance, buy new materials.	Private	This issue is the sole risk of the contractor.	Indifferent or moderate	Although aggravating, theft occurs on a daily basis and is part of building a project.

4.4.2.   Comparing cases with mvQCA and results

The calibration rules for Table 4.2 are shown in Table 4.3. In the first mvQCA iteration, we used Version A of the calibration. However, as it turned out, this produced too many logical contradictions, that is, a configuration that is associated with the outcome in one case and with the absence of the outcome in another. In addition, Version A produced logical remainders, that is, logically possible configurations that are empirically absent. The more contradictions and remainders, the less there is to compare.

Table 4.3 Calibration of conditions for mvQCA

Condition	Abbreviation	Calibration mvQCA (version A)	Calibration mvQCA (version B)
Event	EVENT	0 = Physical	0 = Physical, remote
		1 = Social, project, public	1 = Social, project, public
		2 = Remote	
Management	MAN	0 = Internal	0 = Internal
		1 = External	1 = External
Interaction	INTERA	0 = Autonomous public, private	0 = Autonomous public
		1 = Conflict	1 = Autonomous private
		2 = Cooperation	2 = Cooperation
Satisfaction	SATIS	0 = Indifferent or moderate, low	0 = Indifferent or moderate, low
		1 = High, moderate to high	1 = High, moderate to high

Specifically, first, EVENT{0} and EVENT{2} did not distinguish between cases in any significant way (i.e., it did not resolve a contradiction), but it did produce more logical remainders. That is, the remoteness of the unplanned event to the project does not account for the difference in outcome between cases. However, the difference between the social or nonsocial nature of the event distinguishes different cases from one another. Second, INTERA{1} (i.e., conflict) is empirically absent in our data, and two of the four contradictions could be resolved by distinguishing between 'autonomous private' and 'autonomous public' interaction instead. That is, this first analysis with Version A of the calibration suggested that actions being performed either by the public or the private actor autonomously is possibly an important explanatory feature for assessing the satisfaction with how unplanned events were responded to. Following these first results, the calibration was adjusted to Version B (see Table 4.3). The data matrix resulting from Version B of the calibration is depicted as Table 4.4. In the remainder of the analysis, we proceed with this data matrix based on Version B.

In the next two steps, we organized the cases over the logically possible configurations in a truth table. Our truth table has twelve logically possible configurations ($2^2 \times 3^1$). Each configuration is presented as a row. Each row can be understood as a statement of

Table 4.4 Data matrix (calibration version B)

Case-ID	EVENT	MAN	INTERA	SATIS
TUN	0	0	2	1
BI1	1	0	1	0
BI2	1	1	0	0
WAT	1	1	2	0
LAN	1	1	0	1
ZON	1	1	0	1
ENV	1	0	0	1
LEE	1	1	0	1
WES	1	1	1	1
RIJ	1	1	2	1
TRA	1	0	1	0
CR1	0	0	1	0
CR2	0	0	0	1
SOI	0	0	1	0
BAD	0	0	1	0
PRO	1	1	0	0
CIV	1	1	2	1
THE	0	0	1	0

Table 4.5 Truth table

EVENT	MAN	INTERA	SATIS	N	Cases
0	0	2	1	1	TUN
1	0	1	0	2	BI1, TRA
1	1	0	C	5	BI2, LAN, ZON, LEE, PRO
1	1	2	C	3	WAT, RIJ, CIV
1	0	0	1	1	ENV
1	1	1	1	1	WES
0	0	1	0	4	CR1, SOI, BAD, THE
0	0	0	1	1	CR2

sufficiency. Next, the outcome associated with each configuration is assessed (see Table 4.5) that, so to speak, allows claiming that a statement of sufficiency is true or untrue. Logical remainders are not included in this truth table.

In the fourth step, we minimized the truth table via pairwise comparing configurations that agree on the outcome and differ in but one other condition (Ragin, 1987). For instance, EVENT{1}*MAN{0}*INTERA{0} and EVENT{0}*MAN{0}*INTERA{0} could

be minimized to MAN{0}*INTERA{0}. Contradictory configurations are not included in this minimization process. The results are reported in Table 4.6.

4.4.3. Explanation of the results

The first solution formula [1] is associated with low satisfaction (see Table 4.6). It states that in six of the eighteen cases, irrespective of the nature of the unplanned event, internally-oriented private management responses to events are associated with lower satisfaction. This is certainly the case for BI1, BAD, and TRA, where satisfaction was low. In the other three cases (THE, CR1, and SOI), where satisfaction is indifferent or moderate, this is less clear-cut. For those cases, it is reasonable to assume that those could not have been prevented by the contractor. This could explain the moderate or indifferent satisfaction expressed by managers in those cases. This may be different for the first three cases. We return to this issue in Section 4.5.2.

Table 4.6 Results of the truth table minimization

	Statement of sufficiency			Outcome
[1]	MAN{0}*INTERA{1}			SATIS{0}
Cases	BI1, TRA + CR1, SOI, BAD, THE			
[+ 2A-C]	MAN{0}*INTERA{0} +	EVENT{0}*MAN{0}*INTERA{2} +	EVENT{1}*MAN{1}*INTERA{1}	SATIS{1}
Cases	ENV + CR2	TUN	WES	

The second solution formula [2] consists of three terms [2A, 2B, and 2C] (see Table 4.6). The first term [2A] indicates that in two cases, irrespective of the nature of the unplanned event, internally-oriented public management responses are associated with higher satisfaction. In the case of dealing with the environmental interest group Kloar Loch (ENV), the responsible public planning manager did not engage with the group during the legal procedure. He managed by the adage of "anything you say can and will be used against you in the court of law" (see Table 4.2). In the case of the Crisis and Recovery Act (CR2), this is a different story. Here, the unplanned event is remote to the project and the internally-oriented management qualification reflects this (see Table 4.2).

The second term [2B] indicates that a remote event, that is responded to internally-oriented and in cooperation between principal and contractor, is associated with higher satisfaction. In this case (TUN), internal management strategies were oriented at anticipating the impact of the future legislation on the project. This unplanned event was considered by the managers as a priority issue with a potentially large impact, which could not reasonably be left to Avenue2 to be dealt with. This was recognized by both partners, and this provided a basis for public-private cooperation.

The third term [2C] indicates that a social, local unplanned event (i.e., from the project system), that is responded to by externally-oriented private management, is associated with higher satisfaction. In this case of the objections raised by landscape architect

West8 (WES), some plan adjustments were made that resolved the issue without significant delays or budget overruns. Although this finding is only formally supported by one out of eighteen cases, it is corroborated by the first solution formula [1] that states that when private managers do not engage with the social environment to deal with the issue (MAN{0}*INTERA{1}), this is associated with lower satisfaction.

Arguably, these three statements of sufficiency toward high satisfaction can be said to be empirically weak. That is, although they are consistent (i.e., there are no contradictions on the outcome between the cases covered by them), the terms in the second solution formula [2A-C] are covered by no more than two out of eighteen cases. There is a trade-off between consistency and coverage (e.g., Ragin, 2008a). Utilizing this trade-off to fortify the empirical strength of our results, we performed an additional mvQCA where we included the two contradictory configurations (see Table 4.5) in the minimization for SATIS{1}. Thereby, we increased the number of cases covered by the solution formula [2] by eight (higher coverage), and simultaneously the inconsistency as the added cases BI2, LAN, ZON, LEE, PRO, WAT, RIJ, and CIV do not all have a score of 1 on the outcome. However, only three of those eight cases do not score 1 (i.e., BI2, PRO, and WAT) and none of those three cases has a score in the lowest scores.

This additional mvQCA iteration produced somewhat similar results. The first [2A] and second terms [2B] of the second solution formula remained unchanged. However, the third solution term [2C], that was solely covered by WES, changed. It became more general as it does not matter whether interaction (INTERA) is autonomous public {0}, autonomous private {1}, or cooperative {2}; higher satisfaction is 'produced' nevertheless. Hence, the INTERA condition is dropped from the solution term to yield the more general result: EVENT{1}*MAN{1} → SATIS{1}. This means that externally-oriented management is an INUS condition, which means that it is necessary for dealing with social, local unplanned events, but that there are other combinations of conditions that are also associated with high satisfaction. This is indicated by the existence of the two other solution terms.

4.5. CONCLUSION AND DISCUSSION

In Section 4.5.1, we conclude our analysis by answering the main research question. As announced in Section 4.2.2, in Section 4.5.2, we make a final interpretation of the results to conclude the analytical process, and in this discussion we point to some implications for managers of transportation infrastructure projects. Section 4.5.3 closes the article by briefly discussing some methodological issues and implications for evaluators.

4.5.1. Conclusion

In the introductory section, we set out to investigate how managers in the implementation phase respond to unplanned events that occur in the context of the transportation infra-

structure project, and which management responses produce satisfactory outcomes. We adopted a research approach that combines qualitative in-depth analysis – which is needed to consider context that is explanatory for how outcomes come about in projects – with comparison – which is required to be able to draw lessons for future projects (cf. Verweij & Gerrits, 2013). We were able to show in a systematic way how the influence of certain management responses depends on its interaction with other conditions. Although such claims are expectedly also made in qualitative/interpretative case studies of transportation infrastructure projects, QCA allowed us to do this in a systematic and transparent manner. Using a grounded and iterative research process, we arrived at a number of results.

Specifically, we found that internally-oriented and externally-oriented management responses are associated with high satisfaction, but that this depends on the nature of the unplanned event, and/or on the cooperative relationship between principal (private managers) and the contractor (public managers). In particular, (a) internally-oriented private management is associated with lower satisfaction, (b) externally-oriented management is associated with higher satisfaction in cases of social, local unplanned events, and (c) internally-oriented management is associated with higher satisfaction, depending in particular on the nature of the cooperation between principal and contractor. This shows that unplanned events are responded to in different ways and that balancing management strategies actually entails a *mix* of less balanced management responses *within* a project.

4.5.2.   Discussion and management implications

We pointed at a difference between cases that are covered by the first solution formula associated with SATIS{0}. In all these cases, the unplanned event was responded to by the contractor, and satisfaction was rather low. This is not to say that when private managers deploy internally-oriented strategies, low satisfaction 'automatically' follows.

As mentioned in Section 4.4.3, regarding three of the six cases of this solution formula (THE, CR1, and SOI), managers expressed indifference in the interviews with respect to the outcome condition. They expressed that some events are just impossible to influence or prevent. The implication of this is not that managers should relinquish dealing with unplanned events, but rather that they should be aware that projects will inevitably encounter unexpected events (e.g., Weick & Sutcliffe, 2007).

In other remote unplanned events, the perceived potential impact on the project's critical path (planning) was too great for the managers to remain indifferent to. This is most prominent for the development of the new tunnel standard (TUN). The need to anticipate this impact was felt by Avenue2 and the Project Agency; managers referred to the northerly A73 Roermond tunnel that is plagued by closures for safety reasons since its commissioning in 2008, resulting in limited regular service. With this bugaboo in mind, principal and contractor wanted to build a safe tunnel in Maastricht but not at the expense of construction delays and cost overruns. Indeed, the idea that the city has to endure the discomforts of the construction works beyond 2016 is deemed undesirable. It seems that

this shared sense of urgency is a strong driver for enhanced cooperation as it provided a basis for contractor and principal to cooperate in the project (cf. Verweij, 2012a).

Another possible condition underlying the differences within the first path associated with SATIS{0} may be the extent to which the contractor had a (too) strong focus on design and planning issues (BI1, TRA, and BAD). Encouraged to meet deadlines, contractors tend to focus on making rapid progress thereby sometimes losing sight of the local, social environment in which a project is embedded. This may backfire on the project's process. The implication is that, generally, having an externally-oriented focus produces more satisfactory outcomes. This is supported by the results of our analysis. However, this does not seem a big issue in Maastricht as the project enjoys local support given its clear added value for the city and its citizens. But in more contested infrastructure projects, this may be a whole different story. This implies that support for a project is important for achieving satisfactory outcomes.

The second solution formula [2] indicates that internally-oriented management strategies are sometimes associated with higher satisfaction (ENV, CR2, and TUN). Although the cases associated with these two configurations are quite diverse (see Table 4.2), they seem to have in common that they have a potentially large impact on the project's development. The TUN case was discussed above. For the ENV and CR2 cases, as public planning and procurement were interwoven (Van Valkenburg & Nagelkerke, 2006), and as the bidder was selected before the public planning was finished, changes in the public zoning and Route Decision plans may result in a failed procurement and high costs as the bidder was already selected. Hence, there was a big relief when the Council of State declared the public plans irrevocably.

The analysis also showed that externally-oriented management is strongly associated with high satisfaction and that the opposite is often the case for internally-oriented management. The obvious implication of this finding is that externally-oriented management responses are recommended to deal with unexpected events. However, it should be kept in mind that this could be concluded after including two logically contradictory configurations. Bearing in mind that the contradictions are not very strong, the question of what explains these two contradictions remains. What the three cases with indifferent or moderate satisfaction (BI2, PRO, and WAT) seem to have in common, relative to the five other cases, is that managers expressed their satisfaction in terms of missed opportunities to involve particular actors in the planning of the project. Not involving ProRail (PRO), the Waterboard (WAT), and the Cyclist Union and municipal council (BI2), respectively, was perceived to have caused the unplanned event in the first place. This points us to the importance of closely involving stakeholders in the planning phase.

We showed that transportation infrastructure projects are implemented in a social context, and that this context gives rise to unplanned events. These events are often best managed not by ignoring them or managing inward, but rather by managing outward, that is, engaging with the social context of the project. This points us to the pivotal importance of stakeholder management, not just in the planning phases of a project but also during project implementation. In the A2 project, a lot of resources were allocated to this and

with satisfactory results. The Project Agency and Avenue2 together run a communication office to provide local stakeholders, such as citizens, companies, and local governments, with information about (the progress of) the project. This is quite a success as there are no significant problems with stakeholder unrest during implementation.

4.5.3.   Reflection on the method for evaluation

"QCA does not in itself open up the 'black box' of complex phenomena and processes. However, it rather acts like a flashlight that points at some crucial spots in the black boxes of the cases under investigation" (Rihoux et al., 2009:170). In this article, we illuminated some spots, but many remain to be studied. Nevertheless, we hope to have shown that QCA is a systematic and transparent evaluation approach that, on the one hand, appreciates the uniqueness, diversity, and contextual nature of projects and, on the other hand, searches for patterns. This is imperative to transfer lessons from individual project analyses to future projects. We finish this article with some final points for evaluators.

First, in this article, we applied QCA to a single infrastructure project for in-depth analysis. However, it may also be interesting for evaluators to apply QCA to multiple infrastructure projects (e.g., Verweij et al., 2013) to compare small-n or intermediate-n projects across or within regions (e.g., states) and sectors. Given the fact that evaluators often have to deal with relatively small numbers of cases that makes statistical analysis difficult, this is a significant advantage of QCA. Second, the time dimension is underexposed in QCA approaches. In this article, we have carefully paid attention to time by constructing the cases in such a way that the unplanned event is chronologically prior to the other three conditions (MAN, INTERA, and SATIS) in each case. Moreover, time is also expressed in the qualitative interpretation. Nevertheless, QCA is an approach that is weak on researching the dynamics of infrastructure projects whilst these are pivotal to explaining outcomes (Verweij & Gerrits, 2013). Third, we decided to work with mvQCA. This is arguably not the best method for any evaluation of infrastructure projects. What to use – csQCA, mvQCA, or fsQCA – ultimately depends on the conditions to include in the analysis and how these are operationalized. Crisp, multi, and fuzzy sets all have some distinct disadvantages and advantages (Schneider & Wagemann, 2012; Thiem, 2013; Vink & Van Vliet, 2009; 2013), as do the different software packages related to those methods (see www.compasss.org for an overview). Finally, through the iterative processes of data collection, coding, and casing, we arrived at a certain set of conditions to be included in the QCA process. Other projects with different characteristics, and other methods and techniques of data collection, may result in a different set of conditions. However, this does not invalidate in any way the usability of QCA for evaluating infrastructure development.

5 Management and Public-Private Cooperation in the A15 MaVa Project

Achieving satisfaction when implementing PPP transportation infrastructure projects: A qualitative comparative analysis of the A15 highway DBFM project

Stefan Verweij

ABSTRACT

This article investigates how managers in public-private partnership (PPP) projects respond to social or physical events during the implementation of their projects, and which of their responses produce satisfactory outcomes. Multi-value qualitative comparative analysis (mvQCA) was used to examine the events that took place during a large Dutch Design, Build, Finance, and Maintain (DBFM) transportation infrastructure project. The analysis found that most events were social in nature. Private managers' responses to these events were internally-oriented and resulted in dissatisfactory outcomes. In contrast, externally-oriented managerial responses were associated with satisfactory outcomes. The article concludes that both public and private managers need to invest sufficiently in stakeholder management resources and capabilities when implementing projects. Although the intention of DBFM contracts is to lower the burden on the government, public managers still play an important role as intermediaries between the contractor and the local stakeholders, and this role should not be underestimated.

5.1. INTRODUCTION

Over the last few decades, public-private partnerships (PPPs) have received increasing attention because they are thought to have many benefits (Bovaird, 2004). This is particularly the case with transportation infrastructure development (Kwak et al., 2009). Involving the private sector in infrastructure development is expected to have longer-term benefits, such as 'value-for-money' (Grimsey & Lewis, 2004; Kwak et al., 2009), and shorter-term benefits, such as a reduction in cost and time taken to deliver infrastructure services, higher quality service delivery, lower administrative costs, and the transfer of risks to the private sector (Flyvbjerg et al., 2003; Hodge & Greve, 2007; Kwak et al., 2009; Little, 2011). In the Netherlands, Design, Build, Finance, and Maintain (DBFM) contracts are often advocated (Committee PFI, 2008; Eversdijk & Korsten, 2009). These contracts resemble the U.K. Private Finance Initiative (PFI) projects (Klijn et al., 2007). A DBFM contract is a specific type of PPP where the private partner is integrally responsible for designing, building, financing, and maintaining the infrastructure (Lenferink, Tillema, & Arts, 2013b). However, only few DBFM contracts have been implemented thus far (Klijn, 2009) and research into them is scarce (Lenferink, Tillema, & Arts, 2013b).

Research into PPPs has mainly focused on the extent to which benefits are realized (research into the performance of PPPs) and how such benefits can be increased. Studies on increasing these benefits often examine pre-contract issues (Weihe, 2008b), such as tendering, procurement, risk allocation, and the financing of PPPs (Kwak et al., 2009). However, relatively little research has been carried out on the impact of the events that take place during the implementation phase of an infrastructure PPP, i.e., while it is being constructed and delivered (Jones & Noble, 2008), on project outcomes (Jones & Noble, 2008; Mistarihi et al., 2013; Weihe, 2008b). During the implementation phase, managers are faced with a variety of challenges and delivery difficulties. These challenges and difficulties often come to managers as events, stemming from the project's socio-physical context (Love, Holt, Shen, Li, & Irani, 2002). How managers in a PPP respond to these events during project implementation is an important part of successful infrastructure development (Love et al., 2002). For instance, an inappropriate response to an event may result in decreased shorter-term benefits such as delivery delays, lower delivery quality (leading to reputational damage or unsatisfied stakeholders), or poor relations between the public and private partners. Research, however, does not clearly specify which managerial approaches are the most beneficial for realizing satisfactory outcomes in PPP projects (Edelenbos & Klijn, 2009). The present study therefore aims to examine which managerial responses to events produce satisfactory outcomes during project implementation (cf. Verweij & Gerrits, 2015). The research question for the study is: *how do managers in the implementation phase respond to events occurring in the context of PPP transportation infrastructure projects, and which management responses produce satisfactory outcomes?*

This article is structured as follows. Section 5.2 describes transportation infrastructure project implementation, its implications for the research approach, and the applied research approach of multi-value qualitative comparative analysis (mvQCA). Section 5.3

sets the empirical scene by introducing the Dutch A15 highway DBFM project, and the data collected about it. The data are analyzed in Section 5.4 using mvQCA. MvQCA has recently been suggested as a valuable method for evaluating transportation infrastructure projects (Verweij & Gerrits, 2013), though empirical applications are lacking. Sections 5.5 and 5.6 comprise the discussion and conclusions, respectively.

5.2.   RESEARCHING COMPLEX PPP TRANSPORTATION INFRASTRUCTURE PROJECTS

5.2.1.   Properties of complexity in PPP infrastructure project management

Infrastructure projects are implemented in a socio-physical context where events occur (Gerrits, 2008; 2012; Van Gils, Gerrits, & Teisman, 2009). While these events are external to the project's management (Söderholm, 2008), they can influence it, since projects are open systems (Engwall, 2003). Although "during implementation, projects are supposed [to] be as closed as possible and concentrated on execution according to plans" (Söderholm, 2008:83), events occur in the implementation of the project that require managers to respond to them. The events can have a physical basis, such as changing ground or weather conditions, or be rooted in a social issue, such as objecting stakeholders (e.g., Assaf & Al-Hejji, 2006; El-Gohary, Osman, & El-Diraby, 2006; Odeh & Battaineh, 2002). This article's focus on events that are experienced by managers in PPP projects during the implementation necessitates a grounded approach to identifying these events since they are experienced by the managers, not by a theory proposed by an evaluator.

Managers respond (i.e., adapt) to events to make them manageable (Van Gils et al., 2009). Literature on the management of PPP projects distinguishes between project management and process management (Edelenbos & Teisman, 2008; Edelenbos & Klijn, 2009). A central difference between them is their openness towards the environment. The first focuses on the internal organization of the project, while the latter emphasizes the project's interaction with the societal environment. The first adheres to the idea of projects as closed systems and the second to projects as "contextually-embedded open systems" (Engwall, 2003:790). Although research shows that managerial activities are crucial for successful PPPs (Klijn et al., 2008), Edelenbos and Klijn state that the literature is "ambivalent about what style is most beneficial for realizing outcome of complex decision-making processes, in particular public-private partnerships. (…). There has not been much attention paid to this issue, and empirical results are mostly absent" (2009:321). They conducted a survey on this topic and found that the externally-oriented style of management is positively correlated with good outcomes, while the internally-oriented style is not. Although this is a valuable finding, variable-oriented studies such as this do not explain how good outcomes are actually produced, in contrast to case-based research (cf. Klijn et al., 2008; Verweij & Gerrits, 2013). Klijn and colleagues speculate that managers actually "choose their managerial strategy according to the logic of the situation" but they acknowledge that "this is a

theory that should be addressed through further research that focuses more on individual choices made by managers" (2008:271).

This article responds to this call and examines how managers respond to events in their day-to-day actions (cf. Cicmil et al., 2006; Smits, 2013; Van Marrewijk et al., 2008). Again, a grounded approach applies. The response chosen by a manager, and the complex processes leading to it (see Gerrits, 2012:Ch.4) are driven by the manager's interpretation of the event and his assessment of how it is best dealt with. His interpretation, assessment, and consequent action(s) may be rationally bounded, but they are his, and they produce real outcomes (cf. Gerrits, 2012). It follows that management responses and outcomes can only be understood by taking the manager's view as the point of departure.

While a transportation infrastructure project is being implemented, the management often faces multiple and different events. In a DBFM contract, where the private partner bears the responsibility for project implementation, private managers mainly respond to these events although the public partner may also be involved. Since responses to events can differ, it is possible to find many different examples of 'management responses to events' in a single project. Each example forms a separate case and each case is configurational (Byrne, 2005), which means that the event and the management response(s) combine to produce an outcome (cf. Van Gils et al., 2009).

The cases may be independent or intertwined with one another. For instance, cases may be linked to each other because of related events (e.g., a single stakeholder objects to different parts of the project for the same reason) or the involvement of the same individual/s. Additionally, these cases are also related because, ultimately, they are managed by the same overall contract between a principal and contractor. In sum, a transportation infrastructure project can be understood to consist of strings of cases, which comprise different combinations of similar elements. This implies that cases within a project exhibit both similarities and differences (e.g., Buijs et al., 2009).

5.2.2. Researching complexity in PPP infrastructure project management with mvQCA

Following the properties explained above, the research approach used for the present study consisted of three steps (Verweij & Gerrits, 2015). The first step is the grounded collection of data. This was done by conducting open, qualitative interviews (e.g., Weiss, 1994): managers were asked what events had occurred, how they responded to them, and what outcomes had resulted. This allowed the researcher to obtain the manager's view of the events, response, and outcomes. All the interviews were transcribed. The advantage of using interviews for data collection is that intangible aspects, such body language and tone of voice during the interviews, can be observed and used as cues for aiding interpretation, e.g., how satisfied an interviewee was with the outcome.

In the second step, the interview transcripts were qualitatively coded for events with ATLASti software. ATLASti is a tool for coding qualitative data (Friese, 2013). By coding, the different perspectives of managers are cross-corroborated. This facilitates the synthesis

of the different perspectives into case constructions per identified event although, due to the different tasks and responsibilities of the interviewed managers, not all transcripts contained information on each case. Qualitative coding is a process where codes are developed and can be revisited as the researcher interprets the data (cf. Schwartz-Shea & Yanow, 2012). Using software such as ATLASti enables the researcher to structure and record this interpretive process, including the researcher's considerations to code text in a certain way.

The third step is the application of the QCA method. QCA is an umbrella term for several subtypes, including mvQCA (Rihoux & Ragin, 2009a; Schneider & Wagemann, 2012). QCA is a case-based comparative method. Being case-based, it allows researchers to emphasize the unique aspects of cases (i.e., their differences), while still allowing the identification of patterns (i.e., similarities) between them by comparing them (Ragin & Amoroso, 2011; Verweij & Gerrits, 2013). QCA is a method that facilitates an iterative process – of constructing cases as configurations of aspects, comparing the cases, interpreting the results, and possibly reconstructing the cases – in which (theoretical) ideas and empirical data are in dialogue with (i.e., inform) each other (e.g., Fritzsche, 2014). In QCA, the aspects of cases (here: events, management, and satisfactory outcomes) are called conditions. The advantage of mvQCA (Cronqvist & Berg-Schlosser, 2009) is that the conditions can have values beyond just 0 or 1, whilst remaining discrete (Vink & Van Vliet, 2009).

The basic logic of QCA consists of four subroutines (cf. Verweij & Gerrits, 2015). The first subroutine is the grounded qualitative construction of cases as configurations based on the coded interview transcripts (e.g., Rantala & Hellström, 2001). The cases are then quantitatively coded, and the configurations are placed in a data matrix. In the matrix, the cases are put in the rows and the conditions in the columns. The second subroutine is to reorganize the data into a so-called truth table, which sorts the cases over the logically possible configurations that are present in the data (Schneider & Wagemann, 2012). The truth table is the key tool for the comparative analysis. Each row in the truth table can be read as a statement about whether the configuration represented in the row is 'true' (or not) for (i.e., associated with) the outcome. The third subroutine involves the pairwise comparison of configurations that have the same outcome but differ in one other condition. This process is called truth table minimization. The condition in which two configurations differ is said to be logically redundant because, irrespective of the value of that condition, the outcome is produced nevertheless. The research process from the first to the third subroutine involves shifting the focus from the differences between cases to the similarities between them. The second and third subroutines are performed with software so as to exclude the possibility of human error in the analysis of the truth table (Schneider & Wagemann, 2010). The Tosmana software (Cronqvist, 2011), instead of other QCA software, is used for the present analysis because it can be used for mvQCA. The fourth subroutine is to interpret the patterns that result from the truth table minimization so as to understand the management of the wider context which, in this study, is the A15 highway DBFM project.

Recall that going through these subroutines is an iterative process. For instance, if the truth table contains cases that agree on all the conditions (i.e., are of the same configuration) and contradict on the outcome, this means that there is probably another condition at play that explains the contradiction. Conversely, if there are no contradictory cases in the truth table, the conditions might be further conceptually abstracted, or conditions could be excluded from the data matrix, so that even more general patterns can be identified. In this iterative process, the coded interview transcripts in ATLASti are regularly revisited.

5.3. DATA COLLECTION ABOUT THE A15 HIGHWAY DBFM PROJECT

In the Netherlands, PPPs mostly occur in the areas of infrastructure and area development projects (Klijn, 2009). Many types of PPPs exist in infrastructure development (Grimsey & Lewis, 2004; Kwak et al., 2009; Little, 2011). The DBFM contract is one of them. It is a concessional type of PPP that closely resembles the DBFO (Design, Build, Finance, and Operate) or DBFMO (Design, Build, Finance, Maintain, and Operate) contract (Bult-Spiering & Dewulf, 2006; Grimsey & Lewis, 2004; Yescombe, 2007). DBFM contracts are increasingly being applied in transportation infrastructure but experiences with, and research into, DBFM contracts is to date rather scarce (Lenferink, Tillema, & Arts, 2013b).

5.3.1. The A15 highway project

In December 2010, Rijkswaterstaat (RWS) entered into a DBFM contract, with a total project budget of approx. € 2 billion, with consortium A-Lanes A15 (see also Lenferink, Tillema, & Arts, 2013a; Verweij et al., 2014). RWS is the executive arm of the Dutch Ministry of Infrastructure and the Environment. It is responsible for the national transportation network. One of the main reasons for the project is the expansion of the Maasvlakte II port area. This has led to a need for extra transport capacity on the A15 highway corridor between the Maasvlakte II and the Vaanplein traffic junction near the city of Rotterdam. The general purpose of the project is to enhance traffic flow and safety on the corridor. Construction started in April 2011 and the project should be constructed in December 2015. The project includes the design and build of about eighty-five km of additional traffic lanes, a dynamic traffic management system over the thirty-seven km length of the project area, the renovation of approximately thirty-six civil structures and the construction of twelve new ones, the renovation of two large tunnels, a new Botlekbridge, and the maintenance of the infrastructure system up to 2035. In the Netherlands, infrastructure maintenance is separate from its operation (Lenferink, Tillema, & Arts, 2013b). The operation remains with the relevant RWS road district.

Leading up to the contract closure, RWS closed an administrative agreement and adherent implementation agreements with fourteen (semi-)public stakeholders: the national

Ministry of Infrastructure and the Environment, the regional collaboration Metropolitan Region Rotterdam, the regional Province of South-Holland, the Municipality of Rotterdam, seven other smaller municipalities and boroughs of Rotterdam, the local Waterboard Hollandse Delta, the Port of Rotterdam Authority (HbR), and national railway network manager ProRail. The underlying idea was to have consensus with these actors beforehand so as to smooth the project delivery. RWS incorporated the implementation agreements into the DBFM contract.

In the construction phase of the project, the RWS project organization consisted of a small team headed by five managers, of which the contract manager and stakeholder manager are dominant. The consortium A-Lanes A15 is formed by four companies: three construction firms and a project developer/investor. They are the constituent members of the Special Purpose Vehicle (SPV), which has a DBFM concession contract with RWS. The SPV is a 'virtual organization' responsible for the design, build, finance, and maintenance of the infrastructure system for which it receives income (Grimsey & Lewis, 2004; Ng & Loosemore, 2007; Smyth & Edkins, 2007) consisting of two large payments – one at partial availability and one at availability of the infrastructure system – and availability fees during the whole course of the contract up to 2035. The SPV uses contracts secondary to the concession contract (Ng & Loosemore, 2007) to finance the project, i.e., short- and long-term loans from banks, and to design, build, and maintain the project, i.e., contracts with two joint-ventures that both consist of the three construction firms. The first of the two joint-ventures is the EPC (Engineering, Procurement, and Construction) organization that is responsible for designing and managing the project (including the relationships with the stakeholders of the project) in the construction phase. The second joint-venture is responsible for the maintenance of the infrastructure system during and after the construction phase of the project.

5.3.2. Data collection

A total of twenty interviews were conducted between May 2012 and January 2013: seven interviews were with RWS project managers and thirteen interviews with A-Lanes' directors and project managers. Three managers would not be interviewed. The distribution of interviews reflects the dominant position of A-Lanes in the implementation phase of the project. Additional site visits, document reviews, and website inspections were used to further interpret and understand the interview data and results of the analysis.

5.4. ANALYSIS

This section comprises the third step as explained in Section 5.2. As mentioned before, the analysis was an iterative process, and the fourth section here reports the final results of this process. Section 5.4.1 discusses the first subroutine: the identification of the events, the responses of the project's managers, and the results of their responses. These configurational

cases are reorganized and compared in Section 5.4.2, which covers the second and third subroutines. At that point, the project's complexity and diversity have been systematically channeled into a few general patterns, which substantiate our understanding of the project's management more broadly. This represents the outcomes of the fourth subroutine, and they are interpreted in Section 5.4.3.

5.4.1.   Case constructions of responding to events in the A15 highway DBFM project

Table 5.1 provides an overview of the events that were identified. For instance, in one case, citizens complained about the noise nuisance that was produced when construction took place at night. Many citizens were not made aware of the potential for noise nuisance from construction activities if a northeast wind arose. In another case, ProRail changed the choice it had made in the implementation agreement, and which had been agreed upon by the other parties involved in the project, for a certain type of rail system. A final example from Table 5.1 is the discovery of an explosives risk zone with WWII bombs.

Table 5.1 Events in the A15 highway project

ID	Brief description
CAB1	The project area is packed with cables and pipelines. RWS is responsible for moving the so-called 'category-1' cables and pipelines – prior to project implementation – and A-Lanes for moving 'category-3' ones. During implementation, it appeared that a set of combined category-1 and -3 units near the Aveling secondary road had to be moved after all to be able to widen the A15 highway, which necessarily required coordination with the cable and pipeline owners and stakeholders (such as the Municipality of Rotterdam).
CIT1	Citizens complained about the noise nuisance produced by the nightly construction works (esp. pile driving) near the Botlekbridge. Due to an uncommon, unanticipated northeast wind, especially many complaints came from uninformed Spijkenisse citizens.
CIT2	After A-Lanes informed citizens about the pile driving work plan near the Groene Kruisweg provincial road that would produce about 70 dB, the Albrandswaard citizens asked for work methods and plans that would produce less noise nuisance.
CIT3	About 50 citizens complained about the noise nuisance produced by the nightly pile driving near the Verlengde Zuiderparkweg, upon which the Borough of Charlois decided to make the piling works stop by threatening to withdraw the necessary permit.
CIT4A	Uninformed Barendrecht citizens complained about the noise nuisance produced by the construction works (i.e., sand transportation and pile driving at night) at the Vaanplein highway junction. Hence, the Municipality of Barendrecht demanded to be timely and correctly informed about A-Lanes' activities.
CIT4B	Since the Municipality of Barendrecht was unsatisfied with the communication by A-Lanes and the quality of the permit applications regarding the Vaanplein construction works – which should include apt information and substantiation about the construction activities – it rejected the applications. Also, citizens still complained about the nuisance.
DOW	A downpour near the Groene Kruisweg Viaduct caused a small flood that washed away intentionally deposited sand where a land abutment would be built.

Table 5.1 Events in the A15 highway project (continued)

ID	Brief description
EXP	In a nearby project commissioned by the Municipality of Rotterdam, an explosives risk zone was discovered through a standard so-called NGE-investigation into unexploded WWII explosives. The results of the investigation contradicted the previous NGE-investigation for the A15 highway project. Consequently, owners of Pipeline Corridor-2 demanded additional NGE-investigations for the A15 highway project.
GRO	The ground conditions near Pipeline Corridor-1 appeared more problematic than expected. During the piling works, the ground moved thereby exerting too much pressure on the cables and pipelines in the corridor.
HBR1	It was agreed upon by RWS and the HbR that the latter would become the owner of the new to be built Oudeland Viaduct by A-Lanes. When A-Lanes finished the design according to the requirements in the contract with RWS, the HbR – backed-up by the Municipality of Rotterdam – demanded changes in it. They did not accept the design. Respondents felt that the HbR "find fault with everything" after the HBR3 case.
HBR2	When A-Lanes announced that it would start with reconstructing the Welplaatweg and Hartelkruis junctions, and simultaneously redirecting the hazardous substances route via the Welplaatweg, the HbR objected that the Welplaatweg could not be both reconstructed and serve as the reroute.
HBR3	Motivated by the contract to make a good pace, A-Lanes constructed a temporary road for transporting hazardous substances without coordinating the design with the HbR as they were required to by contract. Consequently, the HbR objected and did not give its approval for the road.
LEI	LSNed, the organization responsible for managing and maintaining the pipeline corridors, demanded changes in the design of the Pipeline Corridor-1 overarch. This was unexpected as RWS did not close an implementation agreement with LSNed.
MUN1	The Municipality of Rotterdam objected to the designs of Ramp700 (a land abutment for the Botlekbridge) as it would make future access to certain cables and pipelines impossible. The Municipality felt that the design did not meet the requirements agreed upon in the implementation agreement.
MUN2	The Municipality of Rotterdam repeatedly did not give its approval for the construction of the Botlekbridge pillars as it was unconvinced that the designed pillars were strong enough to carry the weight of the bridge decks.
PRO	After the contract award, ProRail reconsidered its implementation agreements with RWS. ProRail wished another technical rail system on the Botlekbridge than previously agreed upon, because the then foreseen novel system appeared more susceptible to interference than anticipated.
PRV1	The Province of South-Holland objected to the position of a particular cable near the Groene Kruisweg Viaduct as it would make it impossible for the Province to build a road parallel to the Groene Kruisweg in the future.
PRV2	After the deal with the Province was made about the solution of PRV1, a work foreman announced to the A-Lanes stakeholder manager that he would commence the implementation. When the stakeholder manager passed this to the Province, it objected because it first had to check and formally approve the solution, i.e., no permit was issued yet.
RWS1	The RWS Traffic and Water Management directorate (DVS) demanded changes in the design of the Portland traffic changeover as they thought the current design to be not safe enough.
RWS2	The RWS road district objected to the positioning of a site office by A-Lanes under a flyover near the Vaanplein junction for safety reasons (i.e., fire hazard) and wants the site office to be moved.

Each of the cases in Table 5.1 is constructed in the qualitative analysis as a configuration of conditions (see Section 5.2). As can be seen in Table 5.2, each case consists of four conditions. We explain them below.

Table 5.2 The conditions

Condition	Abbreviation	Numerical codes and meaning
Nature of the event	EVENT	0 = Physical
		1 = Social
Management A-Lanes	MANA	0 = Internally-oriented
		1 = Externally-oriented
Management RWS	MANR	0 = Contractor acts autonomously
		1 = Intermediating role
		2 = Cooperation
Satisfaction	SATIS	0 = Dissatisfaction prevails
		1 = Satisfaction prevails

The first condition (EVENT) concerns the nature of the event, which can be either social or physical. Social events originate from stakeholders, i.e., the social context. Physical events originate from the physical (natural) system. This distinction is relevant because it implies different situational logics which, in turn, could be followed by different management responses. That is, anticipating or responding to physical events is second nature to construction firms, which specialize in project organization/planning and dealing with physical systems. On the other hand, dealing with social events suggests a more open or externally-oriented management response (cf. Edelenbos, Klijn, & Kort, 2009), with which the construction sector is generally less familiar. In the A15 project, the lower level of familiarity is indicated by, inter alia, respondents saying so, and the relatively fewer means allocated to communication and stakeholder management, which private managers pointed out. The difference between a more internally-oriented response, such as doubling shifts or changing construction modes in an attempt to control planning and the budget, and an externally-oriented management response, such as engaging with stakeholders to achieve or maintain good rapport with them, is captured by the second condition: MANA.

The third condition (MANR) concerns the involvement of RWS' management. It is relevant to include this as respondents indicated that both the principal and the contractor, being relatively inexperienced with DBFM, were still discovering how management tasks and responsibilities are best distributed. A preliminary analysis of the interview transcripts revealed that, in some cases, RWS acted as an intermediary between A-Lanes and local stakeholders in order to safeguard good project outcomes, while in other cases RWS cooperated with A-Lanes. In yet other cases – 'in the spirit of DBFM' – RWS did not act as a manager. This triple option requires that mvQCA is used over other types of QCA.

Table 5.3 Responding to events

ID	EVENT	MANA	MANR	SATIS
CAB1	Physical	The focus of A-Lanes was on finding a technical solution to the problem that all stakeholders could agree with.	Their respective obligations to move cables and pipelines made RWS decide to combine the actions to be implemented, and to coordinate with stakeholders together.	This case was excluded from the requirements for the large multi-million payment, and a solution satisfactory to stakeholders was found.
CIT1	Social	A-Lanes decided to start actually measuring noise production to validate its model upon which it was basing its communication policy towards citizens.	As RWS is concerned with being a 'public-oriented network manager', the stakeholder manager started to renegotiate the 50 dB limit at which A-Lanes was required to inform citizens.	The 50 dB limit to inform citizens about construction works near the Botlekbridge was adjusted to 45 dB.
CIT2	Social	A-Lanes reconsidered its work plan which led to an approx. two-thirds reduction of nightly construction works. Additionally, it offered hotel stays to citizens that would be affected still.	There is no indication that RWS was involved in this particular case.	Only one or two complaints were received, and there were no problems with obtaining the needed permits.
CIT3	Social	The focus of A-Lanes was on choosing another method so as to continue construction.	There is no indication that RWS was involved in this particular case.	Construction was delayed for a week, extra costs were incurred, the media got wind of it, and RWS was dissatisfied with the situation.
CIT4A	Social	The focus of A-Lanes remained on achieving quick results, and not on high quality stakeholder informing through, inter alia, producing good permit applications.	RWS did not facilitate or cooperate at this point (but see CIT4B). It even said to the Barendrecht alderman to just reject the application.	RWS was dissatisfied with the situation, and the Municipality of Barendrecht rejected permit applications.
CIT4B	Social	The focus was still primarily on achieving results within time and budget; information about building activities came too late to be included in a newsletter.	RWS stepped forward, i.e., it gave A-Lanes a reprimand and started checking communication means by A-Lanes.	There was some progress regarding the Vaanplein case, but communication by A-Lanes remained an issue.
DOW	Physical	The focus of A-Lanes was on repairing the physical situation and on improving the collaboration between two sub joint-ventures.	There is no indication that RWS was involved in this particular case.	A hard shoulder had to be resurfaced.
EXP	Physical	The additional investigations were carried out by the Municipality of Rotterdam. A-Lanes had to redo its work preparation and increase working speed.	This was the contractor's risk; RWS was not involved in this case although A-Lanes did seek support.	Costs were incurred for the delay and hitherto RWS seemed unwilling to share (part of) the risks or costs.

Table 5.3 Responding to events (continued)

ID	EVENT	MANA	MANR	SATIS
GRO	Physical	The construction method was changed. When it turned out that this did not help, piling works were stopped.	There is no indication that RWS was involved in this particular case.	Costs were incurred (but managed by moving the piling works to the other pipeline corridor), and no solution was yet found.
HBR1	Social	RWS was asked for help in this case as A-Lanes felt that it met all the requirements. Additionally, construction plans were reconsidered as delays were anticipated. Also, some efforts were made to better the relationship between A-Lanes and the HbR.	RWS stepped forward and mediated between A-Lanes and the HbR. An external consultant was called in and RWS sided with A-Lanes in this case.	The construction was delayed and costs were incurred. Managers expressed tiredness with this issue and A-Lanes was still at odds with the HbR.
HBR2	Social	A-Lanes involved eight stakeholders, including the HbR, in a deliberation process to determine the best solution for the rerouting problem.	There is no indication that RWS was involved in this particular case.	A solution was found that satisfied all stakeholders, save the Municipality of Spijkenisse, i.e., rerouting via the Hartelkruis.
HBR3	Social	The actions of A-Lanes were focused on just getting this case over with; the focus was certainly not on building a better relationship with the HbR.	RWS was on the same footing as the HbR and told A-Lanes that the road could not be commissioned until A-Lanes would substantiate the design and get approval from the HbR.	This case was the first to set the scene for the difficult relationship between A-Lanes and the HbR that tormented A-Lanes constantly.
LEI	Social	As no implementation agreement was available, LSNed had neither interest nor contractual responsibility to cooperate. Management was aimed at getting LSNed to cooperate.	After a request for assistance by A-Lanes, RWS wrote an implementation agreement.	Costs were incurred, but the implementation agreement made it possible that LSNed recovered some costs from RWS.
MUN1	Social	The focus of A-Lanes was on quickly finding a technical solution to the problem, but it failed to align its interpretation of the requirements with those of the Municipality.	RWS intervened as it was unclear whether A-Lanes was to blame for the situation or whether the contract contained a contradiction. RWS tried to make A-Lanes and the Municipality to better cooperate with one another.	Delays had occurred and it was yet unclear when construction could start. Moreover, the relationship between A-Lanes and the Municipality was damaged. Also RWS was unsatisfied with A-Lanes' performance in this case.
MUN2	Social	The focus of A-Lanes was on finding a technical solution to the problem that the Municipality could agree with. Simultaneously, the final design for the bridge was not awaited, and ordering steel for the bridge continued so as to limit delays; and the construction planning was revised.	There is no clear indication that RWS was involved in this particular case, although A-Lanes started informing RWS about the slow acting by the Municipality.	The construction of the Botlekbridge pillars was delayed with several months, and costs were incurred in the ordering process for the Botlekbridge.

Table 5.3 Responding to events (continued)

ID	EVENT	MANA	MANR	SATIS
PRO	Social	Initially, according to the RWS contract manager, A-Lanes responded to ProRail by starting a process to explore the possibilities to satisfy the wishes of ProRail.	RWS intervened by making ProRail responsible for all the costs that a design change would cause. This case first had to be resolved between RWS and ProRail before involving A-Lanes, although A-Lanes acted as a 'consultant' to RWS.	RWS appreciated the proactive effort of A-Lanes. The case was still ongoing, but it was clear that A-Lanes was not responsible for solving this issue and thus possible costs involved.
PRV1	Social	A-Lanes' stakeholder manager made a deal with the Province to extend the cable.	There is no indication that RWS was involved in this particular case.	The Province agreed with the solution.
PRV2	Social	The A-Lanes stakeholder manager engaged in a negotiation process with the Province.	There is no indication that RWS was involved in this particular case.	A deal was made that satisfied all actors: the foreman could start his work, and in return A-Lanes would asphalt a bicycle path unrelated to the A15 highway project.
RWS1	Social	The preference of DVS corresponded to a previous design that was abandoned as it scored low on traffic flow. A-Lanes clarified that reverting to the previous design would increase costs, leading to a new reconciliation processes with stakeholders. The solution was to make some small changes in the design.	There is no clear indication that the RWS project organization was involved in this particular case.	In the end, the commissioning of the new traffic lanes was delayed, and a claim by A-Lanes towards RWS to compensate for costs was rejected.
RWS2	Social	A-Lanes initially reacted dismissively but offered a new solution to the road district.	RWS discussed the issue with A-Lanes during a meeting and advised the contractor how to deal with it.	Costs were incurred for moving the site office.

The fourth and final condition concerns the outcome (SATIS). Managers have different backgrounds, tasks, and responsibilities, leading to differences in how they deal with events and what sorts of outcomes mattered to them. The respondents articulated different types of outcomes, such as local stakeholder satisfaction, being on-time, being within-budget, and product quality. For comparative purposes, however, only one outcome condition is included: the aggregate, multidimensional condition of 'satisfaction' of managers with how the event was dealt with (Verweij & Gerrits, 2015).

Tables 5.3 and 5.4 comprise the qualitative construction of cases as configurations, and the quantitative coding of these constructions in a data matrix, respectively. The meaning of the coded conditions in Table 5.4 is provided in Table 5.2. For instance, in the above-mentioned ProRail case, which is coded as a social event (EVENT{1}), A-Lanes responded

by engaging with ProRail (MANA{1}). Also, RWS intervened by making ProRail financially responsible for the design change that it wished for, thus acting as an intermediary between A-Lanes and ProRail (MANR{1}). Although this case was still ongoing when the interviews were conducted, it was clear that A-Lanes would not have to bear the costs for any design changes, and RWS appreciated the proactive effort by A-Lanes to engage with ProRail (SATIS{1}).

In QCA, the numerical scores (Table 5.4) of the qualitative descriptions (Table 5.3) allow the cases to be compared transparently. The coding process, where ideas and data informed each other, involved both tangible and intangible data. The first three conditions are quite tangible as respondents were asked about what empirically happened and how they acted (cf. Verweij, 2012a). Describing and scoring the cases on the outcome condition relied on more intangible cues, such as body language and tone of voice during the interviews, as the respondents were sometimes reticent to explain their position in this respect (see Section 5.2.2).

Table 5.4 Data matrix

Case-ID	EVENT	MANA	MANR	SATIS
CAB1	0	0	2	1
CIT1	1	1	1	1
CIT2	1	1	0	1
CIT3	1	0	0	0
CIT4A	1	0	0	0
CIT4B	1	0	1	0
DOW	0	0	0	0
EXP	0	0	0	0
GRO	0	0	0	0
HBR1	1	0	1	0
HBR2	1	1	0	1
HBR3	1	0	1	0
LEI	1	1	1	1
MUN1	1	0	1	0
MUN2	1	0	0	0
PRO	1	1	1	1
PRV1	1	1	0	1
PRV2	1	1	0	1
RWS1	1	0	0	0
RWS2	1	0	1	0

5.4.2. Comparing cases with mvQCA and results

After constructing the data matrix (Table 5.4), the next step in a qualitative comparative analysis is to reorganize the data into a truth table (Table 5.5). Our truth table has twelve logically possible configurations ($2^2 \times 3^1$): two conditions have two possible values and one condition has three possible values (see Table 5.2). Only the six empirically present configurations are shown in Table 5.5. The table shows that there are three configurations associated with satisfactory outcomes and three with unsatisfactory outcomes.

Table 5.5 Truth table

EVENT	MANA	MANR	SATIS	Cases
0	0	2	1	CAB1
1	1	1	1	CIT1, LEI, PRO
1	1	0	1	CIT2, PRV2, HBR2, PRV1
0	0	0	0	DOW, GRO, EXP
1	0	0	0	CIT3, CIT4A, MUN2, RWS1
1	0	1	0	CIT4B, RWS2, HBR1, HBR3, MUN1

The next step is to minimize the truth table, i.e., to compare configurations that agree on the outcome and differ in but one condition. For instance, if we take the fourth and fifth rows of Table 5.5, configurations EVENT{0}*MANA{0}*MANR{0} and EVENT{1}*MANA{0}*MANR{0} can be minimized into the more generalized MANA{0}*MANR{0}. That is, logically speaking, whether EVENT is {1} or {0}, the outcome SATIS{0} is produced nevertheless. Note that the second and third rows in Table 5.5 cannot be minimized because the configuration EVENT{1}*MANA{1}*MANR{2} is not present in the data. This also applies to the fifth and sixth rows because the configuration EVENT{1}*MANA{0}*MANR{2} is absent. The results of the comparison are depicted in Table 5.6.

In order to arrive at more general patterns for both SATIS{0} and SATIS{1}, the condition MANR was abstracted in the next iteration from a multi-value condition into a binary condition (see Section 5.2.2). Consequently, the number of logically possible configurations changed from twelve ($2^2 \times 3^1$) to eight (2^3). This means that the empirical coverage of the logically possible configurations increased from six out of twelve to six out of eight, meaning that more pairs of configurations would agree on the outcome and differ in but one other condition. The advantage is that the results of the minimization are more general (i.e., less minimal configurations which are comprised of less conditions), making interpretation easier. The results of the new iteration in the comparison are depicted in Table 5.7. It could be argued, on the downside, that this implies a conceptual abstraction into 'RWS is either present {1} or absent {0} as a manager', and the way in which RWS is involved (the previous MANR{1} and MANR{2}) is irrelevant. However, because CAB1 (the only case with MANR{2}) individually constitutes a configuration (see Table 5.6), this abstraction can easily be accounted for in the next section.

Table 5.6 First results of the truth table minimization

SATIS	Configuration	Cases	N
{1}	EVENT{0}*MANA{0}*MANR{2}	CAB1	1
	EVENT{1}*MANA{1}*MANR{1}	CIT1, LEI, PRO	3
	EVENT{1}*MANA{1}*MANR{0}	CIT2, PRV2, HBR2, PRV1	4
{0}	EVENT{1}*MANA{0}*MANR{1}	CIT4B, RWS2, HBR1, HBR3, MUN1	5
	MANA{0}*MANR{0}	DOW, GRO, EXP + CIT3, CIT4A, MUN2, RWS1	7

Table 5.7 Final results of the truth table minimization

SATIS	Configuration	Cases	N
{1}	EVENT{0}*MANA{0}*MANR{1}	CAB1	1
	EVENT{1}*MANA{1}	CIT1, LEI, PRO + CIT2, PRV2, HBR2, PRV1	7
{0}	EVENT{1}*MANA{0}	CIT3, CIT4A, MUN2, RWS1 + CIT4B, RWS2, HBR1, HBR3, MUN1	9
	MANA{0}*MANR{0}	DOW, GRO, EXP + CIT3, CIT4A, MUN2, RWS1	7

5.4.3. Explanation of the results

As shown in Table 5.7, there are two minimized configurations associated with higher satisfaction. The first configuration is represented by case CAB1. It is an odd one out as it is covered by just one case. RWS and A-Lanes responded to the physical event by cooperating to find a solution. They had separate financial responsibilities for dealing with different types of cables and pipelines (see Table 5.1) but, because these were physically intertwined, it made sense to work together. The second configuration was covered by seven cases and stated that an externally-oriented response by A-Lanes to social events was associated with a high level of satisfaction. In some of these cases, RWS acted as an intermediary between A-Lanes and local stakeholders, while in other cases A-Lanes managed to respond satisfactorily without any intervention by RWS.

Two minimized configurations are associated with unsatisfactory outcomes. In nine cases, most of which involved meeting deadlines and getting things built in line with the project plan, encouraged by the structure of the DBFM contract, A-Lanes' managers responded to social events with internally-oriented policies. This meant that the interests of local stakeholders, such as citizens (CIT3, CIT4A, CIT4B), municipalities (MUN1, MUN2), and other (semi-)public actors (RWS1, RWS2, HBR1, HBR3), were not catered for. As shown in Table 5.3, this resulted in stressful relationships with those stakeholders, delays, and/or costs. For instance, in case CIT4A, RWS was dissatisfied with the response of A-Lanes' managers to citizens' complaints, and the relevant municipality rejected permit applications by A-Lanes. The other minimized SATIS{0} configuration is represented by seven cases and indicates that, irrespective of the nature of the event, A-Lanes' managers acted autonomously and responded with internally-oriented actions. Some of these cases

were about social events and are also covered by the previous configuration. The other three are physical events (DOW, GRO, EXP). RWS was absent due to the fact that the events were the contractor's risk. Respondents indicated that costs were incurred as a consequence. Whether the SATIS{0} cases will impact the longer-term benefits remains to be seen.

The majority of the cases (sixteen out of twenty) involve events that had a social basis (see Table 5.5). A closer look at the coded interview transcripts revealed that some of those cases were related to one another. This applies to two clusters of cases, shown in Table 5.8. The first concerns the CIT cases. Citizens complained about the nuisance of construction work (CIT3, CIT4A), which led to the Municipality of Barendrecht eventually rejecting permit applications (CIT4B). The initial autonomous internally-oriented responses by A-Lanes did not result in better outcomes, as can be seen in Table 5.8. In cases that occurred later, RWS became an intermediary in the process by checking (CIT4B) and renegotiating (CIT1) A-Lanes' stakeholder communication policy and channels. In the most recent case (CIT2), A-Lanes' managers responded with an externally-oriented action, and RWS did not become involved. Higher satisfaction was associated with these latter cases. The pattern here is that more satisfactory outcomes were achieved when RWS temporarily intervened but stepped back later, after which A-Lanes used externally-oriented management autonomously. In terms of Table 5.8, the CIT cases are related clockwise through time.

Table 5.8 Responding to social events

	Contractor acts autonomously	Principal intermediates	
Internally-oriented management	CIT3, CIT4A	CIT4B, HBR1, HBR3	Lower satisfaction
Externally-oriented management	CIT2, HBR2	CIT1	Higher satisfaction

The second cluster of cases concerns the HBR cases. A pattern similar to the CIT cases occurred here. The HBR3 case occurred not only because of A-Lanes' desire to make headway, but also because of its failure to improve the relationship with the HbR (see Tables 5.1 and 5.3). The relationship deteriorated to the point that A-Lanes managers felt that the HbR "found fault with everything", impeding the construction process (HBR1, see Table 5.1). At some point, contra the rationale of the DBFM contract according to which the principal is minimally involved, RWS stepped forward to manage the relationship between A-Lanes and the HbR. In the most recent HBR2 case, satisfactory outcomes were produced and RWS was not involved: A-Lanes autonomously organized a deliberative process with stakeholders to find a solution to an objection of the HbR, which resulted in a solution that satisfied all stakeholders (see Tables 5.1 and 5.3).

This pattern explicates what several respondents underlined: although construction companies may not by nature be attuned to societal complexity, they are learning how

to best respond to deliberate attempts by stakeholders to influence the project. Ample involvement in this by the principal was considered important, especially according to private managers.

5.5. DISCUSSION

5.5.1. Discussion of the results

The main purpose of this article was to investigate how managers respond to events in the implementation of PPP transportation infrastructure projects, and which management responses produced satisfactory outcomes. The results show that most cases (sixteen out of twenty) involved social events. In nine of these sixteen cases, the contractor responded with internally-oriented management; in the other seven cases, it responded with externally-oriented management. The results indicate that, for the A15 highway DBFM project, social events that are responded to by managers with externally-oriented actions are associated with satisfactory outcomes, while internally-oriented management responses are associated with unsatisfactory outcomes. This confirms the research findings of Edelenbos and Klijn (2009). The analysis also highlights the importance of the principal's involvement in the implementation phase of the DBFM project.

What then do these results tell us about the role of management in the implementation phase of the DBFM project? First, the prevalence of social events over physical events resonates with the argument of Aaltonen and Sivonen that "stakeholder related conflicts and incidents are among the most significant unforeseen risks in projects implemented in challenging environments" (2009:131). Second, the analysis shows that in the implementation, the primary focus of the contractor is on project activities so as to meet deadlines (cf. Edelenbos & Teisman, 2008) since exceeding those results in missing periodic payments by RWS, which negatively impacts the financial status of the project. Third, however, the contractor is dependent on the project's stakeholders for making progress in the implementation of the project. According to the concession contract, the contractor first needs to get the design requirements from the stakeholders, such as the municipalities and the HbR, after which it can design and plan the project's construction, which in turn has to be coordinated with the stakeholders. Only then can it start constructing the various elements of the project. These stakeholders have their own interests, and their internal processes are organized at their own pace. This means that, to a large extent, the contractor is dependent on the capacitance and willingness of the stakeholders. This dependency requires externally-oriented management. However, the same contract also encourages the contractor to deliver high-quality transportation infrastructure in a cost-efficient and rapid way. These are the main reasons for governments to use public-private partnerships, and to achieve this, the contractor is put at an arm's length from its principal so that he can deploy its skills as a project manager. During the implementation of the project, both management orientations are important, but the A15 highway DBFM project seems

to have had more of an internal orientation (cf. Edelenbos & Teisman, 2008). It seems that the contractor had not yet fully developed the management skills to deal with social events satisfactorily. Fourth, the study showed that RWS' involvement as an intermediary in the relationship between the contractor and the project's stakeholders was important for achieving more satisfactory outcomes. This means that the DBFM contract is not, in the words of some of the private managers, a "Bahamas contract" where the principal is totally unburdened.

The present study responded to the call in the literature to have more insights into what happens in the implementation phase of PPP projects (Jones & Noble, 2008; Mistarihi et al., 2013; Weihe, 2008b), and DBFM projects in particular (Klijn, 2009; Lenferink, Til-lema, & Arts, 2013b), although, of course, the findings of the study cannot be generalized to other DBFM projects. Our analysis suggests that, during the implementation phase, contractors are inclined to focus on project activities, instead of engaging with stakehold-ers, and that the DBFM contract encourages this particular orientation. However, these are as of yet suggestions that need to be corroborated with more comparative research.

5.5.2.   Reflection on the method

This study also contributes to the literature on the evaluation of infrastructure projects. While QCA has recently been suggested as a valuable method for this field, actual applica-tions of it still lack (cf. Verweij & Gerrits, 2015). The mvQCA analysis conducted here indicates several pros and cons of this approach. The main advantage is that QCA is a systematic comparative approach that allows a simultaneous focus on the differences and similarities between cases, thus striking a balance between paying attention to the unique aspects of cases and the identification of patterns. One implication of the configurational nature of QCA is, however, that different conclusions may be arrived at if a single case is added. Indeed, the three managers of the A15 highway DBFM project that would not be interviewed could have pointed at additional cases of events. If those cases represented (an) additional configuration(s), the minimization of the truth table would produce dif-ferent results. However, for the present study this effect is probably not too problematic since the interviews showed that the rate of increase of the number of events introduced by the respondents was declining. Also, with the exception of one configuration, the coverage (by cases) of the minimized configurations is quite strong. Another issue is that mvQCA requires that conditions are simplified into a few possible values. However, this may not be appropriate for more granular activities. For example, the activities of managers in responding to events are more complex than the distinction between being internally- or externally-oriented. To deal with this, future applications of QCA could adopt the fuzzy-set qualitative comparative analysis (fsQCA) subtype. The advantage of fsQCA is that more fine-grained scales, rather than just 0 or 1, can be used (Ragin, 2008a), although these scales may be more difficult to develop in grounded approaches. Finally, only a limited number of conditions can be included in a QCA: because the number of logically possible configurations increases exponentially with the number of conditions, the possibilities for

pairwise comparing cases decrease. This could be solved by adding more cases, although there are practical limits to the number of cases that (a) researcher(s) can manage to study.

5.6. CONCLUSION

The analysis and discussion are by no means intended to criticize the management of A-Lanes. For one thing, other important aspects, such as the decision processes involved in the management responses, could provide more insights into the thinking behind the choice to respond to events in an internally-oriented fashion. Also, the intention is not to judge the final performance and longer-term outcomes of the project: the interviews are a snapshot, and at the time of the interviews the project was still being implemented. These aspects need to be addressed in future research. The implication of the present study is that, whereas policy-makers, at least in the Netherlands, tend to (over)emphasize the potential benefit of DBFM to unburden government, construction companies may have not yet fully mastered the ability to manage relationships with local stakeholders that comes with this type of PPP. In procuring future DBFM projects, public managers may do well to recognize the stakeholder management capabilities of construction companies, as well as their own roles as intermediaries between stakeholders and the contractor in the process of implementing a DBFM project.

6 | Comparing the A2 and A15 Projects: Patterns and Explanations

This chapter is submitted to a journal

Implementing public-private partnerships: How management responses to events produce (less) satisfactory outcomes

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ABSTRACT

Most research on public-private partnerships focuses on the (pre-) contract phase. The phase after contracting has received less attention. However, sound agreements and good intentions can easily fail in the implementation phase that follows contracting. This is often due to the occurrence of unforeseen events and ineffective management responses to them. Based on two qualitative comparative studies of two large infrastructure PPPs, within which thirty-eight event-response-outcome combinations were identified, we found that externally-oriented responses and a cooperative stance produce satisfactory outcomes. In practice, however, management responses are often internally-oriented and non-cooperative, which results in less satisfactory outcomes. This article presents evidence for these patterns, explanations for them, and it indicates how implementation managers in PPPs can achieve satisfactory outcomes.

6.1.   INTRODUCTION

Public-private partnerships (PPPs) are about cooperation between governments and businesses (Selsky & Parker, 2005). Despite their debatable performance (Hodge & Greve, 2007; 2009), PPPs are becoming a prevalent practice (Bovaird, 2004; e.g., OECD, 2012). This is also the case for infrastructure projects (Kwak et al., 2009; Little, 2011). PPPs are expected to result in efficiency and quality gains, value-for-money, reduced pressure on government budgets (Kwak et al., 2009), and less delays and cost overruns in project delivery (Flyvbjerg et al., 2003; Little, 2011). However, these expectations are not always met. Jooste and Scott (2012:150) state that "the international experience of infrastructure PPP implementations has not been perfect" and Hodge and Greve (2007:545) hence argue that "despite their continuing popularity with governments" PPPs have to be studied and assessed "away from the policy cheerleaders". This article fits in that line of argumentation. Relatively new, however, is its focus on the implementation phase.

We know that the conceptual variegation of the PPP concept (Hodge & Greve, 2013; Klijn, 2010; Weihe, 2008a) gives rise to different forms and interpretations. Generally, however, a PPP can be defined as an enduring contractual relationship between two or more partners, of which at least one is a public body, in which both public and private partners bring some kind of resources (e.g., money, property, authority, knowledge) to the partnership, and in which responsibilities and risks (e.g., financial, economic, social) are shared for the purpose of delivering public infrastructure-based products and/or services (cf. Grimsey & Lewis, 2004). Literature reviews (Ke et al., 2009; Kwak et al., 2009; Tang et al., 2010) show that amongst the main researched issues are the formation of PPPs (e.g., Koppenjan, 2005), procurement, tendering, PPP finance, and risk allocation. These are mainly pre-contract phase issues. As Weihe, amongst others, found: "what happens after contracts have been signed […] has received [less] scholarly attention" (2008b:154). Scholars indicated that PPP implementation is a relatively under-researched topic (Jones & Noble, 2008; Mistarihi et al., 2013; Weihe, 2008a; 2009). Researchers studying the management of PPPs (e.g., Edelenbos & Teisman, 2008; Edelenbos & Klijn, 2009; Klijn et al., 2008) also tend to neglect the implementation phase of projects. Sound PPP project preparations, however, can easily be wasted during implementation. This article focuses on PPP implementation, and more specifically on management responses to unforeseen events.

Implementation starts after the negotiations between the partners are concluded in a contract. It is about the execution of a contract "in the form of infrastructure construction and/or service delivery" (Jones & Noble, 2008:109). In PPP implementation towards completion, public and private managers are confronted with a variety of unforeseen events, originating from the dynamic socio-physical context of PPP implementation (Mistarihi et al., 2013; Söderholm, 2008). Scholars on PPP management argue that literature is ambiguous about which kinds of management responses produce better outcomes (cf. Edelenbos & Klijn, 2009). It is assumed that managers choose strategies according to the 'logic of the situation'. How to pinpoint this logic is, however, still an unsolved research question

(Klijn et al., 2008). Our focus will be on 'unforeseen events' in "inherently unpredictable worlds" (March, 1994:36). We assume that these constitute obstacles for reaching satisfactory outcomes in project implementation (Müller-Seitz & Schüßler, 2013; Söderholm, 2008; cf. Van Gils et al., 2009).

We will focus on the relationship between management responses to unforeseen events and satisfactory outcomes: *(1) how do public and private managers respond to unforeseen events during implementation and which management responses produce satisfactory outcomes, and (2) how can it be explained that unforeseen events are often not responded to in these ways?* This question is answered by comparing and building upon the results of two case studies of two Dutch transportation infrastructure PPP project implementations, in which thirty-eight events were systematically and comparatively analyzed (Verweij & Gerrits, 2015; Verweij, 2015a). Our previous studies focused on the first part of the research question; this article focuses on the second part.

Sections 6.2 and 6.3 provide a substantive and empirical background of the case studies. We will elaborate the concepts of unforeseen events, management, and high and low satisfactory outcomes. We will also present a brief sketch of the two infrastructure PPP implementations that are compared in this article: the A2 Maastricht and the A15 Maasvlakte-Vaanplein (MaVa). The research approach that was applied is presented in Section 6.4. Section 6.5 summarizes and compares the relations between the thirty-eight events, the management responses to them, and the outcomes in the two implementation processes, thereby addressing the research question. Section 6.6 articulates the implications of our findings for the management of PPP implementation.

6.2. THE NATURE OF PPP

PPPs in infrastructure emerge in various shapes and sizes (e.g., Kwak et al., 2009). Within the general definition presented above, scholars differentiate between concession and alliance models (Edelenbos & Klijn, 2009; Koppenjan, 2005). In the first model, the "PPP takes the form of a turnkey project in which a private party designs, finances and constructs a public sector project" (Koppenjan, 2005:137). Alliances, in contrast, involve cooperation between public and private parties throughout the whole (implementation) process. Although both types involve contracts between public and private organizations and the monitoring of compliance, the alliance model is said to put less emphasis on contracts (Edelenbos & Teisman, 2008).

6.2.1. Unforeseen events

Implementation is challenging. It has to be achieved in dynamic socio-physical contexts in which unforeseen events will occur (Gerrits, 2012; see also Müller-Seitz & Schüßler, 2013; Van Gils et al., 2009). Unforeseen events often have an impact on implementation (Söderholm, 2008). PPP projects are no exception; they are not context-independent

'islands' (Engwall, 2003) but rather open instead (e.g., Papadopoulos, 2012; cf. Dimitriou, Ward, & Wright, 2013). Naturally, contingency plans are drafted in order to deal with dynamical contexts. These plans are "repositories of expectations on which managers build their daily activities" (Söderholm, 2008:81). They help managers to focus and they guide their actions. By the same token, plans also 'neglect expectations' as they cannot foresee all possible future eventualities. There are limits to predictive and planning capacities, no matter how much information is analyzed (Gerrits, 2012). Consequently, some events will be unforeseen (cf. Söderholm, 2008), thus challenging implementation managers.

The extent to which an event is unforeseen depends on the position of project planners and managers. Events even can be unforeseen by one person and expected by someone else (cf. Rescher, 1995). This does not diminish their potential disruptive effect on implementation, as long as those working in project implementations did not recognize its coming. Unforeseen events are non-stochastic and out of reach of contingency planning, because – contrary to planning for stochastic events in terms of risks – the likelihood of their occurrence is unknown and undetermined. They could not be anticipated, even in the realm of contingency planning.

It is useful to distinguish between two categories of unforeseen events (Van Gils et al., 2009). Events can originate from physical sources, like unstable ground conditions. They can also originate from social sources, such as dissatisfied stakeholders (e.g., citizens, municipalities, or other governmental organizations) or changing laws and regulations. Aaltonen and Sivonen (2009:131) argue that "stakeholder related conflicts and incidents are among the most significant unforeseen risks in projects implemented in challenging environments." During implementation, stakeholders are mostly concerned with "the influence of construction activities on their daily routine activities and life style" (El-Gohary et al., 2006:596). It can be expected that unforeseen events from social sources will need specific managerial responses (cf. Allison, 1983; Ring & Perry, 1985).

6.2.2. Management responses to unforeseen events

Managers often respond to the events by trying to control them or to keep them outside 'their implementation trajectory' (Van Gils et al., 2009). This is one of the responses we are going to elaborate. Drawing on the PPP management literature (e.g., Edelenbos & Klijn, 2009; Klijn et al., 2008), this response is identified as an internally-oriented focus on the project. It is rooted in traditional management models focusing on "structure, administrative systems and the execution of plans" (Söderholm, 2008:81). It is related to 'project management' characterized by a closed, project-inward orientation. The emphasis is on speeding up implementation, mainly by explaining and promoting the project interest. The management persists on achieving pre-determined goals despite unforeseen events. Communication takes a DAD-strategy (decide, announce, and defend).

Alternatively, an externally-oriented response can be applied, emphasizing interaction with the societal environment (cf. O'Toole, Meier, & Nicholson-Crotty, 2005). This response relates to 'process management' approaches (De Bruijn, Ten Heuvelhof, & In't Veld,

2010). It is characterized by an outward orientation, aiming to create or maintain support for the project implementation. Possible solutions are sought together with stakeholders. The management is receptive and flexible towards unforeseen events, and communication takes a DDD-strategy (dialogue, decide, and deliver). Because of its stakeholder-oriented nature, this response can be applied to social events (see, e.g., Edelenbos et al., 2009).

The other dimension of the management response concerns the way public and private partners are involved in the response. We discern three possibilities. Some events are responded to by the public partner; others are responded to by the private partner. This depends on how risks and responsibilities are perceived and allocated in the PPP. A third option is that the partners develop a joint response (Jones & Noble, 2008; Verweij & Gerrits, 2015).

6.2.3. Satisfactory outcomes

Management responses to events produce outcomes. The most common variables for measuring project outcomes concern measures such as efficiency and value-for-money. They, however, can hardly be used in situations wherein projects have not yet reached their stage of delivery and exploitation. Nevertheless, managers will need to assess the quality of the implementation process (cf. Kärnä et al., 2013; Lehtiranta et al., 2012). Indicators like stakeholder satisfaction, incurred costs, time schedule, partner's behavior, and the perceived quality of mutual relations, can serve as next bests (cf. Atkinson, 1999; Jeffares, Sullivan, & Bovaird, 2013). We therefore used self-reported 'managers' satisfaction'. This is a measure of which the importance is increasingly recognized as a way to assess the quality of the implementation process, as it captures the heterogeneous nature of what constitutes successful implementation (cf. Dimitriou, 2014; Kärnä et al., 2013; Lehtiranta et al., 2012). We distinguished between low and high satisfaction.[46]

6.3.   INFRASTRUCTURE PPPS IN THE NETHERLANDS

The concessional form of Design, Build, Finance, and Maintain (DBFM) contracts is promoted in the Netherlands (e.g., Committee PFI, 2008) and in the U.K. Private Finance Initiative (PFI) (Klijn et al., 2007). The number of projects fitting this framework is increasing. To date, however, not many of them have been realized (see Committee PFI, 2008; Klijn, 2009; Ministry of Finance, 2012). In this article, we use the data about the Dutch DBFM project A15 MaVa. The alliance model is less promoted by the national government. In this article, we use the data about the alliance-like project A2 Maastricht.

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46   Others additionally have argued that satisfaction is also a key factor for final project performance (Kärnä et al., 2013; Leung, Ng, & Cheung 2004).

6.3.1. Two PPP transportation infrastructure projects

The A2 Maastricht project has an alliance-like model. It involves the construction of a 2.3 km tunnel underneath the city of Maastricht on the A2 highway corridor, combined with real estate development and landscaping, and the rearrangement of adjacent highway junctions. Partners are the Dutch highway authority Rijkswaterstaat, the Province of Limburg, the Municipalities of Maastricht and Meerssen, and the private consortium Avenue2, wherein the companies Strukton and Ballast Nedam participate. The implementation started with a Design and Construct (D&C) contract, which was signed in 2009. The execution is planned to be finished in 2017.[47] Rijkswaterstaat sponsors € 564 million; the other three public partners contribute € 144 million, including plots for real estate development (Ministry of I&M, 2013). The development of real estate is expected to cover ten percent of the execution costs (about € 70 million) (Lenferink, Tillema, & Arts, 2013a). The private partners have to recoup a substantial part of their investments from selling this real estate. An unusual expression of the alliance approach is that the public and private project organizations are housed in the same building. They even run a joint department responsible for the communication with various local stakeholders (Projectbureau A2 Maastricht, 2012; Verweij, 2012a).

The A15 MaVa project is a DBFM contract. It involves the extension of the 37 km highway corridor from the Rotterdam port area 'Maasvlakte' to the 'Vaanplein' crossing in the Rotterdam highway ring. Its scope encompasses the application of a traffic management system, 85 km of highway lanes, a new Botlekbridge, and the renovation and reconstruction of civil works (e.g., flyovers, tunnels, and bridges) on the corridor. The implementation partners are Rijkswaterstaat and the construction consortium A-Lanes A15, consisting of Strukton, Ballast Nedam, John Laing, and Strabag. The DBFM contract was signed in 2010. The construction is to be finished in 2015; the maintenance contract will last until 2035.[48] The budget is nearly € 2,000 million (Ministries of I&M, EL&I, & BZK, 2012); the construction costs are about € 1,400 million (Lenferink, Tillema, & Arts, 2013a). The opportunities for a viable business case are in the financial constructions between A-Lanes A15 and its funders, and in lifecycle optimization, which should gain the concessionaire some profits. Contrary to Maastricht, the relation between A-Lanes A15 and Rijkswaterstaat is concessional. The emphasis of Rijkswaterstaat is on monitoring the performance of A-Lanes A15 with regard to availability, quality, and stakeholder satisfaction. Based upon this, A-Lanes A15 receives availability fees that co-finance the project.

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47 See http://www.a2maastricht.nl/nl/plan/vooruitblik.aspx (last accessed 2014-12-09).
48 See http://www.verbredinga15.nl/public/A15/hetproject/Paginas/Mijlpalen.aspx (last accessed 2014-12-09).

6.4. RESEARCH APPROACH

6.4.1. Data collection

The main data of the case studies comes from open qualitative interviews conducted with public and private senior project managers and directors. Eighteen interviews with fourteen respondents (average: 80 minutes) were conducted for the A2 project from September to December 2011. Twenty interviews with seventeen respondents (average: 77 minutes) were conducted for the A15 project from May 2012 to January 2013. All interviews were recorded and fully transcribed. This data collection was performed by the researcher.

This method was used for two reasons. First, unforeseen events cannot be identified beforehand through some evaluator's predefined theory (cf. Van Marrewijk et al., 2008). Events have to be identified by asking interviewees in an elaborative way (e.g., Weiss, 1994). Second, managers' responses to events they face have to be detected by asking how they responded and how satisfied they were with the outcomes, instead of filling out pre-defined categories. The abovementioned categories (Section 6.2) were formed in a grounded way through the analysis (Verweij & Gerrits, 2015).

6.4.2. Data analysis

The data analyses consisted of several steps. First, the interviews were qualitatively analyzed with ATLASti coding software: the transcripts were coded for the events, including management responses and satisfaction as reported by the respondents. Determining the unforeseen nature of an event, and the relationship between events, management, and satisfaction, was substantiated in ATLASti. The second step concerned cross-comparing the interviews per event identified, which was facilitated by coding in ATLASti. This resulted in eighteen (A2 Maastricht) respectively twenty (A15 MaVa) combinations of unforeseen events, management responses, and outcomes. The relational patterns between the three elements were reported qualitatively in earlier publications (Verweij & Gerrits, 2015; Verweij, 2015a).[49] These thirty-eight events were analyzed as embedded cases within the two project cases. Subsequently, the categories presented earlier were developed from these cases and linked with literature.

Third, multi-value qualitative comparative analysis (Cronqvist, 2004; Cronqvist & Berg-Schlosser, 2009; Cronqvist, 2011), often abbreviated as QCA, was applied. QCA is a configurational approach (Fiss, 2007). It provided a systematic method to comparatively analyze the thirty-eight events. Its configurational nature highlights combinations of management responses to events. QCA understands the event cases as configurations of aspects (i.e., the source of the event, the nature of the management response, and the public-private cooperation), and then compares empirically present configurations that agree on the outcome (i.e., satisfaction) and differ in just one aspect. This was done sepa-

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49   Additional triangulation with other data sources, such as project-internal management documents, was not possible. These sources were not made available.

rately for each project case. The aspect in which two configurations were different could be considered redundant for explaining the outcome. E.g., if two configurations have high satisfaction, and one concerns a social event with an internally-oriented management response where the private partner acted autonomously, and the other also concerns a social event where the private partner acted autonomously but with an externally-oriented management response, then we infer that the response (internally- or externally-oriented) is not needed for explaining satisfaction: the private actor's autonomous responses to social events produce low satisfaction. This comparative process resulted in patterns of management responses associated with satisfaction or dissatisfaction with how the event was responded to.

These patterns are presented in Table 6.1 (see also Verweij & Gerrits, 2015; Verweij, 2015a). In this article, we will build upon these patterns, trying to explain them by comparing the two project cases.

Table 6.1 Summary of the patterns found in the two studies

Satisfaction	Management responses		Source of the event	Identified events*		Pattern
	Nature of the response	Cooperation				
Low	Internal		Social	9	(A15 MaVa)	A
Low	Internal	Private actor autonomously		6	(A2 Maastricht)	B
				7	(A15 MaVa)	
High	Internal	Public actor autonomously		2	(A2 Maastricht)	C
High	Internal	Cooperation between partners	Physical	1	(A2 Maastricht)	D
High	Internal	Public partner intermediates	Physical	1	(A15 MaVa)	E
High	External		Social	9	(A2 Maastricht)	F
				7	(A15 MaVa)	

* The table contains 42 cases because 4 cases of the A15 MaVa project are both in configuration A and B.

6.5.   PATTERNS AND EXPLANATIONS FOR ACHIEVING SATISFACTORY OUTCOMES

We present two examples of the patterns summarized in Table 6.1 (see for a complete overview: Verweij, 2015a; Verweij & Gerrits, 2015). In one case, the Municipality of Rotterdam (a local stakeholder) disapproved the Botlekbridge pillars construction (event from a social source). A-Lanes A15 responded by searching for technical solutions, to maintain project speed (internal response), by itself (private actor acts autonomously). The Municipality disapproved again, resulting in delays and extra costs. Whether this will

eventually result in further cost overruns and delays remains to be seen. Crucial for us is that the involved managers were dissatisfied with the costs and delays (low satisfaction). In another case, A-Lanes A15 also responded internally and autonomously, also resulting in low satisfaction, but it concerned a situation where the ground conditions nearby an underground pipeline street were worse than expected (event from a physical source). Both cases represent pattern B in Table 6.1.[50] The table summarizes the results of the comparison of the event-response-outcome combinations. It presents two patterns associated with low satisfaction (patterns A and B), and four with high satisfaction (patterns C, D, E, and F). It also shows that events are more often satisfactorily responded to in the A2 than in the A15 project implementation.

Next, the results are explained and interpreted by comparing the projects. Patterns that complement each other are presented and discussed together. Section 6.5.1 focuses on the nature of the management response and Section 6.5.2 focuses on the public-private cooperation.

6.5.1. Internally- and externally-oriented management in responding to social events

There are two important findings on the management response. Pattern F indicates the strong relation between social events, externally-oriented management, and higher outcome satisfaction. Pattern A indicates the strong relation between internally-oriented management of social events and lower satisfaction. The two are contrasts, indicating externally-oriented management as effective responses to social events. These findings corroborate research by Edelenbos and Klijn (2006; 2009), who found that management approaches that emphasize flexibility, openness, and interaction with the societal environment, result in more satisfactory outcomes than approaches that stress the execution of projects according to plans, specified goals, and contractual relations, and that tend to develop a more internal orientation. The A2 project's management responses were more often externally-oriented: in nine out of eighteen events the management responses were externally-oriented. In the A15 project, seven out of twenty responses were externally-oriented (pattern F in Table 6.1).

The first explanation for this difference between the two project cases concerns the difference in time pressure experienced. Several managers in the A15 experienced time pressure in the implementation. Instead of 'being in control' they regularly felt 'lived by' the project's dynamics. The private A15 project director talked about impending budget overruns. Under conditions of (perceived) time pressure, engaging in interactive processes with stakeholders (externally-oriented management responses) feels as time-consuming. Under these conditions, managers aim for quick solutions within their reach (internally-

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50   An empty cell in this table means that the aspect is 'unnecessary' for explaining the outcome. For instance, the empty cell in the column 'source of the event' of pattern B indicates that the pattern 'internally-oriented management and a private actor responding autonomously' is associated with low satisfaction, irrespective of the event's source.

oriented). For example, when the Municipality of Rotterdam did not approve the construction design of the Botlekbridge pillars, being unconvinced of the pillars' strength for carrying the bridge decks (social event), A-Lanes A15's management response aimed to minimize the effect(s) of the event on the project planning by finding a technical solution to the problem and ordering steel for the bridge (internally-oriented response), although the Municipality had not yet approved the design. This response generated financial risks and low satisfaction. In another case, A-Lanes A15 constructed a temporary road for transporting hazardous substances without coordinating the road design (internally-oriented) with the Port of Rotterdam Authority (another local stakeholder). Later, the Authority disapproved the road which generated low mutual satisfaction.

The A2 Maastricht project provides a contrasting picture. In interviews, the private project director showed confidence in progress towards completion. The interviewed managers exhibited less signs of stress and time pressure. At the same time, quite a lot of time was spent on engaging with stakeholders after a social event occurred. For instance, when a local vocational school objected to the phasing of a road bypass during construction (social event), an elaborate informal negotiation process with the school was started (externally-oriented response), resulting in the cancellation of the school's objection and the maintaining of good rapport between the school and the project organization (high satisfaction). The responses to unforeseen social events in the A2 project were often externally-oriented. The managers recognized the importance of stakeholders and invested in the relationships with them. This comparison of the two projects indicates that time pressure reinforces internally-oriented responses which, in the occurrence of social events, often results in dissatisfactory outcomes.

The time pressure explanation can also be found in the literature (cf. Edland & Svenson, 1993). When managers experience time pressure, they draw boundaries in attempts to reduce the complexity of implementation. Information is filtered and ignored (Edland & Svenson, 1993), which allows managers to 'ration attention' (March, 1994) so as to get 'in control'. This simplification is inherent to coping with unforeseen events (Gerrits, 2012; Van Gils et al., 2009). When time pressure increases, focused approaches aiming to get control over implementation are attractive to choose. However, when the societal environment is excluded in responding to an unforeseen event, stakeholders' interests and influence can be overlooked. They can then come back to the managers later on at higher costs. If so, the internally-oriented management response is actually becoming ineffective.

A second explanation for more external oriented responses in the A2 project concerns the organization of stakeholder involvement. This can be explained from the different project scopes (see Verweij et al., 2014). The A2 is about inner-city infrastructure development. It benefits the citizens of Maastricht regarding traffic safety, environmental quality, and traffic congestion. Local actors, such as the municipalities, citizens, and businesses, were facing the negative externalities during implementation (e.g., noise nuisance and limited accessibility during construction), but also the possibilities of prospective revenues, e.g., more safety and environmental quality, and less traffic congestion. The project

was not only about connecting A to B; it was about regaining city qualities. This way of framing seems to be crucial.

The Municipality of Maastricht was partner in the PPP, and was committed to involving local stakeholders in planning, procurement, and implementation. Local stakeholder platforms and citizens had a say in deciding on which project bid would win, and during implementation stakeholders were actively informed about and involved in the project.

In contrast, the A15 MaVa project is not intended nor presented as regional development. It was 'just' an improved connection between A and B. This creates no support amongst local stakeholders. This also tends to reinforce internally-oriented approaches in which stakeholders are external to the project. Nearby residents and municipalities experienced negative externalities during implementation, without positive effects in the future.

In addition to this, the applied concession model created an indirect relation between private management and stakeholders. Stakeholders do have implementation agreements, but with the procurer Rijkswaterstaat. These agreements were included in the DBFM contract between Rijkswaterstaat and A-Lanes A15. Rijkswaterstaat assumed that they had transferred their relationships with stakeholders to A-Lanes A15, who is responsible for implementation (see Verweij et al., 2014).

Local municipal authorities were also at arms-length of the implementation. They were not able to translate stakeholder issues into the project. The issues only found a way out through external events. After citizens complained (to their own municipality) about noise nuisance, the municipality forced A-Lanes A15 to stop pile driving works. In the A2 project, it seemed that internalizing local stakeholder interests into the partnership allowed for proactive and attuned joint actions.

This comparison suggests that in projects with a broader scope of transportation and urban development, where multiple stakeholders are involved in implementation, stakeholder interests are better served, creating also satisfactory outcomes for the implementation managers themselves.

The effectiveness of stakeholder involvement can also be found in the literature, where it is emphasized that involvement is important because actors whose interests are harmed can easily block or hinder implementation (Edelenbos & Klijn, 2006; Koppenjan & Klijn, 2004). Whereas that literature implies that less unforeseen social events may occur when stakeholders are effectively involved, recent research (Verweij et al., 2013) additionally shows that stakeholder involvement, combined with an externally-oriented management, results in satisfactory outcomes.

6.5.2. Public-private cooperation in responding to events

Table 6.1 presents four patterns that indicate public-private cooperation in response to events: patterns B, C, D, and E. These patterns generate additional information and knowledge. Pattern B states that internally-oriented responses by a private partner result in low satisfaction. Patterns C, D, and E, however, indicate that internally-oriented

management can result in high satisfaction. This is an important and intriguing finding. Satisfaction requires that the public partner is also involved in responding to the event.[51] Governments can compensate a private internal orientation.

These findings indicate that joint public-private actions in response to unforeseen events result in higher satisfaction. Joint action may mitigate the internally-oriented response of one of the partners (cf. Jacobson & Choi, 2008; Mistarihi et al., 2013).

The two project cases show a quite different relationship between the public and private partners. In the A2, signing the contract was perceived as the start of actually working together. In the A15, signing the contract was perceived as the moment of transferring responsibilities and risks from the public to the private partner. The public actor was only prepared to play a partnership role as intermediary between A-Lanes A15 and stakeholders in the environment (pattern E in Table 6.1), and only after the tension between project and stakeholders got high (see also Verweij, 2015a).

In both projects, the private partners were primarily concerned with maintaining a financially viable business case. Projects have to be realized within time and budget, according to quality standards contractually agreed upon. In the A15 project, the business case strongly depends on fees that will be received after the project's construction is finished. In the A2 project, the business case depends on the possibilities of urban development on top of the new tunnel. This also creates sensibility for the city.

In both projects, the public partner Rijkswaterstaat followed a businesslike, formal approach. This was reflected in Rijkswaterstaat's role perception in the PPPs, which mainly concerned contract monitoring and project control. In the A2 project, however, the managers from the municipality applied another approach and were able to compensate the Rijkswaterstaat way of working. These managers were much more socio-politically oriented and not only focused on contract monitoring and project control. The A2 project director had a longstanding career as manager and director of urban development projects in Maastricht, and the project's stakeholder manager was in close contact with the Maastricht alderman. The municipal managers brought to the partnership local ways of working, characterized by open and informal relationships with private partners. The cooperation of local (municipal) and national (Rijkswaterstaat) public managers created a project culture with a unique and joint set of norms, values, and principles tending towards partnership (Verweij, 2012a). According to respondents, the open and informal public-private partnership culture in the A2 project was also instigated by the proximity of the public and private management: they were housed in the same building. Whereas the informal relationship and the proximity were regularly stated in the A2 Maastricht interviews as success factors for implementation, in the A15 MaVa interviews, in contrast, the businesslike (formal), tense, and remote nature of the relationship was stressed (see also KING, 2009).

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51 Note that pattern C could be considered an 'odd one out' as these situations did not actually concern project implementation events, but pre-contract events. This can be explained by the particular planning process of the A2 Maastricht project, where procurement and public planning were intertwined (see Van Valkenburg & Nagelkerke, 2006). Given our definition of project implementation (see Section 6.1), because the PPP contract was closed before public planning procedures were finalized, the two events were included in the analysis.

This partnership culture explanation is also found in the PPP literature, often by reference to the two PPP models that underlie the projects. Scholars argue that the concessional model (found in the A15 project) "is not a real partnership because co-production is limited, risk-sharing is absent, and relationships are purely contractual" (Weihe, 2008b:157). The argument is that the strict demarcation between public and private actors, anchored in contracts, discourages co-operation. So, the advantages of not blurring different value systems (Jacobs, 1992), by which public and private sector actors are governed (cf. Ring & Perry, 1985), can easily become a hindrance for stakeholder involvement and externally-oriented approaches. This is also an intriguing finding. In the alliance model, the demarcation between the partners is less strict, generating fears about corruption by some, but also facilitating satisfactory cooperation in implementation. Governments are more intensively involved, taking care of public interests after unforeseen events emerge (Edelenbos & Teisman, 2008).

6.6. CONCLUSIONS AND DISCUSSION

6.6.1. Conclusions

How do public and private managers respond to unforeseen events in implementation? Which management responses produce more or less satisfactory outcomes? And what can explain these patterns? These are the questions we set out to answer in the introduction of this article. Based upon two qualitative comparative project analyses of a total of thirty-eight identified cases of unforeseen events in two major Dutch PPP infrastructure project implementations, conclusions can be drawn. The first is that externally-oriented management responses to social events result in satisfaction, and internally-oriented management responses to social events do not (Edelenbos & Klijn, 2009). The second, however, is that internally-oriented management responses can also result in satisfaction, but that this requires a public partner to be involved so as to intermediate between the management and the environment. This insight emphasizes the importance of cooperative management in PPP implementation. A third conclusion is that managers often apply internally-oriented and autonomy-seeking responses to events.

By comparing the two projects, we found some intriguing explanations for these phenomena. First, the combination of local and national management cultures in the A2 Maastricht project resulted in a unique externally-oriented and cooperative PPP approach, different from the normal way of working of Rijkswaterstaat. Such a combination was absent in the A15 project, where cooperation was restricted by the concessional DBFM contract. Consequently, cooperative action only happened reactively when tensions were already high (see also Verweij, 2015a), resulting in an implementation that is experienced as stressful.

A second explanation is time pressure. A characteristic of PPP implementation, i.e., the project construction and delivery, is the increasing time pressure. After contracting,

when the project "starts rolling" (Jones & Noble, 2008:109), time is experienced as more pressurized. This pressure is felt by managers, which explains their inclination towards internally-oriented and autonomy-seeking responses (cf. Gerrits, 2012).

Third, although excluding local stakeholders from the implementation scheme seems attractive in advance because it seems to simplify implementation, in practice, however, this may generate a project-inward orientation and (hence) unforeseen social events. Internalizing local stakeholders as partners in the partnership seems to pay off.

6.6.2.   Discussion

The patterns and explanations for achieving satisfactory outcomes in PPP project implementation are based upon two case studies from the Netherlands. Although more comparative research is thus needed to corroborate the conclusions, our research points to several implications for PPP project implementation.

Because events mostly have social sources, and because they are best responded to with externally-oriented management responses and public-private cooperation, allocating sufficient recourses (e.g., time, attention, money, personnel) to stakeholder management, and to managing the public-private partnership itself, is important (El-Gohary et al., 2006; Jones & Noble, 2008; Mistarihi et al., 2013) in avoiding bigger problems and greater costs later on. The importance of these aspects is easily overlooked or underestimated, because staying in control of planning and budget during PPP project implementation requires managers' full attention. Keeping the project 'under control' is strived for through different monitoring mechanisms deployed by public principals. Although these mechanisms are indisputably important – inter alia for safeguarding public values as quality, accountability, and transparency (Reynaers, 2014), and the prevention of ambiguous relationships between the partners – the danger in implementation is that monitoring becomes the sole focus. Consequently, stakeholders and their interests and influence on the project may be missed (Dimitriou et al., 2013). The clear division of tasks, risks, roles, and responsibilities is stressed but our study shows that investment in cooperation, and the closer involvement of local stakeholders (such as municipalities) in the partnership, so as to achieve mutual satisfactory results, is equally important.

It would also be worthwhile researching more flexible contract structures. It was in fact suggested in the interviews that the integrated area development approach of the A2 Maastricht project generated fewer stress-sensitive incentives and allowed more flexibility, because the profits are in the development of real estate, and private contractor Avenue2 was given some degree of flexibility in planning the exact construction of the real estate, i.e., to build real estate when there is a favorable market for it. Perhaps such characteristics can also be incorporated in concessional PPP models, thus creating more flexibility in project implementation.

Public agencies are increasingly looking to DBFM for the delivery of public works and services (e.g., Rijkswaterstaat, 2011). We understand the attractiveness of the concessional model. It promises the advantages of partnerships and simultaneously the separation of

the public and private domains to prevent intransparency and corruption. We understand and support these values. At the same time, our research suggests, although this should be corroborated with further studies into DBFM projects, that there are other PPP models more prone to externally-oriented management and public-private cooperation, resulting in more satisfactory outcomes during implementation. The alliance model seems more flexible in the sense that it facilitates externally-oriented management and public-private cooperation. Of course, it remains to be seen whether the more contractual and non-cooperative approach, that characterized the concessional model in project implementation, also explains poor project performance (in terms of, e.g., quality, cost overruns, and time delays) at the delivery of the total project. More research is needed for this. However, our broader message here is that policy-makers may do well tempering their enthusiasm for DBFM a bit and to take a critical attitude towards it (cf. Hodge & Greve, 2007), or at least to bear in mind that the concessional DBFM model is not the only way to advance in infrastructure project realization. Other PPP formats may have certain advantages over DBFM.

PART 4

Cross-Project Analysis of Multiple Infrastructure Project Implementations

The basic rationale of Chapter 7 is to evaluate to what extent the management patterns and explanations, found in Part 3 of this thesis, are also found in a larger set of PPP infrastructure project implementations (i.e., the fourth and fifth sub-questions). This shift from the studies of the two project implementations of the A2 Maastricht and the A15 MaVa, via a comparison of them, to a comparison of the implementation of a medium number of projects, can be imagined as a T-structure: the 'leg' of the T represents the two studies and the 'roof' represents the comparison of multiple project implementations. This research strategy from in-depth to cross-case has been proposed as a meaningful way to study complexity (Buijs et al., 2009).

In addition to evaluating whether the management patterns found in Part 3 are reproduced in a medium-n of project implementations, Chapter 7 is also an attempt to evaluate whether different management patterns can be found in different kinds of projects, in terms of contract, scope, and size. The chapter has been submitted to a journal.
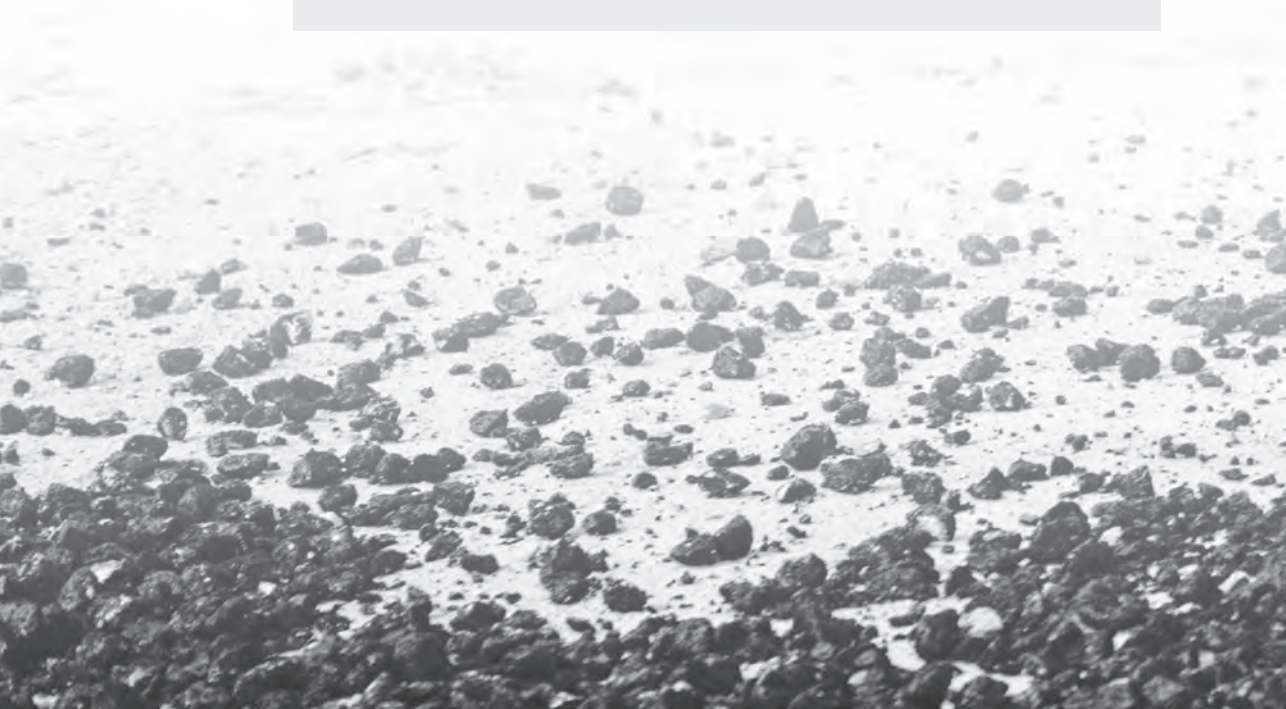
7 | Management and Cooperation in Different Kinds of Projects

Stefan Verweij

ABSTRACT

An understudied but important aspect of the successful completion of infrastructure projects is the extent to which they are satisfactorily implemented. This article, therefore, examines how satisfactory outcomes are produced in the implementation phase of infrastructure projects. To this purpose, twenty-seven Dutch road construction projects are systematically analyzed with fuzzy set qualitative comparative analysis (fsQCA). The results indicate that externally-oriented management and close public-private cooperation are positively associated with satisfaction. Moreover, in projects with a narrower scope, cooperation can also be more contractual and less close. This article concludes that public and private partners interactively working together, and a stakeholder-oriented project implementation approach, result in satisfactory outcomes. In less complex projects with narrower scopes, the partners may rely on less interactive forms of cooperation, more characterized by monitoring contract compliance.

7.1. INTRODUCTION

Implementing infrastructure projects, such as highways, railways, tunnels, and bridges, is complex. Government policies require that projects are implemented in public-private partnerships (PPPs), using innovative contract types such as Design, Build, Finance, and Maintain (DBFM), with minimal impact on the environment (in terms of, e.g., noise nuisance and road availability) and maximum quality, and for as low as possible budgets. Rijkswaterstaat, the major public procurer of transportation infrastructure in the Netherlands, is a case in point (Rijkswaterstaat, 2014). It has a "the market unless" policy, wants to double its number of DBFM projects by 2020, aspires being a "public-oriented network manager" (Metze, 2010), and it wants to attain the same or higher levels of production (i.e., road construction and maintenance) with smaller budgets (Rijkswaterstaat, 2008, 2011). The construction of projects is also complex in itself (Baccarini, 1996; Bertelsen, 2003), involving many stakeholders with different and sometimes unforeseen changing interests, a multitude of regulatory frameworks and restrictions, and complex and sometimes unplanned physical and technical situations (De Bruijn & Leijten, 2008; Hertogh & Westerveld, 2010; Teisman, Westerveld et al., 2009; Verweij & Gerrits, 2015). Hence, if not managed successfully, obtained or anticipated gains in the planning, procurement, and contracting of infrastructure projects might easily be lost in the implementation (i.e., construction and delivery). Implementation, however, is a relatively under-researched topic in the literature. Research on PPPs in construction focuses instead on planning and pre-contract issues (Jones & Noble, 2008; Weihe, 2008b), especially procurement, tendering, risk allocation, and PPP finance (Ke et al., 2009; Kwak et al., 2009; Tang et al., 2010). Therefore, this article studies how infrastructure projects can be successfully implemented.

Building on PPP management literature (Edelenbos & Klijn, 2009; Edelenbos & Teisman, 2008; Verweij, 2015a), the focus is on the management orientation and the public-private cooperation as explanatory conditions for successful implementation. Research, mostly case studies (e.g., Verweij, 2015a; Verweij & Gerrits, 2015), has stressed the importance of externally-oriented management approaches, and close and informal public-private cooperation. However, infrastructure projects are no one size fits all; e.g., a DBFM contract may require different cooperation and management orientations than a Design and Construct (D&C) contract. This article, hence, investigates whether different kinds of infrastructure projects – in terms of contract type, project scope, and project size – may be (or need to be) managed differently to have a successful implementation process.

An important issue here is the measure of success. Concerns have been raised in the literature as to how success should be defined. It is increasingly argued that the complexity of infrastructure projects, involving multiple stakeholders with different interests, requires measures beyond the iron triangle's cost, time, and quality (e.g., Atkinson, 1999; Dimitriou et al., 2013; Jeffares et al., 2013); the iron triangle does not capture well the complexity of what may constitute a successful project implementation. For instance, infrastructure projects may be completed within time and budget and according to specifications, but

public values such as transparency or accountability (e.g., Reynaers, 2014) may have been impaired, the public-private relationship may be strained, or external stakeholders' interests may have been harmed by the project. To capture the heterogeneous and subjective nature of success in infrastructure project implementation, the concept of 'satisfaction' is deployed (cf. Kärnä et al., 2013; Lehtiranta et al., 2012; Verweij, 2015a; Verweij & Gerrits, 2015). The central research question of this article thus is: *which combinations of management and public-private cooperation, in different kinds of infrastructure projects, produce satisfactory outcomes in the implementation phase?*

Another important issue is the research approach to this question. To understand how satisfactory outcomes in complex project implementation processes are actually produced, scholars have called for more contextualized, practice-oriented approaches to project management research (cf. Blomquist et al., 2010; Cicmil et al., 2006). Nevertheless, research on construction management still lacks a focus on project implementation in a contextual perspective (Hu, Chan, Le, & Jin, 2013). Case studies that are conducted can provide valuable in-depth insights into the complexity of infrastructure project implementation (cf. Blomquist et al., 2010). However, their findings are often difficult to generalize, exactly because the uniqueness and complexity of the infrastructure projects is emphasized in the case studies (Verweij & Gerrits, 2013). What is hence needed is research that strikes a balance between highlighting the unique aspects of projects, and the commonalities between them. This article studies a medium-n of project implementations, allowing for limited generalization. It applies fuzzy set qualitative comparative analysis or fsQCA (Ragin, 2008a), a methodological approach that was recently proposed for infrastructure project research (Verweij & Gerrits, 2013), that is well-suited for studying a medium-n of cases and limited generalization.

This article is further structured as follows. In Section 7.2, the background of the research is briefly presented, providing the framework for the analysis. Section 7.3 presents and explains the data and methods. The analysis and results are provided in Section 7.4. Section 7.5 comprises the discussion of the results, including some reflections on the study and the method. Conclusions are drawn in Section 7.6.

7.2. MANAGING INFRASTRUCTURE PROJECT IMPLEMENTATION

In their study of eighteen large, complex infrastructure projects, Edelenbos and Klijn (2009) made a distinction between project management and process management (see also De Bruijn et al., 2010; Edelenbos & Teisman, 2008). Project management is characterized by a closed, internal project orientation. Indicators are that minimal information is provided to the stakeholder environment about the project's progress, the emphasis is on making progress by speeding up processes, solutions for problems are sought in the project organization so as to promote the project interest, management persists on achieving pre-determined goals regardless of changing circumstances, and communication

to the stakeholder environment takes a DAD-strategy (decide, announce, and defend) (Edelenbos & Klijn, 2009). This internally-oriented approach is often associated with traditional modes of management that emphasize the iron triangle measures of success (Edelenbos & Teisman, 2008). Implementing infrastructure projects, however, does not happen in isolation. They are implemented in a social context of external project stakeholders. Because these stakeholders, such as municipalities or interest groups, can hamper or advance project implementation (Olander & Landin, 2005), for example by granting or not granting permits, this creates interdependencies between the internal and external project stakeholders. This idea is well-documented in network management theory (Koppenjan & Klijn, 2004) and stakeholder (management) theories (see Atkin & Skitmore, 2008). The process management approach embodies the idea that stakeholder interests in project implementation should be prominently addressed because of the interdependencies (De Bruijn et al., 2010; Edelenbos & Klijn, 2009). It is characterized by an open, external project orientation. Indicators are (see Edelenbos & Klijn, 2009) that the project is accessible to interested parties, the emphasis is on creating or maintaining support for the project, solutions are sought together with external stakeholders if possible, management is receptive and flexible to changing circumstances, and communication takes a DDD-strategy (dialogue, decide, and deliver). Edelenbos and Klijn (2009) and others (Verweij, 2015a; Verweij & Gerrits, 2015) found that the externally-oriented management approach is associated with better outcomes, and others have claimed as well that addressing stakeholders is crucial for project success (e.g., El-Gohary et al., 2006).

In carrying out either the project or process management approach, the public principal and private contractor may operate in a less or more cooperative fashion. With regard to cooperation, building on the research of Edelenbos and Klijn (2009) and Edelenbos and Teisman (2008), a distinction can be made between a more cooperative and a more contractual approach. Indicators for the latter are a strong emphasis on the contract, limited interaction between the public and private partners, and on monitoring compliance with the contract. The more cooperative orientation puts less emphasis on the contract, 'working together' does not stop once the contract is signed but continues in the implementation phase of the project, and it is characterized by more public-private interaction and mutual trust. Recent research (cf. Verweij, 2015a; Verweij & Gerrits, 2015) shows that the cooperative orientation is associated with better outcomes in project implementation. Often, when contracts have been signed, the public-private relationship changes from one of collaborative plan development to one in which the contractor manages implementation. This, however, may leave potential resources untapped; public principals often have longer-standing relationships with local external project stakeholders than private contractors, and they may use these relationships to manage external stakeholder issues more effectively (Verweij, 2015a; cf. De Schepper, Dooms, & Haezendonck, 2014). Other studies also indicate the positive relationship between cooperation and outcomes in infrastructure projects (e.g., Chan, Chan, & Ho, 2003; Larson, 1997).

In assessing how infrastructure projects can be successfully implemented, it is understood that success in implementation can entail different things. Costs, time, and

quality matter, but other outcomes – e.g., a good public-private relationship, safety, political support, or external stakeholder satisfaction – also determine whether a project implementation is regarded as successful or not (cf. Jeffares et al., 2013). The concept of 'satisfaction' captures this. It is a multi-dimensional, heterogeneous concept (Lehtiranta et al., 2012). The study of satisfaction in infrastructure projects receives growing attention in the literature, as it is increasingly recognized that satisfaction of project participants is an important indicator of project success (Kärnä et al., 2013; Leung, Ng, & Cheung, 2004). It is a 'soft performance indicator' that complements the traditional performance measures of time, cost, and quality (cf. Atkinson, 1999), and which is better able to address the holistic, heterogeneous, and subjective nature of success in implementing infrastructure projects (Kärnä et al., 2013; Lehtiranta et al., 2012).

7.2.1. Contract type, project scope, and project size

Two in-depth case studies into the management practices of transportation infrastructure projects found that a more externally-oriented management approach, and a more co-operative management approach, produces satisfactory outcomes in the implementation phase – and the other approaches less so (Verweij, 2015a; Verweij & Gerrits, 2015). One project was characterized by more cooperation and an externally-oriented management approach, and mainly satisfactory outcomes were produced. In contrast, the other project was characterized more by a contractual relationship between the partners and an internal-ly-oriented management approach; its implementation was unsatisfactory, characterized by cost overruns and strained relationships between the project partners and between the project and external stakeholders.

The successful project implementation concerned a project with a D&C contract. Assuming a broad definition of PPP, a D&C project is a partnership where, in contrast to typical public procurement, the contractor is also responsible for the design of the project (Yescombe, 2007; 2013). The second project has a DBFM contract (see, e.g., Yescombe, 2007). In this type of PPP, the contractor also bears responsibility for financing and the maintenance (often for periods exceeding ten years) of the project. Especially characteristic for DBFM contracts is that they insert clear contractual divisions into the partnership (cf. Edelenbos & Teisman, 2008; Klijn & Teisman, 2005) – the philosophy of this contract type is that the market's potential is maximally used when the government is minimally involved in project implementation, only in terms of monitoring contract compliance. The success depends largely on achieving the predefined milestones (because these milestones are linked to periodic payments by the public principal and, therefore, to the financial constructions between the contractor and lenders). It was further suggested in the case study of this second project that the nature of the DBFM contract also strengthened the internal management orientation, as it was felt by project managers that engaging with stakeholders pressurized the achievement of the milestones.

The first project involved the reconstruction of a highway into a 2.3 km long tunnel, combined with inner-city urban development. It is an integral urban project wherein

different spatial functions were combined to achieve synergy. This wide scope meant that many different stakeholders were involved, with their interests embedded in the project scope. In fact, the project's clientship was held by Rijkswaterstaat together with local and regional governments. For these local project stakeholders, communication and stakeholder management were top priorities and principal and contractor cooperated closely herein. In contrast to the first project, the DBFM case involves one spatial function: the reconstruction of a 37 km long highway corridor. Rijkswaterstaat bears sole responsibility for the corridor and is the principal of the project. External stakeholders are not closely involved, and rather act to minimize the impact of the project on their interests. In the present article, by comparing multiple infrastructure project implementations, we will seek to find out whether projects with different contract types and project scopes, as was suggested in the case studies, are indeed managed differently, thus contributing to explaining different project implementation successes.

In addition to contract type and project scope, project size is also suggested as a possible determinant for success in Dutch projects. Studies have suggested that infrastructure projects with smaller budgets tend to have larger average percentages of cost overrun (Verweij et al., 2015; Cantarelli, Van Wee et al., 2012; see also, e.g., Odeck, 2004), for instance because the larger projects are linked to the most capable managers (Verweij et al., 2015). On the other hand, larger projects, as evidenced by the two case studies, may attract more socio-political attention, are riskier, and are easier criticized, which are factors that may also constitute satisfaction. Including project size in the analysis may shed light on which is the case.

7.3.   METHODS AND DATA

7.3.1.   Data collection

Rijkswaterstaat is the executive agency of the Dutch Ministry of Infrastructure and the Environment. It is the major procurer of public transportation infrastructure, with an annual turnover of approximately € 5 billion (Rijkswaterstaat, 2014). Since 2011, Rijkswaterstaat integrated all its project data into a single database, from which the project implementation data were collected. A few projects had some missing data, for which MIRT Project Books (e.g., Ministry of I&M, 2013) and Rijkswaterstaat managers were consulted.[52] The database contained 134 projects, twenty-seven of which had data about the implementation phase of the project that was detailed enough for analysis. Data collection took place between November 2013 and June 2014 at the Rijkswaterstaat office in Utrecht (the Netherlands). The results of the analysis have been discussed with, and fed back to, Rijkswaterstaat managers. In this way, the present study intends to have contributed to reducing the gap between infrastructure project management research and practice (cf. Blomquist et al., 2010; Winter et al., 2006). Publishing about the data was

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52   The MIRT is the Multi-Year Plan for Infrastructure, Spatial Planning, and Transport.

allowed, provided that the projects were anonymized. The project-identifiers used in the analysis (see the tables) correspond to the identifiers in the Rijkswaterstaat database.

7.3.2.   Method: fuzzy set qualitative comparative analysis

A methodological approach that is especially suitable for comparatively analyzing a medium-n of qualitative cases and limited generalization is fuzzy set qualitative comparative analysis (Ragin, 2000; 2008a). QCA is becoming increasingly popular (Rihoux et al., 2013). One important reason is that it strikes a balance between in-depth contextual case knowledge and case complexity on the one hand, and identifying commonalities between cases and pattern generalization on the other hand (Verweij & Gerrits, 2013). It was recently introduced in the field of transportation infrastructure research (Jordan et al., 2011; Verweij & Gerrits, 2013).

In QCA, cases are understood as combinations of conditions, i.e., configurations (Schneider & Wagemann, 2012). Each case – infrastructure project implementations in the current article – has membership between 0 and 1 in each condition and the outcome (Ragin, 2008a). The conditions are: management, cooperation, contract type, project scope, and project size. Each condition has cross-over points that separate qualitatively different cases from each other. In the QCA approach, it is assumed that configurations produce the outcome. In this article, the outcome is satisfaction. By systematically comparing configurations that agree on the outcome but differ in one of the conditions, more general patterns can be discovered, pointing to conditions (or configurations) that might be considered necessary or sufficient to produce the outcome. Basically, a condition is necessary when it has to be present for the outcome to occur, and it is sufficient if it can produce the outcome by itself (Schneider & Wagemann, 2012). The analysis in this article adheres to the QCA standards of good practice as outlined by Schneider and Wagemann (2010; 2012). The comparative process of QCA entails a number of steps (see Verweij, 2015a).

After the case data have been collected and coded, the first step in QCA is the construction of the data matrix. This means that each case is scored on each of the conditions and the outcome. It involves calibration: the transformation of raw data into fuzzy scores between 0 and 1 (see Section 7.3.3) by clustering similar cases per condition. The calibration process and data matrix are important parts of QCA and have to be reported (Schneider & Wagemann, 2010). Each row in the data matrix represents a case as a configuration.

The second step is grouping cases together that exhibit the same configuration. This leads to the truth table (see Section 7.4). This table lists all the logically possible configurations and shows which configurations are covered by which cases. With five conditions, the number of logically possible configurations is thirty-two (i.e., 2^5). Configurations that are empirically absent (i.e., 'empty truth table rows') are called logical remainders. These may be used later in the comparative process as counterfactuals, so as to arrive at more parsimonious patterns (Ragin & Sonnett, 2005).

The third step is the truth table minimization (see Section 7.4). This involves comparing truth table rows that agree on the outcome and differ in one of the conditions. It often occurs that a truth table row is covered by cases with opposite outcomes. Such logical contradictions are expressed with the consistency value (Schneider & Wagemann, 2012). A consistency of 1.0 means that a configuration has no contradictions; lower values signal imperfect relationships between the configuration and the outcome. If the consistency of a truth table row is high enough (see Schneider & Wagemann, 2012), then it is assigned the outcome (i.e., 1); if not, it is assigned the absence of the outcome (i.e., 0). It is important to examine the cases that cover configurations before outcome scores are blindly assigned (see Section 7.4).

The final step is the interpretation and discussion of the results – also called solutions in QCA – of the truth table minimization (see Section 7.5.1), in terms of the cases that are covered by the patterns and in terms of theoretical expectations. The QCA process that is very briefly summarized here is iterative (Rihoux, 2013; Rihoux & Lobe, 2009); for instance, contradictions may signal the researcher to return to the qualitative case data, which may lead to recalibration.

7.3.3. Data and calibration

For each project, the level of completeness was calculated to ensure comparability of the projects. The completeness level is defined as the number of days between the start of the implementation phase (i.e., project realization) and the date at which the project data were measured, divided by the number of days between the start of the implementation and the (planned) project delivery date. Depending on the completeness level, the project data were measured at January 1st 2012 (i.e., data about 2011), 2013 (i.e., data about 2012), or 2014 (i.e., data about 2013). For instance, the D&C project discussed above started construction on 14-2-2011, has a planned delivery date of 16-12-2016 (see Projectbureau A2 Maastricht, 2014), and the data were measured at January 1st 2014. This resulted in a level of completeness of 49%. The average completeness level was 73%, with a median of 74%, and a standard deviation of 17%. The projects are thus fairly similar with regard to their completeness.

7.3.3.1. Satisfaction

Three times a year, the project managers qualitatively assess their project on multiple indicators: budget of the project, cash prognosis, achievement of milestones, risk management, administrative-political issues, public-orientedness, cooperation with the market, and safety in the project.[53] Based on their qualitative assessments, the managers score

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53   Three indicators were not used (i.e., signing of scope documents, capacity of the principal's project team, and evaluation of project quality). They could not be related, based on the qualitative empirical data, to management or public-private cooperation in the project. They concerned Rijkswaterstaat-internal issues rather than project-related issues.

their project on each indicator with either code red (low satisfaction, 0 points), code orange (medium satisfaction, 1 point), or code green (satisfaction, 2 points). Satisfaction is measured by aggregating the scores for the eight indicators and then averaging the year's three measurements.

Using the QCA Tosmana software (Cronqvist, 2011), which performs a cluster analysis to group similar projects, and separate different ones, three cross-over points were identified: 10.17, 12.34, and 13.50. This means that the twenty-seven projects are divided into four groups. Using the QCA package in R (Duşa & Thiem, 2014; Thiem & Duşa, 2013b), this resulted in the following fuzzy four-value (see Ragin, 2008a) calibration: 0.00 (8.67-10.17), 0.33 (10.18-12.34), 0.67 (12.35-13.50), and 1.00 (13.51-16.00).[54]

7.3.3.2. Management and cooperation

For the management and cooperation orientations in the projects, only qualitative data were available. Three types of management reports from the database were used: general management summaries (one report per year), stakeholder environment reports (three reports per year), and market cooperation reports (three reports per year). The seven reports per project, 202 pages in total for all projects, were coded with qualitative data-analysis software (Provalis Research, 2013). For instance, if a text fragment fitted with indicators for externally-oriented management (see Section 7.2), then it was coded as such. Based on the coded data, qualitative project descriptions were constructed and these were cross-compared (Ragin, 1992). This process consisted of two iterations – a few small contradictions led to reexamination of some project data, resulting in additional insights, recoding, and a recalibration – as is common in QCA, and resulted in four clusters of projects, with scores of 0.00, 0.33, 0.67, or 1.00. Low scores indicate a more internal management orientation and a contractual orientation, and higher scores indicate more external management and cooperative orientations.

7.3.3.3. Contract type, project scope, and project size

The contract type has two possible values: D&C and DBFM. The D&C projects were assigned a score of 1.00 and the DBFM projects were assigned a score of 0.00.

Four clusters of projects were identified with regard to the project scope. Standard road construction projects were assigned a score of 0.00, road projects that also included the construction of several new (i.e., not just the renovation of existing ones) tunnels or bridges were assigned as score of 0.33, more complex road projects with large new tunnels or bridges (e.g., the DBFM project mentioned in Section 7.2.1 that includes a new double vertical lift bridge of nearly 180 meters) received a score of 0.67, and integral projects that combine several spatial functions (e.g., the D&C project from Section 7.2.1) were scored 1.00.

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54 A finer-grained scale was not used because the managers' qualitative assessments did not allow the interpretation of small differences in project satisfaction scores.

The project size was measured by taking the projected final expenditures of the projects. The largest project has a size of € 2,269 million (i.e., over € 2.2 billion). The smallest project is just under € 9.5 million. The average project size is € 386 million, with a median of € 211 million and standard deviation of € 556 million. Using the QCA Tosmana software, three cross-over points were identified: € 76.566 million, € 242.894 million, and € 584.061 million. This resulted in the following calibration: 0.00 (€ 9.488 to € 76.566 million), 0.33 (€ 76.567 to € 242.894 million), 0.67 (€ 242.895 to € 584.061 million), and 1.00 (€ 584.062 to € 2.268.904 million).

7.3.3.4. Data matrix

The calibration leads to the data matrix provided as Table 7.1. For the conditions project size (SIZE) and contract type (CONT), and for the outcome satisfaction (SATIS), the raw data are also provided. Due to space restrictions, for the other conditions – management (MAN), cooperation (COOP), and scope (SCOPE) – only the calibrated data are provided. Finally, the completeness levels of the projects and the used data (i.e., 2011, 2012, or 2013) are provided.

7.4. ANALYSIS AND RESULTS[55]

Using the QCA package in R, the truth table is constructed (see Table 7.2). The table shows that eleven logically possible configurations are empirically present. This means that there are twenty-one logical remainders. The frequency cutoff (see the "n" column) is set at 1: configurations that are covered by at least one project are included in the further analysis. The consistency cutoff point is set 0.875 (see the "incl." column). Four arguments substantiate this choice (see Ragin, 2009; Schneider & Wagemann, 2012). First, it is well above the lowest 'permitted' value of 0.75. Second, a clear gap in consistency values can be recognized at 0.875. Third, the high PRI (i.e., Proportional Reduction in Inconsistency) scores (see Schneider & Wagemann, 2012) indicate that there is a big difference between the configurations' consistency scores for high satisfaction and low satisfaction. Fourth and most importantly, the cutoff point is substantiated by examining the cases covered by the configurations.

Configurations 8, 21, 23, 24, and 28 are covered by project implementation cases that all have high satisfaction. The configurations with consistency scores below the 0.875

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55   This section focuses on the truth table analysis, which is the analysis of sufficiency. An examination of the XY-plots, and the test for necessity, revealed that there are no conditions or configurations that can be considered necessary according to the commonly accepted consistency threshold of 0.9 (Ragin, 2009). Only three conditions had consistency values above a 0.8 threshold: scope (con. 0.818, cov. 0.775), CONT (con. 0.873, cov. 0.695), and SIZE+coop (con. 0.873, cov. 0.685). All the analytical steps in this section have also been performed with the fs/QCA software (Ragin & Davey, 2014), which produced the exact same results as the QCA package in R.

Table 7.1 Data matrix

Project	Data	CONT		SCOPE	SIZE		MAN	COOP	SATIS		Completeness
		Raw	Cal.		Raw (k€)	Cal.			Raw	Cal.	
P.0008	2013	D&C	1	0.33	278146	0.67	0.67	0.33	13.00	0.67	59%
P.0029	2013	D&C	1	0.00	274787	0.67	0.33	0.00	16.00	1.00	102%
P.0034	2013	D&C	1	1.00	620693	1.00	1.00	1.00	15.00	1.00	49%
P.0059	2011	D&C	1	0.33	114215	0.33	0.67	0.00	15.00	1.00	70%
P.0077	2012	D&C	1	0.67	276962	0.67	0.67	0.33	14.00	1.00	76%
P.0094	2013	D&C	1	1.00	319694	0.67	1.00	0.67	11.67	0.33	83%
P.0095	2012	D&C	1	0.00	97741	0.33	0.67	0.33	14.67	1.00	69%
P.0096	2011	D&C	1	0.00	103709	0.33	0.33	0.00	12.00	0.33	85%
P.0102	2011	D&C	1	0.00	48783	0.00	1.00	0.00	14.00	1.00	76%
P.0149	2013	D&C	1	0.67	686322	1.00	1.00	0.33	11.00	0.33	41%
P.0165	2011	D&C	1	0.33	211000	0.33	0.33	0.00	9.67	0.00	96%
P.0179	2013	D&C	1	0.00	121555	0.33	1.00	0.33	9.67	0.00	46%
P.0190	2013	DBFM	0	0.67	2268904	1.00	0.00	0.00	8.67	0.00	65%
P.0196	2012	D&C	1	0.67	127013	0.33	1.00	1.00	15.33	1.00	77%
P.0200	2011	D&C	1	0.00	55391	0.00	1.00	0.00	15.00	1.00	90%
P.0218	2012	DBFM	0	0.67	2187177	1.00	0.67	0.33	10.67	0.33	67%
P.0227	2013	D&C	1	0.67	300261	0.67	0.67	0.00	11.33	0.33	56%
P.0247	2012	DBFM	0	0.00	683008	1.00	1.00	1.00	16.00	1.00	89%
P.0272	2013	D&C	1	0.33	547430	0.67	0.67	0.67	14.67	1.00	74%
P.0319	2013	D&C	1	0.00	54750	0.00	0.33	0.00	15.00	1.00	89%
P.0351	2013	DBFM	0	0.00	332229	0.67	1.00	0.67	14.67	1.00	45%
P.0631	2013	D&C	1	0.00	9488	0.00	1.00	0.33	15.33	1.00	88%
P.0641	2012	D&C	1	0.00	163773	0.33	1.00	0.00	16.00	1.00	101%
P.0755	2013	D&C	1	0.00	159293	0.33	0.33	0.00	14.67	1.00	68%
P.1106	2013	D&C	1	0.33	21473	0.00	0.00	0.00	9.00	0.00	56%
P.2355	2012	D&C	1	0.00	42997	0.00	0.00	0.33	10.67	0.33	85%
P.2365	2012	D&C	1	0.00	320761	0.67	1.00	0.00	12.67	0.67	63%

cutoff point are all covered by (a clear majority of) cases with low satisfaction. Two of the configurations above the cutoff point, however, can be considered contradictions.

Configuration 32, which is covered by cases P.0034 and P.0094, is a contradiction because P.0094 has a satisfaction score of 0.33 (see Table 7.1). However, the raw satisfaction score for P.0094 is closer to a fuzzy value of 0.67 (i.e., 12.34-11.67=0.67) than to a value of 0.00 (i.e., 11.67-10.18=1.49). Moreover, the qualitative raw data for this case (i.e., the managers' qualitative assessments) made clear that the project implementation had multiple orange codes not so much because managers were dissatisfied with the implementation, but rather to signal to the Rijkswaterstaat hierarchy that the project had a "high risk

Table 7.2 Truth table

No.	CONT	SCOPE	SIZE	MAN	COOP	SATIS	N	incl.	PRI	Cases
8	0	0	1	1	1	1	2	1.000	1.000	P.0247, P.0351
28	1	1	0	1	1	1	1	1.000	1.000	P.0196
21	1	0	1	0	0	1	1	0.909	0.875	P.0029
32	1	1	1	1	1	1	2	0.898	0.854	P.0034, P.0094
19	1	0	0	1	0	1	7	0.884	0.864	P.0059, P.0095, P.0102, P.0179, P.0200, P.0631, P.0641
23	1	0	1	1	0	1	2	0.875	0.819	P.0008, P.2365
24	1	0	1	1	1	1	1	0.875	0.834	P.0272
31	1	1	1	1	0	0	3	0.724	0.568	P.0077, P.0149, P.0227
17	1	0	0	0	0	0	6	0.681	0.597	P.0096, P.0165, P.0319, P.0755, P.1106, P.2355
15	0	1	1	1	0	0	1	0.493	0.000	P.0218
13	0	1	1	0	0	0	1	0.330	0.000	P.0190

Number of logical remainders: 21

profile" and thus required unabated management attention. Given these considerations, the truth table row was still assigned the outcome (i.e., 1).

The second contradiction concerns case P.0179 in configuration 19. The qualitative raw data showed that this case is a clear low-performer. Rijkswaterstaat managers identified that the contractor's "knowledge and information systems" were not trustworthy. Because Rijkswaterstaat monitors contract compliance via system-based contract management, its managers could not, as a consequence, assess whether the quality of the construction works was according to contract specifications. In other words, the public values of transparency and quality (see, e.g., Reynaers, 2014) were at stake, preventing Rijkswaterstaat from making legitimate payments to the contractor. This situation deteriorated the public-private relationship. It also, as a consequence, increased the risks in the project and compromised the achievement of implementation milestones. Despite this case, the configuration is still assigned the outcome, because the other six cases all have satisfaction scores of 1.00. The contradiction is reflected in the less-than-perfect consistency score.

The next step is the truth table minimization, which was conducted with the eqmcc() function in the QCA package in R. The results are presented in Tables 7.3 and 7.4. The conservative truth table solution, shown in Table 7.3, is produced by not including logical remainders in the minimization (Schneider & Wagemann, 2012). Uppercase letters in the table indicate a 0.67-1.00 condition score (e.g., SCOPE means a wide scope), and lowercase letters indicate a 0.00-0.33 condition score (e.g., scope means a narrow scope).

Table 7.3 Conservative solution

	Minimized configuration	incl.	cov.r	cov.u	Cases
1	CONT*SCOPE*MAN*COOP	0.907	0.181	0.091	P.0196; P.0034, P.0094
2	CONT*scope*MAN*coop	0.871	0.491	0.237	P.0059, P.0095, P.0102, P.0179, P.0200, P.0631, P.0641; P.0008, P.2365
3	CONT*scope*SIZE*coop	0.883	0.272	0.019	P.0029; P.0008, P.2365
4	scope*SIZE*MAN*COOP	0.929	0.236	0.128	P.0247, P.0351; P.0272
	Solution	0.891	0.746		

Table 7.4 Intermediate solution

	Minimized configuration	incl.	cov.r	cov.u	Cases
1	CONT*MAN*COOP	0.874	0.254	0.109	P.0272; P.0196; P.0034, P.0094
2	CONT*scope*MAN	0.858	0.545	0.237	P.0059, P.0095, P.0102, P.0179, P.0200, P.0631, P.0641; P.0008, P.2365; P.0272
3	CONT*scope*SIZE	0.895	0.308	0.019	P.0029; P.0008, P.2365; P.0272
4	scope*SIZE*MAN*COOP	0.929	0.236	0.109	P.0247, P.0351; P.0272
	Solution	0.878	0.782		

The intermediate solution, provided in Table 7.4,[56] is produced by including logical remainders in the truth table minimization (Schneider & Wagemann, 2012). It involves the formulation of directional expectations as to how conditions might contribute to producing satisfactory outcomes in project implementation. Based on the framework presented in Section 7.2, two expectations are formulated: (1) a cooperative orientation (COOP) contributes to producing satisfaction and (2) externally-oriented management (MAN) contributes to producing satisfaction. For the other three conditions (i.e., contract type, project scope, and project size) no directional expectations are formulated because the evidence base is considered not strong enough to support this. Indeed, the aim is to explore whether different kinds of infrastructure projects may be managed differently to have a successful implementation process. Comparing the intermediate solution with

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56 The row dominance (row.dom) argument was applied. Two intermediate solutions were produced. The intermediate solution not shown in Table 7.4 was the same as the conservative solution in Table 7.3, with the only difference that the minimized configuration CONT*scope*SIZE*coop (with incl. 0.883, cov.r 0.272) became a bit more parsimonious: CONT*scope*SIZE (with incl. 0.895, cov.r 0.308). The fs/QCA software (Ragin & Davey, 2014) only provided the intermediate solution in Table 7.4 by default (see Thiem & Duşa, 2013a), but the QCA package in R provided two dominant prime implicants. A prime implicant is a minimized configuration, that 'implies' a certain set of configurations from the truth table, which cannot be minimized any further. Sometimes there are multiple minimization outcomes for the truth table, defined by which implicant is chosen. Finally, it must be mentioned for good order (Schneider & Wagemann, 2010) that the parsimonious solution for Table 7.4 was COOP + scope*SIZE + scope*MAN (incl. 0.865, cov.r 0.818).

the conservative solution, in effect, case P.0272 now covers all minimized configurations, resulting is somewhat less complex patterns.

To complete the analysis, a fuzzy set qualitative comparative analysis was also performed for low satisfaction, for which a separate truth table was constructed (not reported in the present article). Given the consistency scores in that truth table, only the two configurations covered by cases P.0190 and P.0218 (see Table 7.2) could be included in the truth table minimization. Both cases have low satisfaction (see Table 7.1). Combining these two configurations yielded cont*SCOPE*SIZE*coop as being associated with low satisfaction (with incl. 1.000, cov. 0.154).

7.5.   DISCUSSION

7.5.1.   Interpretation and discussion of the results

First of all, the results show that there are no necessary or sufficient conditions for producing satisfactory outcomes in the implementation phase of infrastructure projects: none of the five conditions appears in each minimized configuration (necessity), and no condition appears independently of other conditions (sufficiency). Instead, the results indicate that conditions combine in configurations, and that there are four configurations that are sufficient for producing satisfactory outcomes. This highlights the configurational and equifinal nature of transportation infrastructure development (Verweij & Gerrits, 2013). For the interpretation of the results, we will focus on the conservative solution (i.e., Table 7.3) because the substantial simplification that is accomplished in the intermediate solution (i.e., Table 7.4) is caused by only one case (i.e., P.0272), which seems a rather meager basis for drawing much more parsimonious conclusions.

The first pattern of the conservative solution states that externally-oriented management combined with a cooperative public-private approach, in projects with a wide scope and a D&C contract, produces satisfactory outcomes. This pattern underscores the importance of externally-oriented management and a cooperative relationship. This result substantiates previous research into the management of PPP projects (Edelenbos & Klijn, 2009). In fact, one of the three cases covered by this pattern is the D&C infrastructure project discussed in Section 7.2.1 (Verweij & Gerrits, 2015). In each of the three projects, technically and socio-politically complex and innovative project scopes – in two cases inner-city urban development (P.0034 and P.0094) – were implemented in close cooperation with external project stakeholders and between the public and private partners (see also Lenferink, 2014). Stakeholders are co-principals in the project (P.0034), or they are proactively involved by the project in the implementation (P.0094) to tackle problems upfront. In the projects, there was intensive communication towards citizens via, e.g., Facebook, newsletters, information-meetings, emails, and construction site visits. The communication monitors deployed by the projects found that this was appreciated by citizens, who showed understanding for the nuisances caused by the projects (cf. Hamersma, Tillema, Sussman, & Arts, 2014). Of course,

the partners in the projects had contracts that clearly defined roles and responsibilities. However, the sharing of knowledge for effective joint communication about the project (P.0034), the joint preparation of contract changes before they are formally submitted (P.0094), or the joint formulation of project goals and "celebration of small successes" (P.0196) proved effective and resulted in satisfaction. All projects had green codes for the indicator 'cooperation with the market', an important aspect of successfully implementing infrastructure projects (Chan et al., 2003; Larson, 1997).

The second configuration states that externally-oriented management combined with a contractual public-private approach, in projects with a narrower scope and with D&C contracts, also produces satisfaction. Compared to the previous one, this configuration shows that externally-oriented management remains important for achieving satisfaction (Edelenbos & Klijn, 2009; El-Gohary et al., 2006), but that D&C projects with a narrower scope can also do without intensive public-private cooperation. The nine cases covered by this pattern are all more or less 'straightforward projects', such as the construction of new roads and additional traffic lanes. It seems that more traditional line-oriented road projects can be implemented more at arm's length from public principals; the more multifaceted, socio-politically complex, area-oriented projects involving multiple stakeholders (i.e., the previous configuration) require closer public-private cooperation (cf. Geraldi, Maylor, & Williams, 2011; Heeres et al., 2012; Lenferink, 2014).

In fact, the solution that is associated with low satisfaction (i.e., cont*SCOPE*SIZE*coop), which represents the DBFM infrastructure project discussed in Section 7.2.1 (Verweij, 2015a), seems to further substantiate this finding. It states that in large and multifaceted DBFM projects, a contractually-oriented cooperation is associated with low satisfaction. In the case of P.0190, the 37 km long highway corridor cut through many jurisdictional areas, affecting many local public stakeholders. As a governmental organization, Rijkswaterstaat was well-connected in this institutional landscape of public actors (e.g., municipalities and port authorities), but the private construction consortium not so much. Driven by the idea that the market was to be left responsible for managing the stakeholder relationships (Rijkswaterstaat's "the market unless" policy), Rijkswaterstaat took a background position in the project's implementation phase. When external stakeholders were dissatisfied with the project, however, they turned to Rijkswaterstaat to seek redress. When Rijkswaterstaat decided to become more active in the stakeholder management, stakeholder's concerns were somewhat relieved. In hindsight, it thus seemed to have been a better strategy if the project had continued to make active use in the implementation phase of the stakeholder relationships that were built by Rijkswaterstaat in the planning phase (cf. Lenferink, 2014; Verweij, 2015a), instead of halting the public-private cooperation in stakeholder management when the project entered the implementation phase.

The third configuration of the conservative solution offers an important nuance to the identified importance of the externally-oriented and cooperative management approaches for producing satisfactory outcomes (cf. Edelenbos & Klijn, 2009). As can be seen from Table 7.3, the pattern is covered by three cases. It indicates that in large projects with a D&C contract and a narrow scope, cooperation can be contractual, but also management

need not to be externally-oriented to achieve satisfaction in implementation. Case P.0029, for instance, was a rather straightforward road construction project that received little media attention, upon which it was decided to only use basic press notifications to inform external stakeholders about road closures for construction. It suggests that less complex projects may need less far-reaching stakeholder management measures, and that more traditional modes of management and project organization can be relied upon in such cases (cf. Geraldi et al., 2011; Whitty & Maylor, 2009).

The fourth pattern states that the combination of externally-oriented management and a cooperative public-private orientation, in large projects with a narrow scope, still produces satisfactory outcomes in infrastructure project implementation. In other words, although the third configuration indicates that it is not necessary in large projects with narrow scopes, externally-oriented management and a cooperative orientation still produce satisfactory outcomes. This further underpins the positive relationship between externally-oriented management and public-private cooperation for achieving satisfaction (Edelenbos & Klijn, 2009; Verweij & Gerrits, 2015). Interestingly, two of the projects covered by the fourth configuration have DBFM contracts (i.e., P.0247 and P.0351). Whereas previous PPP studies suggested that DBFM contracts might amplify project-inward and contract-focused orientations (Edelenbos & Klijn, 2009; Edelenbos & Teisman, 2008; Verweij, 2015a), the two cases P.0247 and P.0351 in the present study show that this is not necessarily true. Therefore, further research is required into the relationship between the nature of DBFM and the achievement of satisfactory outcomes in the implementation of transportation infrastructure projects.

7.5.2. Some reflections

The Rijkswaterstaat database provided valuable information about the reality of infrastructure project implementation (cf. Cicmil et al., 2006). Comparatively analyzing twenty-seven projects, however, restricts the extent to which implementation practices can be known in-depth. Whereas in-depth case studies can provide more accurate descriptions of the management and cooperation practices in projects, this is difficult when comparing a medium number of projects. The upside is, though, that it allowed pattern generalization. This is the classical trade-off between in-depth knowledge and the reconstruction of cross-case patterns. Both are important in studying the management of infrastructure projects (Buijs et al., 2009; Verweij & Gerrits, 2013).

As can be seen from the data matrix, there is little variation between the projects with regard to contract type. The reason is, simply, that few DBFM projects have been or are implemented in the Netherlands. Contract type was still included as a condition in the analysis so as to test the conjecture that the DBFM model might amplify project-inward and contract-focused orientations. The implication here is that no bold conclusions should be drawn with regard to the performance or success of DBFM in the Netherlands. At most, the results from the present analysis with regard to DBFM are provisional; once

more DBFM projects are implemented in the Netherlands, future studies may generate more conclusive results.

Notwithstanding the limitations of fsQCA, it is a useful method for infrastructure research (Jordan et al., 2011; Verweij & Gerrits, 2013). Among its advantages are the abilities to deal with a medium-n of projects, to combine qualitative and quantitative data and methods in a single analysis (Rihoux & Lobe, 2009), to provide a system of procedures that lead to a systematic comparison, and to strike a balance between in-depth knowledge and cross-case patterns (Verweij & Gerrits, 2013). The new QCA package in R proved a workable and trustworthy complement to the existing range of QCA software. Applications of QCA in this field are yet scarce (exceptions are, e.g., Delhi et al., 2012; Gross & Garvin, 2011; Verweij, 2015a; Verweij & Gerrits, 2015) but, as the method is gaining a strong foothold in the social sciences (Rihoux et al., 2013), more applications can be expected to follow.

7.6.   CONCLUSION

Many studies in the field of infrastructure projects have focused on explaining the failure of projects (e.g., Flyvbjerg et al., 2003). This article took a different approach. Comparatively analyzing twenty-seven infrastructure road constructions, patterns were identified and discussed that are associated with satisfactory outcomes in transportation infrastructure development. Satisfaction is an important prerequisite for project success; dissatisfaction of project members and stakeholders hampers smooth project implementation and can contribute to project failure (Kärnä et al., 2013; Lehtiranta et al., 2012). This study confirmed findings from previous research, showing that public and private partners interactively working together, and a stakeholder-oriented project approach, are important contributors to satisfaction. In addition, in projects with a narrower scope, cooperation can also be more contractual and less close; in less complex projects, the partners may rely on less interactive forms of cooperation, more characterized by monitoring contract compliance, thereby saving costs for the project (cf. De Schepper et al., 2014). These findings can provide practitioners and policy-makers in the field of transportation infrastructure projects with reference points as to how projects might be planned prior to implementation.

PART 5

Conclusions and Discussion

The fifth and final part of this thesis consists of one chapter. Chapter 8 provides a brief recapitulation of the study, it formulates the conclusions by answering the research questions, and it provides a discussion by revisiting the practical and scientific relevance articulated in the introductory chapter. It discusses how learning processes within project implementations, across project implementations, and between people in implementation processes, can be facilitated. It also discusses how PPP implementations can be improved by reconsidering the drawn boundaries between the public and private partners, and between the project and the stakeholder enironment.

8 | Conclusions and Discussion

8.1. THE WICKEDNESS OF PROJECT IMPLEMENTATION AND EVALUATION

In 2014, the Dutch newspaper *Het Financieele Dagblad* published an article with the headline "Contractors struggle with A15 Maasvlakte-Vaanplein" (Editors, 2014). The article reported:[57]

> "In total, the cost overrun amounts to € 217 million according to the latest project report from A-Lanes A15 (…). One of the major problems is the fact that Rijkswaterstaat as principal has changed its design several times. Additionally, there are a thousand permits involved in the project, where different stakeholders have different interests, with delays as a result. Also, the consortium faces the very complicated issue of needs and demands of various stakeholders – which are no contractual parties (…)."

Later, the same newspaper reported that this estimated cost overrun had increased to € 253 million and that this number was going to increase more (Verbraeken & Weissink, 2014). It further stated:[58]

> "According to Ballast Nedam [one of the participants in consortium A-Lanes A15, author], the cost overruns should be borne by the principal, Rijkswaterstaat. (…). It appears that Rijkswaterstaat does not have its act together in this project. An active role of Rijkswaterstaat is expected in the obtaining of timely and consistent cooperation of the relevant public stakeholders in the provision of permits, says Ballast."[59]

The articles recapitulate the motivation for this study (Section 1.2), and they show that the observations of the Scientific Council for Government Policy (WRR, 1994a) two decades ago, and of the Temporary Committee on Infrastructure Projects (TCI, 2004b) and the Committee Acceleration Decision-Making on Infrastructure Projects (Advisory Committee VBI, 2008) one decade ago, bear relevance still. Implementation processes, i.e., project construction and delivery, of public-private partnership (PPP) infrastructure projects are persistently complex endeavors and this can be subjacent to poor performance (inter alia, budget overruns). In other words, project implementation is 'wicked': difficult to improve on (as indicated by an abundance of empirical research)[60] because of its inherent complex systemic nature (Rittel & Webber, 1973). One manifestation thereof is the occurrence of unforeseen events.

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57   The quote is translated from Dutch. See: http://fd.nl/ondernemen/91995/aannemers-worstelen-met-a15-maasvlakte-vaanplein (last accessed on the 19th of November, 2014).

58   The quote is translated from Dutch. See: http://fd.nl/ondernemen/897192/nieuwe-botlek-brug-zorgt-voor-grootste-kostenoverschrijding-a15-project (last accessed on the 19th of November, 2014).

59   See also Editor (2014): http://fd.nl/ondernemen/897162/partijen-a15-maasvlakte-vaanplein-zwijgen-over-kostenconflict (last accessed on the 19th of November, 2014).

60   E.g., Cantarelli (2011), Flyvbjerg, Bruzelius, and Rothengatter (2003), WRR (1994a), Merrow (1988), and Hodge and Greve (2007).

This wickedness signals that the management of the implementation process is all the more important, so as to actually achieve the results anticipated in the planning – i.e., legal planning, procurement, and contracting – of the PPP infrastructure projects (Chapter 1). Indeed, if not managed properly, obtained or anticipated gains in the planning of infrastructure projects might be lost in the implementation phase. Pressman and Wildavsky ([1973]1984) already pointed this out several decades ago, but the management of implementation is still an understudied topic in PPP infrastructure research (see Chapter 1). Moreover, if we want to improve other (future) development processes of infrastructure projects, we need to learn from other (past) experiences with managing project implementation. This requires evaluation (Sanderson, 2002; Van der Meer & Edelenbos, 2006). As Pressman and Wildavsky expressed it: "learning is the key to both implementation and evaluation. We evaluate to learn, and we learn to implement" ([1973]1984:xviii).

However, implementation and evaluation are often separated (Pressman & Wildavsky, [1973]1984). There is an implementation-evaluation gap. That is, the inherent systemic complexity of the implementation processes – which means that the causes of, and solutions for, outcomes in/of projects cannot be predicted and identified unambiguously (Rittel & Webber, 1973) – is often not recognized or admitted in evaluations (Chapters 1, 2, and 3). The ambiguity is even more evident in PPP projects, where managers and organizations with fundamentally different perspectives, interests, goals, and practices (Jacobs, 1992) are involved. The gap between implementation and evaluation hampers learning (Pressman & Wildavsky, [1973]1984). That is: evaluations that fail to take into account the systemic complexity of implementation are based on unrealistic assumptions, and this makes them ineffective for learning from past experiences because they do not tell us what works when in which contexts and why (Chapter 3). In the case of infrastructure project development specifically: the failure to recognize or admit the systemic complexity of implementation sometimes, as a consequence, means that evaluations are used for reasons of accountability and blaming culprits instead of for learning (Lehtonen, 2014; Chapter 1). Learning from evaluation thus requires that the evaluation methodology and application do justice to the systemic complexity of the evaluand (Chapters 1 and 3). Connecting the implementation and evaluation of infrastructure projects is the challenge faced in this thesis.

In this doctoral study, implementation and evaluation are brought together for learning. This was done by establishing qualitative comparative analysis (QCA) as a complexity-informed evaluation approach, and applying it to the study of the management of implementation processes of Dutch PPP transportation infrastructure projects. Combining literatures from the scientific fields of complexity, evaluation, project management, and public-private partnerships (see Section 1.5), the following question was researched: *how can the implementation and management of PPP infrastructure projects be understood and evaluated from a complexity perspective using QCA, what management responses in project implementation yield (un)satisfactory outcomes, and how can this be explained?*

Chapters 2 and 3 in Part 2 of the thesis focused on the first part of the research question. They lay the ontological, epistemological, and methodological foundations of this thesis. It was first argued that reality in general, and implementation processes of infrastructure

projects in particular, are complex. Second, it was explained what methodological requirements this complexity imposes on the evaluation of infrastructure projects. Third, it was assessed to what extent, and concluded that, QCA is able to meet these requisites.

In Chapters 4 to 7 in Parts 3 and 4 we put the money where the mouth was, applying QCA as a complexity-informed evaluation approach to the study of project implementations. The chapters mainly focused on the second part of the research question. Their basic logic followed a T-structure as proposed by Buijs, Eshuis, and Byrne (2009) in their discussion of approaches to researching complexity in public management. The 'leg' of the T is comprised of analyses of the A2 Maastricht (Chapter 4) and the A15 Maasvlakte-Vaanplein (MaVa) (Chapter 5) projects, followed by a comparison of the two (Chapter 6). The 'roof' of the T is Chapter 7, where a larger number of projects (i.e., twenty-seven) are cross-compared so as to assess the generalizability of the two project studies.

In this final chapter, the research question is answered by drawing on the articles (i.e., chapters) that constitute this thesis (see Table 1.1) and the thesis' lessons are enumerated. In Section 8.2, it is explained what the building blocks are of the complexity of project implementation (i.e., the first sub-question). In Section 8.3, the empirical findings of the research are presented, indicating how implementation processes are managed, and what management responses yield (un)satisfactory outcomes, and why (i.e., the fourth and fifth sub-questions). Section 8.4 presents the methodological findings of this study, explaining what the requirements are for evaluating complex infrastructure projects, and how QCA meets these requirements (i.e., the second and third sub-questions). Section 8.5 comprises the discussion. Based on the research, an agenda for learning in project implementation processes is proposed, focusing on QCA as an approach for learning in and across implementation processes of public-private partnership projects (Section 8.5.1), and on the management lessons for future project implementations (Section 8.5.2). Final remarks are placed in Section 8.6.

8.2. THE FOUR BUILDING BLOCKS OF THE SYSTEMIC COMPLEXITY OF PROJECT IMPLEMENTATION

If we want to learn how other (future) implementation processes of PPP infrastructure projects can be improved, we need, first, to understand the complexity of implementation processes. This complexity refers not just to the fact that implementation processes are very difficult. <u>Complexity is a property of reality.</u> The world of implementation is not a closed system controlled by a single project organization or manager. Rather, it is composed of open systems that are nested and interrelated. This implies that reality is non-decomposable, contingent, non-compressible, and time-asymmetric (see Chapter 2). This view on reality has consequences for understanding the implementation and management of projects (see mainly Chapter 3, but also the first parts of Chapters 4 to 6).

Non-decomposability means that the implementation of a PPP infrastructure project cannot be understood by only studying the individual parts of a project, and then putting

the studied parts together. The implementation and its outcomes emerge from interactions between parts. These parts are both internal in (i.e., within the project's organization) and external to (i.e., in the socio-physical environment or context) the project. In terms of internal parts, inter alia, public and private organizations are bound by a construction contract, and based on this contract they interact in various formal and informal ways to construct and deliver the project. In terms of external parts, when a project is being implemented, this means that the project interacts with an existing socio-physical system. This socio-physical system can be understood as a 'syntax' or specific mix of physical and social elements. For example, the system consists of roads, tunnels, bridges, rivers, dikes, and residential areas with dwellings, which are distributed in a certain way, and public organizations (e.g., municipalities, provinces, and waterboards) bear responsibilities for these physical elements which are also used by citizens and businesses. When the project interacts with this system, the system reacts. That is, social and physical events occur. These events are managed by public and private managers for the purpose of the project's construction and delivery. From this myriad of dynamic interactions within the project and between the project and the context, the infrastructure project and its outcomes emerge. The whole outcome can be less or more than the assessments of individual internal or external parts indicate. For instance, public and private partners can be satisfied with a particular PPP contract, but in implementation unforeseen social events from the project's context may impact the functioning of the contract, making it a less effective model for achieving intended outcomes (see also Section 8.5.2).

The non-decomposable nature of projects is crucial for understanding and evaluating projects. Simplistic evaluation methods that look at the effect of singular variables on outcomes do not create a realistic understanding of implementation processes, thus sustaining the implementation-evaluation gap. This makes them ineffective for learning.

Second, *contingent reality* implies that, because projects interact with socio-physical environments (i.e., contexts), and because environments differ between projects, the implementations of projects and project outcomes are unique for a specific environment. That assumption helps to understand why certain management strategies that result in satisfactory outcomes in one project may not generate satisfaction in another project. This thesis emphasizes the explanatory value of the context for project implementation and the unique properties of contexts (e.g., specific physical elements, spatial functions, or stakeholders). Because this context is systemic – i.e., because it consists of interacting systems – it has similarities with other contexts (e.g., certain laws and regulations enforced by public actors apply nationwide). This means that socio-physical systems that are interacted with have similarities and peculiarities. Similarities can be managed with known strategies; peculiarities, however, will have to be managed adaptively. Together, this will and must result in unique and balanced implementation management strategies for projects. Contingency further means that explanations for projects, and outcomes in/of projects, are time-sensitive: an explanation for outcomes in a project at t_n may not apply to outcomes at t_{n+1}. It signals that the causal relationships between the interacting parts of the implementation with the partly-unique, partly-similar contexts, are inherently emerging

and can only be known for a specific time and place. The contingent understanding of reality boils down to the notion that explanations for project implementation processes and outcomes are case-specific, but that patterns may be explored and recognized across cases.

Contingency means that project implementations have to be understood and evaluated in-context. Evaluation methods that 'control for context', or aim to establish universal laws, do not create a realistic understanding of implementation, which makes them ineffective for learning.

Reality is essentially *non-compressible:* implementation processes and outcomes result from the interacting systems in systems in systems. People cannot perceive and understand the full complexity of their reality; there are limits to humans' cognitive capacities and the future still has to unfold itself. It simply cannot be understood a priori. This first means that public and private implementation managers draw boundaries, i.e., that their perceptions of their project, desired outcomes, and explanations of how these outcomes have to be achieved, are inevitably compressions – reductions and simplifications – of reality. Public and private managers have different backgrounds, tasks, roles, responsibilities, etcetera: they are nested in, and interact with, a specific subsystem (and a specific experience – path-dependency). Based thereon, they draw specific boundaries. They have a specific understanding of their project, and based on their simplifications of their project reality they act. They don't have another choice. The managers' actions are grounded in their perceptions, understanding only a part of the relevant project reality.

Evaluations of implementation processes of infrastructure projects are also simplifications. The differences of managers, and the unfolding future and changing implementation context, mean that an effective management approach can easily become ineffective. Simplistic evaluation methods ignore this, creating an unrealistic understanding of implementation, which makes them inadequate for learning.

Time-asymmetry means that the trajectory of an infrastructure project is unidirectional or irreversible. Causality is emergent.[61] This means that, although the outcomes in/of implementation may appear to be the result of a logical sequence of events in hindsight, this sequence of events is not there at the start of implementation. The sequence unfolds in the future. If time would be reversible, causality in social reality would be linear, and a particular sequence of events that occurred in the past could be used to perfectly predict future (sequences of) events. Reality, however, is 'developmentally open'. Events occur in implementation, which are unforeseen. Thus, public and private managers can have (quite accurate) expectations about events, and they make plans for implementing projects (which are based on compressions of reality) to manage prospective events, but these plans cannot foresee all possible future eventualities. It means that projects and outcomes emerge in time and that implementations face uncertainty.

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61   Note that this is synchronic emergence. Whereas diachronic emergence assumes that a clear starting point of a sequence of events can be identified, synchronic emergence inherently accepts the limitations of managers' cognitive capacities. It stresses that no clear starting point of a sequence of events can be identified unambiguously (Teisman & Gerrits, 2014).

The time-asymmetric nature of implementation means that evaluation methods that ignore time are inadequate for understanding and evaluating implementation processes.[62] Because future events cannot be precisely calculated/predicted, someone has not necessarily miscalculated and can be named a culprit (see also Section 1.5.3). Accepting this implies that evaluations should be used less for holding actors accountable or blaming and more for learning to adapt to changing conditions.

In the next section, lessons are drawn by briefly presenting the main empirical patterns of the complexity-informed QCA evaluations of the A2 Maastricht (see Chapters 4 and 6), the A15 MaVa (see Chapters 5 and 6), and the twenty-seven project implementations (see Chapter 7).

8.3. THE EMPIRICAL REALITY OF MANAGING THE COMPLEXITY OF PROJECT IMPLEMENTATION

The implementations of the A2 Maastricht and the A15 MaVa projects were accompanied by multiple social and physical unforeseen events. It was found that social events dominate in the implementation challenge. When projects are implemented, stakeholders in the context (e.g., citizens, municipalities, provinces, and waterboards) react in various ways to the implementation. Often, this means that stakeholders refuse to approve of designs and permit applications by the project organization. Implementation managers in the projects respond to these reactions in order to minimize the impact on the construction and delivery process and on the desired outcomes.[63] It was found that the satisfaction of managers with their responses takes various forms. In the implementation of complex infrastructure projects with heterogeneous participants and stakeholders, project success is not only about costs, time, and quality – the dominant measures in the project management and PPP infrastructure fields of research. It entails a wider variety of aspects. Two important additional aspects are stakeholder satisfaction and the public-private partnership relation itself (see also Chapter 7).[64]

The studies showed that managers often choose to use internally-oriented (closed, project-inward) responses; sometimes they use externally-oriented (open, project-outward) responses. The latter recognizes that the stakeholder context is to be managed by emerging and constructive interaction, and acts upon this recognition. This externally-oriented approach contributes to satisfactory outcomes. Shielding the project from the context, the dominant internally-oriented reaction, is less effective.

1. Internally-oriented responses to social events are associated with low satisfaction.
2. Externally-oriented responses to social events are associated with high satisfaction.

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62 Cf. Bressers, Van Twist, and Ten Heuvelhof (2013).
63 Cf. Piperca and Floricel (2012).
64 See also, e.g., Toor and Ogunlana (2010), Kärnä, Junnonen, Manninen, and Julin (2013), Lehtiranta, Kärnä, Junnonen, and Julin (2012), and Leung, Ng, and Cheung (2004).

Public and private managers can also choose to act more autonomously (acting alone), or to respond in a more cooperative fashion (acting together to solve an issue). The A2 Maastricht and A15 MaVa studies showed that the cooperative approach contributes to more satisfaction.

3. Internally-oriented responses by the private partner are associated with low satisfaction.
4. Internally-oriented responses by the public partner or in some form of public-private cooperation are associated with high satisfaction.

From the four patterns (see also Table 6.1),[65] lessons can be drawn. The patterns show that there are several ways for managers to yield satisfactory outcomes (patterns 2 and 4) or unsatisfactory outcomes (patterns 1 and 3). There is no single superior or inferior way for managers to respond to unforeseen events in project implementation; there are multiple ways.[66] Managers will have to reflect on the choice they have to make; it is not the case that anything goes.

Internally-oriented management responses to social events are associated with low satisfaction (patterns 1 and 3). Externally-oriented management responses to social events are associated with high satisfaction (pattern 2). The simple lesson would be to prefer and prescribe an externally-oriented approach. However, an internally-oriented management approach can also be associated with high satisfaction, under the condition that the public and private partners cooperate in the response (pattern 4).[67] That is, they have to apply a joint response to unforeseen events, or the public partner has to intermediate between the private partner and the project's societal environment. Public-private cooperation is thus associated with high satisfaction (pattern 4). Non-cooperation, conversely, is associated with low satisfaction (pattern 3). The simple lesson could thus be to prefer and prescribe the cooperative approach. However, if management is externally-oriented, close

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65   In Tosmana (Cronqvist, 2011), the software program that was used for the analyses of the A2 Maastricht and A15 MaVa projects, consistency and coverage scores are not produced. More recently, this option has become available in R (Thiem & Duşa, 2013c:Ch.5; Thiem, 2015). The consistency and coverage scores, derived with the QCA package in R (Duşa & Thiem, 2014), are as follows. For the patterns in Table 4.6 (i.e., the results of the A2 Maastricht project): pattern [1] (incl. 1.000, cov.r 0.667), pattern [2A] (incl. 1.000, cov.r 0.222, cov.u 0.222), pattern [2B] (incl. 1.000, cov.r 0.111, cov.u 0.111), and pattern 2[C] including the eight cases from the two contradictory rows (incl. 0.667, cov.r 0.667, cov.u 0.667). For the patterns in Table 5.7 (i.e., the final results of the A15 MaVa project): first pattern for SATIS{1} (incl. 1.000, cov.r 0.125, cov.u 0.125), second pattern for SATIS{1} (incl. 1.000, cov.r 0.875, cov.u 0.875), first pattern for SATIS{0} (incl. 1.000, cov.r 0.750, cov.u 0.417), and second pattern for SATIS{0} (incl. 1.000, cov.r 0.583, cov.u 0.250).

66   In other words, causality is characterized by equifinality.

67   Note that the three minor patterns (i.e., the patterns covered by few cases), shown in Chapter 6, are taken together here in pattern 4 because they are logically compatible. This compatibility was confirmed by running the mvQCA for the 38 cases together in a single analysis (Cronqvist, 2011), which produced pattern 4. By taking these three minor patterns together, (1) whether events are social or physical of nature becomes redundant, and (2) 'cooperation' is abstracted further to 'some involvement of the public partner' instead of cooperation/intermediation. Chapter 6 provides a more nuanced elaboration.

cooperation is not a necessity for achieving satisfaction (pattern 2). This tells us that the effectiveness of internally-oriented and non-cooperative responses may be increased by cooperative and externally-oriented approaches, respectively.

The comparison of the A2 Maastricht and A15 MaVa evaluations showed that the A2 Maastricht project is more externally-oriented and cooperation-oriented. This seems to explain why outcomes in responding to events are generally more satisfactory. The A15 MaVa project is less externally-oriented and less cooperation-oriented. This goes hand in hand with the project's less satisfactory outcomes in dealing with events in implementation. Two factors were identified in explaining the differences in management and cooperation orientations.

A. The implementations apply different PPP-models. The A15 MaVa implementation has a concessional model in a DBFM contract and the A2 Maastricht has more of an alliance-like model in a D&C contract.[68] The first model stresses the boundaries and division of responsibilities between the public and private partners and it incites an internally-oriented focus. The latter model stresses cooperation.[69]

B. The projects have different scopes. The A15 MaVa is purely a transportation project with few participants: the principal Rijkswaterstaat and the construction consortium. The A2 Maastricht is an integral project where different local spatial functions are combined, with hence multiple project stakeholders closely tied to each other: Rijkswaterstaat shares the clientship with local governments. This integrality of the project instigated cooperation and an external management orientation.

The evaluation of twenty-seven PPP infrastructure project implementations attempted to corroborate the findings from the A2 Maastricht and A15 MaVa studies. This medium-n evaluation cannot be a perfect match with the two project evaluations, because the data and data-collection strategy are of a different nature.[70] Still, the patterns from the A2 Maastricht and A15 MaVa studies are supported, and amended, by those of the medium-n study.

5. Projects with a broader scope and a D&C contract are characterized by externally-oriented management and a cooperative orientation, and associated with high satisfaction.

6. Projects with a limited scope and a D&C contract are characterized by externally-oriented management and a contractual orientation; this is also associated with high satisfaction.

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68 DBFM stands for Design, Build, Finance, and Maintain. D&C stands for Design and Construct.

69 Another related but different distinction that can be found in the literature is between contractual PPPs (cPPP) and institutionalized PPPs (iPPP). See Marra (2007) and Da Cruz, Somóes, and Marques (2013).

70 Moreover, different and more conditions are included in the analysis which makes it unlikely that the patterns from the two project evaluations are exactly reproduced.

7. Large projects with a limited scope and a D&C contract are characterized by a contractual orientation; this is also associated with high satisfaction.
8. Large projects with a limited scope are characterized by externally-oriented management and a cooperative orientation, and this is associated with high satisfaction.

Comparing these four patterns with those from the A2 Maastricht and A15 MaVa evaluations, several conclusions can be drawn. First, the patterns confirm that there are indeed multiple ways of management responses that yield satisfactory outcomes (patterns 5 to 8). Moreover, externally-oriented management (patterns 5, 6, and 8) and a cooperative orientation (patterns 5 and 8) are indeed associated with high satisfaction. Patterns 6 and 7, however, indicate that a contractual orientation can be associated with high satisfaction as well, in projects with a limited scope. Furthermore, pattern 5 supports the explanation that an integral (i.e., broad) project scope could instigate a cooperative and external management orientation,[71] resulting in high satisfaction.[72] Put alternatively, larger and integral projects may require externally-oriented and cooperative orientations more than smaller and/or limited-scope projects. The patterns from the medium-n evaluation show that different kinds of PPP infrastructure projects may require different management approaches to achieve satisfactory outcomes in implementation.

   The empirical findings of the evaluations in Chapters 4 to 7 do not provide contradictory evidence. Rather, they indicate that externally-oriented management and closer public-private cooperation are generally a 'safer bet' for achieving satisfaction in implementing PPP infrastructure projects. Additionally, in specific cases – whether on the level of responding to unforeseen events in projects (Chapters 4 to 6) or on the project level as a whole (Chapter 7) – other management and cooperation approaches may suffice as well. These findings can inform the planning and implementation of other (future) projects, as will be discussed in Section 8.5.2.

8.4. THE COMPLEXITY-INFORMED NATURE OF QCA

If we want to improve other (future) implementation processes of projects, this requires evaluation. Evaluation can facilitate learning in and across implementation processes of PPP infrastructure projects. Section 8.5.1 discusses how QCA can be used for learning in practical situations, utilizing it as a collaborative, interactive and systematic evaluation instrument, making tacit knowledge in projects explicit.

   A precondition for this is that the method and application have to create a realistic understanding of the implementation being evaluated. It means that the evaluation meth-

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71   Or, at least, they do not disconfirm this. The contract type (D&C or DBFM) and the integrality of a project are at best proxies for the more detailed explanations provided in Chapter 6.

72   Similarly, Nijkamp, Van der Burch, and Vindigni (2002) found that urban PPP projects, with joint-venture models and a broad scope, are likely to be more successful.

odology needs to be complexity-informed. This implies that it has to meet the following four requirements (see also Section 8.2).

1. *Non-decomposability:* because outcomes in/of project implementations emerge from interactions between elements, the method has to be able to evaluate how combinations of elements explain outcomes.
2. *Contingent reality:* because context is explanatory for how outcomes in/of project implementations emerge, the method has to be able to evaluate the role of context in explaining outcomes. Specifically, because context is systemic and dynamic, it has to be capable of:
   a. Identifying project peculiarities that explain outcomes in/of cases, and exploring and identifying patterns in/across cases.[73]
   b. Limited generalization, recognizing that patterns' explanatory values may not apply to all cases at all times.
3. *Non-compressibility:* because managers in project implementations act based on different simplifications of their project reality, the evaluation method has to be able to include these different project realities in the explanation of outcomes.
4. *Time-asymmetry:* because causality is emergent, the evaluation method has to be capable of capturing the time dimension in explaining outcomes.[74] It also implies that it has to accept that perfect prediction of events and outcomes is not possible.

The first requisite is met. QCA is a decidedly configurational approach. This means that it assumes that causality is configurational. In QCA, cases (such as implementation processes or events in implementation processes) are conceptualized as combinations of conditions (i.e., configurations), and these configurations explain an outcome. Although the results of an evaluation with QCA may point to singular conditions being associated with the outcome, QCA assumes a priori that configurations, and not single conditions, produce outcomes. The results of an analysis show the evaluator which configurations.

The second requirement is met. A qualitative comparative analysis starts from the premise that projects are unique and implemented in a unique context. The method is decidedly case-based, assuming that the unique properties could hold explanations for the outcome of interest. Each implementation is first researched in-depth on various project and context-specific properties. The coding of the cases on specific conditions thereafter results in a data matrix. Via the grouping of cases in a truth table, the comparison (i.e., minimization of the truth table) then explicates the patterns in/across them. Basically, the QCA evaluation process can be imagined in terms of the aforementioned T-structure.[75] This is shown in Figure 8.1. The 'leg' of the T is the qualitative study of cases, and via the

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73   The importance of this was also pointed to by Marsden and Stead (2011) in their review of policy transfer and learning in the field of transport research.
74   See also Rogers (2011).
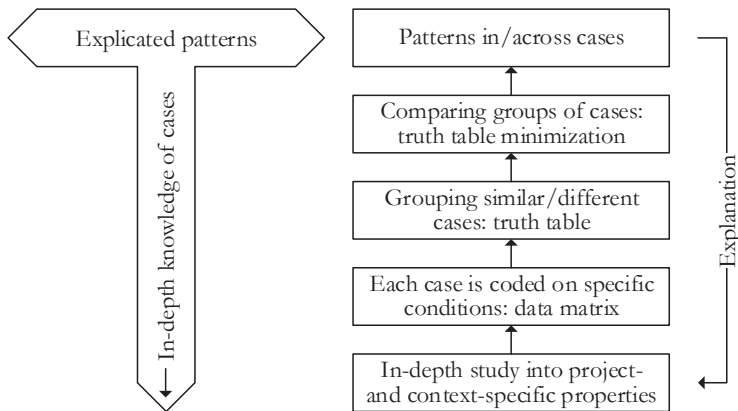75   See Buijs, Eshuis, and Byrne (2009).

Figure 8.1 The T-structure of QCA

data matrix, the truth table, and then the minimized patterns, the evaluator has arrived at the 'roof' of the T. S/he has made tacit knowledge and implicit patterns in/across cases explicit. Once there, s/he has to look down (back) again to be able to explain the explicated patterns.[76] In this way, the QCA process allows the evaluator to iterate between case peculiarities and generic patterns. Importantly, because the studied cases group together in different configurations,[77] limited generalizability of patterns is implied in the method: a pattern only applies to the subset of cases covered by the pattern.

The third requirement is met. QCA in itself does not necessarily imply that the differences between project actors are included in explaining the patterns and outcomes, but it certainly does not rule out this option. The case-based nature of the method means that implementations can be evaluated as cases in various ways. Textbooks on case study research abound, exemplifying a wide variety of case study approaches, methods, and techniques including inductive, grounded approaches. Therefore, QCA can be applied in a grounded way, constructing cases via an inductive process, starting with the perceptions of managers in project implementations. By doing so, as little as possible of the complexity of reality is compressed at the start of the evaluation. In this respect, the complexity-informed approach to QCA deviates from many conventional approaches to, and applications of, the method. Whereas conventional approaches often start with theoretical frameworks so as to select and define cases and conditions, the complexity-informed approach to QCA postpones simplification and starts with the empirical observations of the actors in the projects.[78]

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76 Cf. Rihoux and Lobe (2009) on QCA and the funnel of complexity.

77 That is, equifinality.

78 Cf. Amenta and Poulsen (1994), Befani, Ledermann, and Sager (2007), Hicks (1994), and Yamasaki and Rihoux (2009).

The fourth requisite is partly met. In essence, the time dimension is not captured in the method. Cases as configurations are compared at a certain point in time, not through time. Although a number of proposals are available to include time in QCA,[79] the approach is not a longitudinal one that is able to capture the complex dynamics of implementation processes in its systematic comparative procedures. In the analyses of the A2 Maastricht and A15 MaVa implementations, the temporality of events-responses-outcomes was taken into account by ensuring in the qualitative coding process that events occurred before management responses, after which outcomes were produced. Nevertheless, the outcomes in/of implementations are synchronized with the sequences of events from which they emerged,[80] at the very moment a data matrix is constructed. If evaluators seek to systematically disclose how sequences of events gave rise to outcomes in/of implementation processes, and are not willing to accept a workaround solution to the time problem, other research approaches may be preferred.[81]

However, the notion of an unfolding reality, and the uncertainty about future events and outcomes that this implies, is supported in QCA. This part of the fourth requisite is met. Conventionally, the method is applied so as to identify necessary and sufficient (combinations of) conditions for outcomes. This nomenclature signals the deterministic nature of QCA,[82] which could be construed as that uncertainty is actually not allowed by QCA. However, in the complexity-informed approach to QCA, associations between configurations and outcomes are not causally deterministic – causal in the ontological sense – but logically deterministic.[83] Configurations can, and often have, contradictory outcomes; the relationships between conditions and outcomes in/of projects are not linear; and generalization is limited. These properties of QCA make clear that the notion of uncertainty of causal relations is supported in QCA. This is an important and realistic, but not often desired, insight. In an attempt to diminish the uncertainty, patterns of associations identified with a QCA evaluation provide clear and communicable suggestions for improvements of infrastructure development implementation,[84] e.g., externally-oriented management and public-private cooperation. These are, however, not laws cast in stone.[85]

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79   See, e.g., Caren and Panofsky (2005; cf. Ragin & Strand, 2008), Hak, Jaspers, and Dul (2013) and Hino (2009).

80   Cf. Teisman and Gerrits (2014).

81   See, e.g., Boons, Spekkink, and Jiao (2014) and Spekkink (OnlineFirst).

82   See, e.g., Lieberson (2004) and Mahoney (2008).

83   In fsQCA, this logical determinism is 'relaxed' since conditions or configurations can be almost consistent or partly consistent with statements of necessity or sufficiency (Rihoux, 2006). See also, e.g., Ragin and Rihoux (2004) on fsQCA and determinism.

84   A similar argument is made by Rihoux and Grimm (2006a). See for a critique: Tanner (2014).

85   See also Rihoux (2003).

8.5.   TOWARDS LEARNING IN IMPLEMENTATION

In this penultimate section, the intensions of the thesis are revisited, discussing a number of (potential) implications for evaluation (Section 8.5.1) and implementation management (Section 8.5.2).

8.5.1.   An agenda for learning from evaluation with QCA

When policy-makers, decision-makers, managers, or academics refer to the evaluation of infrastructure projects, they often refer to ex-ante project evaluation. Infrastructure project appraisal methods such as environmental impact assessment, multi-criteria analysis, and especially cost-benefit analysis – and in the case of PPP projects, to an increasing degree methods such as the public sector comparator – are now commonly applied in planning for infrastructure projects (see, e.g., Bristow & Nellthorp, 2000; Browne & Ryan, 2011; Grant-Muller, MacKie, Nellthorp, & Pearman, 2001; Grimsey & Lewis, 2005; Hayashi & Morisugi, 2000; Vickerman, 2007). Because expectations and intentions in planning can easily fail in implementation, evaluation of the implementation phase is, however, at least equally important. Evaluations can contribute to learning how (future) implementation processes of PPP infrastructure projects can be improved (e.g., EVA-TREN, 2008). This requires first that the evaluation method and application take into account the systemic complexity of implementation. This aspect of narrowing the implementation-evaluation gap was addressed in this thesis by establishing and applying QCA as a complexity-informed evaluation approach. Other aspects of narrowing the gap are that evaluations are conducted in the first place, and that the results of evaluations are used in practice. This section proposes an agenda to further increase learning in and of project implementation processes with QCA.

8.5.1.1. Intensified evaluation practice through academia-practice partnerships

Post-contract evaluation in transport infrastructure development receives insufficient attention (cf. Short & Kopp, 2005). Due to its low position on the public agenda, data are often not collected, data are fragmented or lacking quality, or organizations do not or insufficiently allocate resources (e.g., time, budget, skills, or experience) to evaluation (cf. Pattyn, 2014). The fear that evaluation results are used to hold implementers accountable for poor performances can also explain the lack of implementation evaluation (Short & Kopp, 2005; Torres & Preskill, 2001).[86] The implementation of transportation infrastructure projects therefore continues to be based on personal, though unsystematically analyzed, preferences, experiences, and expectations (cf. Pfeffer & Sutton, 2006; Rousseau, 2006) that are possibly inefficient, ineffective, or obstructive to project implementation, without practitioners knowing or acknowledging this.

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86   These reasons were also conjectured in personal communications between the researcher and managers and strategic advisors within Rijkswaterstaat.

It is therefore important that real data from current and past projects are <u>systematically</u> collected and analyzed, so as to verify whether and which past experiences contribute to project implementation (cf. Sager, 2007).[87] This evidence can be the knowledge base for future learning. The significance of learning from the past is even larger in current times of breaking down infrastructure development into sequential and parallel projects,[88] where managers rush from one project to the next. The current trend of outsourcing management tasks – e.g., not all managers of Rijkswaterstaat projects are Rijkswaterstaat staff (or 'Waterstaters') – further challenges the learning of projects, because gained knowledge and experiences leave once projects are finished (cf. Lei & Hitt, 1995). Individual people learn, but new managers will start 'from scratch'. The knowledge gained in the projects is partial and not automatically institutionalized on the organizational level to inform the planning and implementation of future projects (Bakker, Cambré, Korlaar, & Raab, 2011; Boh, 2007; Cooper, Lyneis, & Bryant, 2002). More systematic evaluation is thus needed.

The potentials for systematic evaluation are there, but largely unrealized. Rijkswaterstaat collects qualitative and quantitative project data on a periodic basis about a wide variety of conditions – e.g., budget, planning, risks, project context, contractual issues, personnel, quality, and scope. These data are used for project accounting, but hardly for evaluation.[89] There seems to be an underdeveloped evaluation culture in the implementation domain.[90] One way to accomplish intensified post-contract evaluation of (PPP) transportation infrastructure projects (cf. Siemiatycki, 2009) is to create a partnership between practice and academia to take up the evaluation challenge (e.g., Verweij et al., 2015; Chapter 7). In this way, researchers can gain real project data to evaluate (Short & Kopp, 2005), and public organizations can use the research resources (e.g., time, budget, experience) for their own learning (cf. Torres & Preskill, 2001). Such a partnership between academia and practice (e.g., Verweij et al., 2015; Chapter 7) could help closing the gap between implementation and evaluation.

The partnerships in evaluation should consist of academics, public procurers, stakeholders from the environment, and private contractors (e.g., Bressers, 2011). The inclusion of the variety of actors in the evaluation is important for three reasons. First, infrastructure projects are implemented in a context of heterogonous stakeholders and managed by heterogeneous public and private actors. These project stakeholders and participants draw specific boundaries. That is, they have partial knowledge. By including a multitude of actors and perspectives in the evaluation, the data, knowledge, and experience base – the evidence base – can be broadened and strengthened (cf. Chapters 2 and 3 on negotiated

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87   Note that QCA can only be applied to real (i.e., non-artificial, non-simulated) data because case-knowledge is required in the QCA process. See, e.g., Ragin (2014) and Olson (2014) for recent arguments against using simulated data in QCA. See also Byrne and Callaghan (2013:51-55).

88   This is also referred to as the 'projectification' of infrastructure development (cf. Maylor, Brady, Cooke-Davies, & Hodgson, 2006).

89   This is derived from personal communications with a strategic advisor and a project management specialist within Rijkswaterstaat, who both are concerned with training and learning in the organization. This communication took place during the employment as a visiting researcher at Rijkswaterstaat (see Chapter 7).

90   Ibid.

subjectivism).[91] Second, a collaborative evaluation process may lead to increased interaction, trust, consensus, and mutual learning (see, e.g., Bryson, Crosby, & Stone, 2006; Greene, 2001). This can improve the quality of cooperation, contributing to the satisfaction of outcomes (Section 8.3). Third, knowledge that is co-created becomes immediately part of a feedback loop into the practice that is being evaluated, thus enhancing evaluation utilization and learning (Patton, 2011).

In sum, more systematic evaluation is needed, and creating partnerships between stakeholders, public, private, and academic actors in the evaluation process is important to increase the learning potential of evaluations (cf. Edelenbos & Van Buuren, 2005; Van der Meer & Edelenbos, 2006). It is proposed here that qualitative comparative analysis can be instrumental to this purpose.

8.5.1.2. *Qualitative comparative analysis as a collaborative and interactive learning tool for evaluation[92]*

The QCA approach can be a valuable addition to the evaluation toolbox (Stern et al., 2012). It has been proposed in the evaluation literature before (see Section 1.5.2),[93] inter alia as a method for realistic evaluation (Befani & Sager, 2006; Befani et al., 2007; Sager & Andereggen, 2012). This section adds to this literature by proposing QCA as an approach for collaborative and interactive evaluation (cf. Varone et al., 2006).[94] As such, it can be a valuable tool for learning. Its grounded and dialogical nature (e.g., Fritzsche, 2014; Rantala & Hellström, 2001) facilitates the inclusion of, and interaction between, a multitude of heterogeneous actors and perspectives. Additionally, its comparative and systematic procedures allow the variety of data, knowledge, and experiences (evidence) to be compressed in a communicable, generalized format. This is important for utilization (Greene, 1988), but often lacking in interactive and dialogical types of evaluation (Edelenbos & Van Eeten, 2001).

There are three dimensions of learning with QCA.[95] This is depicted in Figure 8.2. The first involves learning across projects. The cases being compared are projects or project implementations (e.g., Chapter 7). Cross-project comparison tells us what kinds of projects require what kind of implementation management, and how projects can be managed more effectively by adapting lessons from successful cases.[96] For instance, the analysis in

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91   In other words, a quadruple helix brings a variety of tacit knowledge together and gives evaluators the opportunity to create explicated knowledge in a systematic way.

92   For this subsection, some basic knowledge about QCA is assumed, which can be acquired by studying the previous chapters.

93   See also Gerrits and Verweij (Accepted).

94   The proposal outlined here is informed by a QCA experience with multiple researchers (i.e., Verweij, Klijn, Edelenbos, & Van Buuren, 2013).

95   Similarly, Rihoux and Lobe (2009) state that cases can be macro-, meso-, or micro-level.

96   Importantly, as Marsden and Stead (2011) rightly suggest, lessons learnt should not be adopted but rather adapted to other cases because cases' different contexts may influence, e.g., the effects sorted by certain management strategies. What (not) works in one context does not necessarily (not) work in other contexts (Engwall, 2003; Chapters 2 and 3), as the empirical results of this thesis also indicate (Chapters 4 to 7).
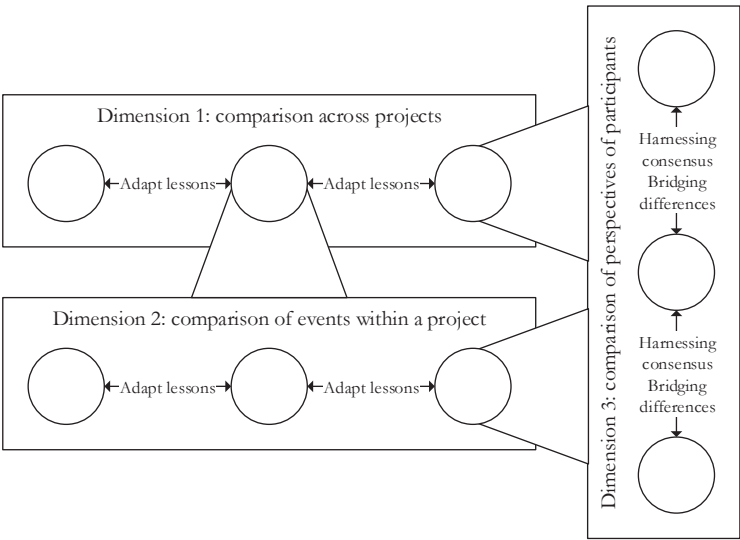
Figure 8.2 Three dimensions of learning with QCA

Chapter 7 showed that large, integral projects (broad scope) may require a cooperative management orientation (see Section 8.3): configurations 31 and 32 in the truth table (Table 7.2) illustrate that the same type of project (D&C contract, broad scope, and large size) has a higher satisfaction with a cooperative orientation (configuration 32), than without (configuration 31). This suggests that the projects of configuration 31 may have to adapt their cooperation strategy so as to achieve more satisfactory outcomes.[97]

The second dimension is learning within projects, by comparing events or situations within a project implementation (e.g., Chapters 4 and 5). This tells the project managers what kinds of situations require what kind of management, and how adapting their management strategy may generate better outcomes. For instance (see Chapter 6), managers that responded to social events with internally-oriented management are advised to adapt: either they respond externally-oriented in future cases, or public and private managers respond jointly (see Section 8.3).

The third dimension concerns learning about project participants' perspectives in a project – with regard to the project or events/situations within a project (see Figure 8.2) – by comparing these perspectives on certain aspects. Each participant is a case

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97   Metaphorically speaking, the truth table can be imagined as an n-dimensional space or landscape where some coordinates are associated with higher performance and other coordinates with lower performance. The distance between two coordinates in the landscape is defined by the number of conditions in which two configurations in the truth table differ. Actors might alter their strategies (e.g., cooperative orientation) so as to 'move to' a different coordinate on the landscape to gain higher performance. Future methodological research might study the links between QCA and the notion of fitness or performance landscapes (cf. Poon, Chan, Poon, & Land, 2013). See Gerrits and Marks (OnlineFirst) for an overview of fitness and performance landscapes in the social sciences.

(cf. Kort, Verweij, & Klijn, Accepted). For example, instead of comparing events in a project, each manager's perspective of the event with regard to how it was managed can be studied. Comparison of perspectives tells the participants where there is common ground or mutual understanding between them (i.e., when managers are positioned in the same or similar truth table rows), or where perspectives diverge. The assessment of similar and dissimilar perspectives can show where consensus between participants can be harnessed, and where differences can be sought to be bridged.

Collaboration and interaction between the evaluation participants occurs throughout the QCA process, due to the dialogue between ideas and evidence that characterizes QCA (see, e.g., Berg-Schlosser et al., 2009; Ragin, 1987). This is shown in Figure 8.3. As the figure depicts, the process consists of four steps: casing, calibration (data matrix), truth table analysis, and dealing with contradictions.
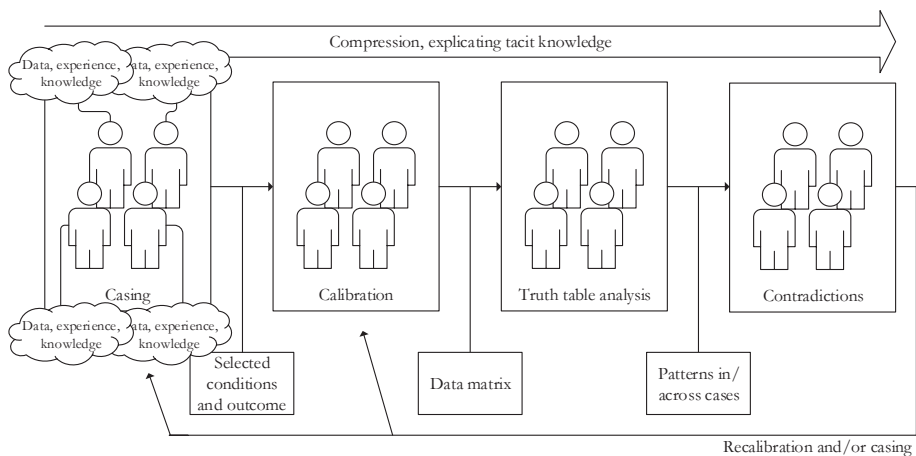

Figure 8.3 QCA as a collaborative and interactive tool for evaluation

The first step, 'casing' (see Carter & Sealey, 2009; Ragin, 1992), is the initial construction of cases. Various project data, project experiences, and project knowledge are shared between the evaluation participants. More precisely, casing involves the construction of cases as configurations of conditions (cf. Byrne, 2005) by using empirical evidence. The decision as to which conditions are to be included in the evaluation is part of the discussion (grounded), thereby taking into account that participants may have different perspectives and ideas about this (Patton, 2008). If conditions would be predefined by the evaluator, participants might take obstructive attitudes towards the evaluation and its results instead of using it and learning from it (Patton, 2008). The grounded casing also ensures that as little as possible of the complexity of the cases is compressed at the start of the evaluation. This is important for a broad evidence base for learning. Basically, this step

answers the question as to what is/are the outcome(s) of interest, and which conditions could explain the outcome(s).

The second step is calibration, where the case constructions by the participants have to be quantified into a data matrix. Each row in the data matrix represents a case. Each case is scored on the selected conditions that constitute the case. By quantifying the cases, tacit knowledge of projects (first dimension), in projects (second dimension), and of perspectives (third dimension) is made explicit. The quantification forces the evaluation participants to reflect upon and explicate their knowledge and perspectives of/on the conditions. In this calibration process, interaction occurs between the participants from different projects, in events, or with different perspectives: because of the case-comparative nature of QCA, they have to reach agreement on the scales used for scoring the cases. Multiple options are available that accommodate different scales for scoring cases on the conditions: crisp-set QCA, multi-value QCA, and fuzzy-set QCA (see, e.g., Rihoux & Ragin, 2009a; Schneider & Wagemann, 2012). If participants disagree about the score of a project or event on a certain condition or outcome, a fuzzy scale ranging from 0 to 1 can accommodate the diverging views of the participants regarding these conditions/outcomes. Alternatively, if a participant is a case, fuzzy or multi-value scores can accommodate participant views that are not simply expressed in a binary ('yes or no') fashion (e.g., Kort et al., Accepted). Basically, the second step answers the question as to how the different cases score on the outcome and the conditions.

The third step, as shown in Figure 8.3, is the construction and analysis of the truth table. The rows in the truth table represent the various different combinations of conditions (configurations) that are possible. The construction of the truth table involves the grouping of cases: projects, events, or perspectives that are similar are positioned in the same row. It means that a variety of data, knowledge, and experiences is compressed into patterns. The analysis highlights the similarities and dissimilarities (cf. Ragin & Amoroso, 2011) across cases. The truth table is a tool that explicates the different options for adapting lessons from successful cases (first and second dimensions of learning) to improve other (future) cases (cf. Bakker et al., 2011), or where consensus between perspectives can be harnessed and where differences can be bridged (third dimension of learning).

It often occurs that a truth table row is a logical contradiction: the same configuration is associated with both the outcome in some cases and the negation of the outcome in other cases (see, e.g., Table 4.5).[98] As a fourth step, this contradiction has to be dealt with. It requires that the evaluation participants return to the previous steps of the QCA process (see Figure 8.3). There are multiple ways of dealing with contradictions (see, e.g., Rihoux & De Meur, 2009). For instance, a contradiction can signal that an additional condition explains the different outcomes of the similar cases (casing). Alternatively, it may signal that previous scorings of cases (calibration) – projects, events in projects, or participant perspectives – have to be revisited. In this way, the occurrence of contradictions enforces iterations between the steps in the QCA process. This is shown with the bottom arrows

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98   In fsQCA, contradictions are indicated by lower consistency scores of truth table rows (cf. Rubinson, 2013).

in Figure 8.3. It requires that new evidence is brought to the table and discussed, thereby further increasing interaction and collaboration between participants.

When the contradictions are solved, the truth table can be minimized. The minimization is the final compression in the QCA process. It results in a generalized pattern (i.e., the solution formula) using Boolean algebra. Several examples of these generalized patterns can be found in the empirical chapters of this thesis (Chapters 4, 5, and 7). The patterns communicate the substantive results of the evaluation process, showing what the core conditions or perspectives are that explain the outcome of interest.

The dialogical QCA process of knowledge co-creation started with a variety of data, knowledge, and experiences, which are gradually compressed – via the construction of the data matrix and subsequently the truth table (see also Figure 8.1) – into a communicable, generalized format.[99] In the process, tacit knowledge has been explicated in a transparent and systematic manner.

This thesis has established and applied QCA as a complexity-informed approach, thereby narrowing the gap between implementation and evaluation. This section has additionally proposed QCA as a collaborative and interactive approach for evaluating infrastructure PPP project implementation processes, so as to further narrow this gap. Its true worth as such for learning from evaluation, however, has to be tested in future evaluation practices.

8.5.2. Managing project implementation processes: boundaries in public-private partnerships

Empirical patterns such as in Section 8.3 are not deterministically causal. Each case is unique; simply adopting (copying) 'best practices' can lead to disappointing outcomes because cases have different public-private-context relations. The context matters. The patterns, however, can help to serve learning. They do provide clues – they are a 'flashlight' (Rihoux, 2003) – as to where improvements in implementation strategies can be found. A number of improvements are discussed here.

8.5.2.1. Public-private boundaries in implementation

Public-private partnerships can be found in many forms, types, uses, and meanings (e.g., Klijn, 2010; Linder, 1999; Schaeffer & Loveridge, 2002; Weihe, 2008a; Wettenhal, 2003). A dominant type in PPP discussions is the DBFM concessional model (Reynaers, 2014). On the spectrum from wholly public sector projects (i.e., public sector procurement) to wholly private sector projects (i.e., privatization), DBFM is often positioned somewhere in the middle (Bult-Spiering & Dewulf, 2006; Koppenjan, 2008; Kwak et

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99   The QCA process adheres to the 'logic of discovery' (see Chapter 2) which incites reflexivity and interaction in evaluative processes (Patton, 2011:283-287). This logic is "built around a dialogue process of discovery. The dialogue is back and forth between possibilities (hypotheses) and explanations, with observations (data) mediating the dialogue" (Patton, 2011:286).

al., 2009; Yescombe, 2007). This could imply that it is the ultimate type of public-private partnership. However, the contracting-out nature of DBFM contracts is in sharp contrast with the idea of a true partnership between the public and private parties, where public and private partners cooperate – cooperation in the sense of interactive processes of joint problem-solving – in implementing a transportation infrastructure project (Klijn & Teisman, 2000a; 2005; Teisman & Klijn, 2002).[100]

The study in Chapter 5 supports the view that the DBFM concessional model generates clear boundaries between the public and private partners in terms of their tasks, roles, risks, and responsibilities (Eversdijk & Korsten, 2008; Klijn & Teisman, 2000a; 2005). This model is increasing in popularity. Rijkswaterstaat, the Dutch major public procurer of transportation infrastructure, provides a case in point.[101] It is guided by the principle 'the market unless' (see Goverde, 2012; Metze, 2010; Van den Brink, 2009). The principle dictates that the market is responsible for implementation. Rijkswaterstaat as the public principal takes a backseat position in implementation. Keeping this distance to implementation, and a clear contractual division of tasks, roles, risks, and responsibilities, serves government's desire to safeguard the separation of public and private accountability and by doing so creating transparency in PPPs. Monitoring and control mechanisms, not cooperation, then become the instruments applied by the public principals (Forrer, Kee, Newcomer, & Boyer, 2010; Reynaers & De Graaf, 2014).

This research (see Chapters 4 and 5) on implementation processes of transportation infrastructure projects, however, highlights the need for cooperation in unpredictable and dynamic socio-physical contexts, especially for achieving satisfactory outcomes in projects with broader scopes (Chapter 7). Cooperation requires that the clear public-private boundaries are crossed.[102] It points to the need for managing project implementations not 'to the letter' but 'in the spirit' of the contract (Da Cruz et al., 2013). Whereas the first incites contractual discussions about which partner was responsible for risks that occurred (e.g., the A15 MaVa project), the latter accepts that in the face of project uncertainty and dynamics, the public and private partners must be flexible, setting aside public-private differences when a situation requires it, thus operating side-to-side to manage ongoing issues that often will arise during implementation (e.g., the A2 Maastricht project) (cf. D'Alessandro, Bailey, & Giorgino, 2014; Da Cruz & Marques, 2012).[103]

It is suggested in the literature that alliance-like PPP models are more likely to allow managing 'in the spirit' of the contract (see, e.g., De Brux, 2010). Empirical Dutch cases indicate that alliance might help to deal with uncertain, heterogeneous, and dynamic

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100 See also, e.g., Lawther and Martin (2014:222-223).

101 See, e.g., http://www.rijkswaterstaat.nl/zakelijk/zakendoen_met_rws/werkwijzen/gww/contracten_gww/dbfm/index.aspx (last accessed on the 13th of January, 2015).

102 Put differently, rigid contract structures are to be relaxed (cf. Chapters 4 and 6) so as to achieve satisfactory outcomes that are best-for-project (cf. Cruz & Marques, 2013; Da Cruz et al., 2013; Sakal, 2005).

103 It is argued that, because of the inherent uncertainty and unpredictability of events in projects, PPP contracts are incomplete by definition. This requires management 'in the spirit' of the contract as opposed to 'to the letter' of the contract. Whereas the first allows for renegotiation and problem-solving, the latter is more rigid and sticks to the contract thus creating contractual conflicts (see De Brux, 2010).

stakeholder environments (e.g., Neele, 2003). Alliance-like PPPs, such as the A2 Maastricht project (Chapter 4), allow cooperation across public-private boundaries (see Chapter 6). The focus is less on monitoring and control mechanisms, and more on breaking down public-private organizational barriers (Grimsey & Lewis, 2004), thus pooling public and private resources (e.g., skills or experience) to manage arising and ongoing issues. Attention is centered on the project and not on the individual partners (Grimsey & Lewis, 2004). Table 8.1 summarizes differences between the two models.

Table 8.1 Trade-offs between the two PPP implementation models

Appearance	DBFM	Alliance
Strength	Transparency and a clear division between the public and private partners.	Managing 'in the spirit' of the partnership contract: cooperation across public-private boundaries.
Challenge	Managing 'in the spirit' of the partnership contract: cooperation across public-private boundaries.	Maintaining transparency and a clear division between the public and private partners.

A specific aspect at which the public-private boundaries discussion becomes apparent is *stakeholder management* in implementation.[104] The current trend seems to be that the public-private boundaries drawn in PPP transportation infrastructure implementation delegate most responsibilities for stakeholder management to the private consortium (cf. Eversdijk & Korsten, 2008; Verweij et al., 2014). This is evident in the DBFM model (see Chapter 5). This leaves untapped, however, the potential strength of PPPs to cooperate across public-private boundaries (see Table 8.1), pooling public and private resources to manage arising and ongoing stakeholder issues in implementation.

An important resource is the public principal's relationships with stakeholders in the socio-physical system with which the project interacts. Public principals, such as Rijkswaterstaat, are often longstanding governmental organizations that are part of established, institutionalized (local) networks of actors. These networks consist of, inter alia, political organizations, permitting authorities (e.g., municipalities, provinces, waterboards, and port authorities), and citizen and business groups (Koppenjan & Klijn, 2004), as can be seen in the A2 Maastricht and A15 MaVa projects (Chapters 4 and 5). Private construction consortia are not part of these established networks.[105] Rather, they are ad hoc visitors (or more negatively: intruders) to the socio-physical system (Verweij et al., 2014). This means that private partners have less-developed relationships with the stakeholder environment. Because the public principal has more-developed relationships with the local stakeholders, it is better able to anticipate and respond to arising stakeholder-related issues (cf. Klijn & Teisman, 2000a). This can be seen in the A2 Maastricht and A15 MaVa projects. For

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104 In Dutch, this is often referred to as *omgevingsmanagement*.

105 Cf. Siemiatycki (2011) on the temporary but punctuated nature of PPPs as systemic public-private networks.

instance, in the A2 Maastricht, when a local vocational school objected to the phasing of a road bypass, the public manager, who was familiar with the school and its interests, successfully engaged in a negotiation process with the school (see Chapter 4). In contrast, Rijkswaterstaat in the A15 MaVa DBFM project implementation initially did not use its standing relationships with local stakeholders to its maximum potential (Chapter 5). Whereas it had the more-developed relationships with stakeholders, the clear division of tasks, roles, and responsibilities was stressed instead: private consortium A-Lanes A15 was initially left alone to manage stakeholders-related issues. Only later did Rijkswaterstaat step forward (it crossed the public-private boundary) to intermediate between the stakeholders and the private consortium, after which the difficult relationship between A-Lanes A15 and the stakeholders improved.

This discussion shows that in projects implemented in uncertain, heterogeneous, and dynamic stakeholder environments, careful consideration is needed about which partner has the best skills for stakeholder management (cf. De Schepper et al., 2014). In contrast to what is often desired in DBFM, this is not necessarily the private partner. The task of, and responsibility for, stakeholder management in transportation infrastructure project implementation should not necessarily be (fully) transferred to the private sector (cf. Leendertse & Arts, 2013). Especially in larger, multifaceted implementation processes, tasks, roles, and responsibilities for stakeholder management may be allocated to the public principal, or the public and private partners may organize stakeholder management in an alliance-like manner, as in the A2 Maastricht project (cf. De Schepper et al., 2014).

This is not to say that the DBFM concessional model should be abandoned (cf. Chapter 7). Rather, in light of the increasing popularity of the DBFM model, both in the Netherlands (Reynaers, 2014) and beyond (see Siemiatycki, 2009),[106] this discussion raises the question as to how the specific public-private boundaries should be drawn in DBFM project implementation (cf. Eversdijk & Korsten, 2008).[107] The suggestion here is that the strengths of DBFM can be combined with those of the alliance-model (see Table 8.1), by way of organizing stakeholder management in an alliance embedded in a DBFM project.[108] This can improve project implementation processes, especially when the stakeholder environment is more complex, i.e., heterogeneous and dynamic. Future practices and research may further enquire into this option.

8.5.2.2. *Public-private-context boundaries in implementation*

The discussion in the previous subsection focused on the boundaries between the public and private project partners. Implementation also concerns the inclusion and exclusion of stakeholders. This boundary between the public-private partnership on the one hand, and

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106 This concessional type of PPP closely resembles the DBFO (Design, Build, Finance, and Operate) or DB-FMO (Design, Build, Finance, Maintain, and Operate) contract (Bult-Spiering & Dewulf, 2006; Grimsey & Lewis, 2004; Yescombe, 2007).

107 It was not possible to investigate this with the available information in the Rijkswaterstaat database.

108 Frits Verhees pointed me in the direction of this idea.

the stakeholder context on the other, will have to be dealt with effectively. An important question is who gets to participate and how (De Schepper et al., 2014; Verweij et al., 2014).

In the A15 MaVa project, local stakeholders were more excluded from the process (see Chapters 5 and 6; Verweij et al., 2014). In the A2 Maastricht project, they were much more included, especially by the Municipality of Maastricht (see Chapters 4 and 6; Verweij, 2012a). Implementation can thus vary in how stakeholders and their interests are included. This can be understood as the paradoxical choice between internalizing and externalizing contextual complexities (cf. Verweij & Gerrits, 2011). Internalizing means that stakeholder interests and interactions become an organized part of implementation processes. It leads to a more complex perceived implementation process, but it also means that the interests become more visible and easier to anticipate and respond to: uncertainty might decrease (cf. Aaltonen, Kujala, Lehtonen, & Ruuska, 2010; Ward & Chapman, 2008). In the A2 Maastricht project, for instance, regular meetings with citizens and businesses were organized to inform them, simultaneously informing the managers about the concerns of the local community. This allowed them to anticipate these concerns. Externalizing the stakeholders can be considered as attractive because it creates a simpler perceived implementation as fewer actors and interactions are part of it, but it can imply a less-developed 'stakeholder antenna' thus increasing uncertainty (cf. Gerrits, 2012; Pel, 2009; Verweij et al., 2014). Stakeholder exclusion can create delays and overruns (cf. De Hoo, 1982; e.g., Chapter 5) when stakeholders become active themselves without invitation. In the A15 MaVa project, for example (see Table 5.1), citizens' interests were voiced via local municipalities that were not included in the public-private partnership (an unforeseen event), resulting in the temporary stoppage of piling works. Table 8.2 summarizes differences between stakeholder inclusion and exclusion.

This dilemma between internalizing and externalizing can be understood as achieving balance between control and co-creation (cf. Edelenbos et al., 2009; Hertogh & Westerveld, 2010). The classical challenge is to draw the initial participation boundaries and redraw them when needed before stakeholders in the context react against the project (cf. Boons, Van Buuren, Gerrits, & Teisman, 2009:244-245; Verweij et al., 2014). Literature indicates that more complex project contexts (environments) need more complexified implementation approaches (cf. Boisot & McKelvey, 2011; Morgan, 2006:33-71). Future research will have to delve into the public-private configurations of tasks, roles, risks, and responsibilities that are most effective for achieving this balance in different project contexts (cf. Verweij et al., 2013).

Note that stakeholder participation in infrastructure implementation is lower than in many spatial planning processes (El-Gohary et al., 2006). In the planning literature, many authors agree that open, more inclusive, participatory public consultation processes are favorable over closed, technical, non-participatory processes (e.g., Booth & Richardson, 2001; Edelenbos & Klijn, 2006; Forester, 1999; Healey, 1997; Innes & Booher, 2010; Koppenjan & Klijn, 2004; Verweij et al., 2013). It is argued that open and participatory approaches increase accountability, democratic legitimacy, innovativeness, and richness of solutions (e.g., Lenferink, Tillema, & Arts, 2013a), and also performance. In the domain

Table 8.2 Trade-offs between stakeholder inclusion and exclusion

	Stakeholder inclusion	Stakeholder exclusion
Description	Interests of and interactions with stakeholders are internalized.	Interests of and interactions with stakeholders are externalized.
Example	Inviting stakeholders to have a look behind the scene and to voice their interests in organized meetings.	A more distant relationship; stakeholders are informed via websites or mailings.
Advantage	Having a better stakeholder antenna thus decreasing uncertainty.	Lower perceived complexity thus less stakeholder relations that need to be managed (costs less project resources).
Challenge	Higher perceived complexity thus more stakeholder relations that need to be managed (costs more project resources).	Having an accurate stakeholder antenna that decreases uncertainty.

of infrastructure project implementation, once the shovel hits the ground, it is assumed that less internalization is needed. Some studies (Dimitriou et al., 2013) indicate that in the pre-implementation phase projects should be treated as open systems for reasons such as just mentioned, and that the projects should be treated as closed systems during implementation (i.e., construction and delivery). This thesis warns against too closed project orientations.

Indeed, the danger is that the open and participatory stakeholder approach in planning a project is disconnected from the closed and non-participatory approaches in implementation. In the period between planning and implementation (procurement and project design), the project can become a black box for local stakeholders because they are often not allowed (by law) to participate in procurement processes. The significant risk is that stakeholder support/understanding for the project dwindles, and that detailed decisions are made in procurement and design that stakeholders oppose to in project implementation (see, e.g., Hertogh, Baker, Staal-Ong, & Westerveld, 2008). It is, therefore, important to minimize the gap between planning and implementation processes. One possibility is to interweave public planning, consultation, and procurement processes (see, e.g., Lenferink, Arts, Tillema, Van Valkenburg, & Nijsten, 2012; Van Valkenburg & Nagelkerke, 2006; Chapter 4). The management of stakeholder interactions and events in implementation, however, remains of unabated, pivotal importance for satisfactory outcomes in transportation infrastructure project implementation (Chinyio & Olomolaiye, 2010; Hertogh et al., 2008). Solutions for this, pointed out in thesis, are externally-oriented management and/or public-private cooperation (see Section 8.3).

8.6. CONNECTING IMPLEMENTATION TO PLANNING

Implementing transportation infrastructure projects is an inherently complex and uncertain endeavor. This thesis builds on this notion to stress that it is important for people

involved in project management, public-private partnerships, and project evaluation to learn to cope with complexity. As an insurmountable consequence of the complexity-informed research, boundaries were drawn to restrict the scope of this study. This reduced the complexity of this research and made it manageable. For instance, the research focused on current road transportation infrastructure projects in the Netherlands. Therefore, this thesis does not claim that its conclusions necessarily apply to other projects (e.g., water infrastructure or utilities), in the past or in the future, in other countries. Perhaps the most significant boundary, however, was the choice to focus on the implementation phase of infrastructure projects. This drawn boundary neglected the important fact that much has already happened in projects before the shovel hits the ground, inter alia, planning and procurement. As projects emerge through time, the pre-conditions for successful implementation are born (long) before shoveling starts (path dependency). These pre-implementation paths are blind spots in this study, as, vice versa, project implementation is in studies in spatial planning. By connecting the results of this study to other – both existing and future – studies and practices of PPP infrastructure development at large, we (might hope to have) learn(t) a bit more about how we can continue to improve the development of PPP infrastructure projects.

Summary in Dutch

1. AANLEIDING, DOELSTELLING EN RELEVANTIE VAN HET ONDERZOEK

Dit proefschrift gaat over het managen van complexe implementatieprocessen van publiek-private samenwerking (PPS) infrastructuurprojecten en het evalueren hiervan met de methode 'systematische kwalitatieve vergelijkende analyse', ofwel *qualitative comparative analysis (QCA)*.

Tegen de achtergrond van de vaak tegenvallende prestaties van infrastructuurontwikkeling, zoals kostenoverschrijdingen, tijdsoverschrijdingen en sociale onvrede en onenigheid, hanteren de praktijk en literatuur op het gebied van (PPS-)infrastructuurontwikkeling vaak een risicoperspectief. Dit perspectief gaat uit van een realiteit die kenbaar en calculeerbaar is. Risico's worden geïdentificeerd, gecalculeerd en neergelegd bij die publieke of private partner die het beste in staat is het risico te managen. Evaluaties van projecten wijzen dan vaak in de richting van ineffectieve of strategische risico-identificatie, -calculatie en -management als oorzaken van tegenvallende prestaties. Echter, de realiteit van de implementatie van infrastructuurprojecten is niet perfect kenbaar en calculeerbaar. Zij is fundamenteel complex.

Er gaat in de praktijk en literatuur veel aandacht uit naar het plannen van projecten. Maar hoe zorgvuldig ze ook gepland zijn, tijdens de implementatie van projecten – 'zodra de schop de grond ingaat' – treden er gebeurtenissen op die vaak onvoorzien en ongepland waren. Als deze complexiteit wordt herkend en erkend, dan richt de aandacht bij projectevaluaties zich op de vraag wat kan worden geleerd van eerdere ervaringen met het management van de gebeurtenissen, teneinde toekomstige gebeurtenissen en projecten effectiever te managen. Hieraan contribueren is de eerste doelstelling van het onderzoek. De fundamentele complexiteit van infrastructuurontwikkeling stelt ook eisen aan de te gebruiken evaluatiemethode. De methode moet de complexiteit erkennen; zij moet complexiteit-geïnformeerd zijn. Evaluatiemethoden die dat niet zijn vormen een onrealistisch begrip van implementatieprocessen met het gevolg dat lessen uit evaluaties weinig zeggen over wat wel en niet werkt, in welke context en waarom. Dit bemoeilijkt leren van evaluaties. Het identificeren van de eisen waaraan de complexiteit-geïnformeerde

evaluatiemethode moet voldoen, en het bepalen van de mate waarin QCA aan deze eisen voldoet, is de tweede doelstelling van het onderzoek.

De doelstellingen zijn vervat in de volgende centrale onderzoeksvraag: *hoe kan de implementatie en het management van PPS-infrastructuurprojecten worden begrepen en geëvalueerd vanuit een complexiteitsperspectief met QCA, en welke managementstrategieën in projectimplementatie leveren (on)bevredigende uitkomsten op en hoe kan dat worden verklaard?*

Met het onderzoeken van deze vraag wordt beoogd bij te dragen aan verschillende literaturen. Dit wordt hieronder kort besproken.

1.1.   Complexiteit en QCA

Uit de complexiteitsliteratuur wordt duidelijk dat complexe systemen, zoals implementatieprocessen van PPS-infrastructuurprojecten, emergeren uit de interactie tussen een veelheid aan elementen binnen het systeem en met de context van het systeem. Een noodzakelijke voorwaarde voor het begrijpen van complexe systemen is dus dat de details en context ervan worden bestudeerd. Casusstudies zijn hiervoor een geschikte methode. De complexiteitsliteratuur maakt ook duidelijk, omdat systemen met elkaar interacteren in een deels gedeelde context, dat er gelijkenissen of patronen tussen systemen kunnen worden ontdekt. Deze patronen zijn belangrijk om lessen uit casusstudies relevant te maken voor andere casus. Echter, casusstudies kunnen moeilijk worden gebruikt om generaliseerbare patronen te ontdekken. Dit proefschrift voegt QCA toe aan de complexiteitsliteratuur als een geschikte methode om de bestudering van details en context te combineren met de noodzaak van patroonontdekking.

1.2.   Evaluatie en QCA

QCA is een methode in opmars. Literatuurreviews laten zien dat het aantal QCA-toepassingen, waaronder in de bestuurskundige literatuur, de laatste jaren sterk is toegenomen. Ook in de evaluatieliteratuur wordt steeds meer over QCA geschreven. Daar wordt het onder andere geconceptualiseerd als een geschikte methode voor theorie-gestuurde, realistische evaluatie. In dit proefschrift wordt QCA geconceptualiseerd als complexiteit-geïnformeerd. Het wordt daarmee toegevoegd aan de QCA- en evaluatieliteratuur als een meer *grounded* methode. Als zodanig herkent en erkent QCA de complexiteit van projectimplementatie en daarin de heterogeniteit van de betrokken publieke en private partners en projectstakeholders. Dit maakt QCA als complexiteit-geïnformeerde methode geschikt voor leren van evalueren. De empirische studies in dit proefschrift introduceren QCA tevens in het veld van, en de literatuur over, (PPS-)infrastructuurprojecten.

1.3.   Projectmanagement en infrastructuurprojecten

De literatuur over het management van infrastructuurprojecten wordt gedomineerd door benaderingen die projectmanagement opvatten als een rationeel proces. Projecten zijn

dan gesloten systemen die volgens vooraf opgestelde protocollen en planningen worden uitgevoerd. Dit is echter geen realistische opvatting van projectmanagement. Projecten worden niet geïmplementeerd in isolatie; ze interacteren met de sociaal-fysieke context waarin ze worden uitgevoerd. Projecten zijn open systemen. Hoewel de fundamentele complexiteit van projectimplementatie in toenemende mate wordt herkend en erkend, wordt hieraan nog onvoldoende gevolg gegeven in het begrijpen en bestuderen van projectimplementatie. Dit proefschrift geeft gehoor aan de roep in de projectmanagementliteratuur om meer situationele, contextuele benaderingen van projectmanagementonderzoek. Dit wordt gedaan door projectimplementatie en -management te conceptualiseren vanuit een complexiteitsperspectief en dit toe te passen in empirische studies.

1.4. Publiek-private samenwerking en infrastructuurprojecten

Publiek-private samenwerking is geen nieuw fenomeen. Wel geniet het de laatste decennia toenemende populariteit bij overheden als middel om de prestaties van infrastructuurontwikkeling te verbeteren. In de praktijk en literatuur gaat vooral veel aandacht uit naar de planning – de ruimtelijke en publieke planning en aanbesteding – van PPS-projecten. De implementatie – de bouw en oplevering – die volgt op de fase van planning krijgt minder aandacht. Dit is onterecht, want als het implementatieproces ineffectief wordt gemanaged dan kunnen geanticipeerde of verkregen voordelen in de planning verloren gaan in implementatie. Dit proefschrift beantwoord aan de vraag in de PPS-literatuur naar meer onderzoek naar het management van implementatieprocessen van PPS-infrastructuurprojecten. Daarnaast levert het een bijdrage aan de vooralsnog grotendeels ontbrekende kennis over de werking en uitkomsten van DBFM contracten in Nederland – een specifieke vorm van PPS – door een empirische studie van een DBFM project.

In de volgende paragraaf wordt aangegeven hoe de centrale onderzoeksvraag is onderzocht en hoe het proefschrift is opgebouwd. Daarna worden de conclusies gepresenteerd.

2.   STRUCTUUR VAN HET PROEFSCHRIFT

Het proefschrift bestaat naast een inleidend en concluderend hoofdstuk uit een zestal artikelen. Deze artikelen vormen de bouwstenen voor het beantwoorden van de onderzoeksvraag (zie Paragraaf 1.3 en Tabel 1.1 in Hoofdstuk 1).

De eerste twee artikelen (Hoofdstukken 2 en 3) leggen de basis voor de empirische studies. Ze gaan in op het eerste deel van de onderzoeksvraag. Op basis van complexiteitsliteratuur wordt een perspectief uiteengezet over hoe de realiteit te begrijpen is. Dit perspectief wordt daarna toegespitst op infrastructuurontwikkeling, en vervolgens specifieker op implementatieprocessen in PPS-infrastructuurprojecten. Het complexiteitsperspectief resulteert in een aantal methodologische vereisten voor evaluatie. De methode *qualitative comparative analysis* wordt vervolgens getoetst aan deze vereisten.

De andere vier artikelen zijn empirisch. In de eerste twee (Hoofdstukken 4 en 5) worden afzonderlijk de implementatieprocessen van twee Nederlandse transportinfrastructuurprojecten geanalyseerd: de A2 Maastricht en de A15 Maasvlakte-Vaanplein. Op basis van kwalitatieve, open interviews worden reeksen onvoorziene gebeurtenissen geïdentificeerd. Deze gebeurtenissen zijn fysiek of sociaal van aard. Voor elke gebeurtenis wordt bepaald: (1) hoe die werd gemanaged (een project-interne of een project-externe oriëntatie), (2) hoe hierin tussen publieke en private managers werd samengewerkt (coöperatie of non-coöperatie), en (3) met wat voor uitkomsten (tevredenheid of ontevredenheid). De gebeurtenissen worden vervolgens geanalyseerd met QCA. Dit resulteert per project in managementpatronen die geassocieerd zijn met tevreden of ontevreden uitkomsten in de implementatieprocessen van de PPS-projecten.

Daarna wordt in Hoofdstuk 6 een vergelijking gemaakt tussen de patronen van de A2 Maastricht en de A15 Maasvlakte-Vaanplein projecten. De twee projecten worden onder andere gekenmerkt door verschillende managementoriëntaties, publiek-private samenwerkingen en uitkomsten. De projectvergelijking biedt verklaringen voor deze verschillen. In Hoofdstuk 7 worden vervolgens de implementatieprocessen van zevenentwintig transportinfrastructuurprojecten geanalyseerd met QCA. Hiervoor zijn kwalitatieve en kwantitatieve data gebruikt uit de projectendatabase van Rijkswaterstaat, welke waren verzameld door gastonderzoeker bij Rijkswaterstaat te zijn. Door deze medium-n vergelijkende casusanalyse worden de patronen en verklaringen uit de twee projectstudies gecorroboreerd en verder gegeneraliseerd.

3.   RESULTATEN EN CONCLUSIES

In deze paragraaf wordt een samenvatting gegeven van de resultaten en conclusies van het onderzoek. Allereerst wordt aangegeven wat de vier bouwstenen van de complexiteit van projectimplementatie zijn, waarna QCA wordt getoetst aan deze bouwstenen om te kunnen concluderen hoe, en in welke mate, QCA een complexiteit-geïnformeerde evaluatiemethode is. Dit betreft het eerste deel van de centrale onderzoeksvraag. Daarna worden de empirische resultaten samengevat om conclusies te trekken ten aanzien van het management en de publiek-private samenwerking in de implementatieprocessen van PPS-infrastructuurprojecten.

3.1.   De vier bouwstenen voor complexiteit-geïnformeerde evaluatie

Leren van evaluaties vereist dat de evaluatiemethode complexiteit-geïnformeerd is. Deze complexiteit verwijst niet enkel naar het feit dat implementatieprocessen erg ingewikkeld zijn. De realiteit is fundamenteel complex. Zij bestaat uit geneste systemen die met elkaar verweven zijn. Dit impliceert dat de implementatie en het management van PPS-infrastructuurprojecten kunnen worden begrepen aan de hand van vier bouwstenen

van complexiteit: niet-desintegreerbaarheid, contingentie, niet-compressibiliteit en tijd-asymmetrie (zie Paragraaf 8.2 in Hoofdstuk 8).

Niet-desintegreerbaarheid, ofwel *non-decomposability*, betekent dat de implementatie en het management van PPS-infrastructuurprojecten niet kunnen worden begrepen door het afzonderlijk bestuderen van de individuele elementen. Immers, implementatieproces-sen emergeren uit de interactie tussen de projectelementen (o.a. managementstrategieën en PPS-contracten) en met de context van het systeem (o.a. stakeholders en de fysieke omgeving). Evaluatiemethoden die gericht zijn op het isoleren van het effect van singuliere variabelen op een uitkomst creëren daarom geen realistisch begrip van de implementatie-processen.

De tweede bouwsteen is contingentie, ofwel *contingency*. Dit betekent, doordat pro-jecten interacteren met sociaal-fysieke contexten die veranderlijk en verschillend zijn voor projecten, dat implementatieprocessen uniek zijn. Tegelijkertijd kunnen er gelijkenissen of patronen worden ontdekt, omdat projecten zich bevinden in een deels stabiele en ge-deelde context. Gelijkenissen kunnen worden gemanaged met bekende strategieën terwijl uniekheden vragen om een situationele aanpak. Voor evaluatie betekent contingentie dat methoden die trachten universele wetmatigheden vast te stellen, geen realistisch begrip creëren van implementatieprocessen.

Niet-compressibiliteit, ofwel *non-compressibility*, verwijst naar het feit dat de realiteit fundamenteel niet te versimpelen is: implementatieprocessen en uitkomsten emergeren uit de interactie tussen systemen in systemen in systemen (genestheid). Echter, om de complexe realiteit te bevatten, simplificeren publieke en private managers hun projectwer-kelijkheid. Zij hanteren verschillende simplificaties doordat zij zich bevinden in verschil-lende systemen, op basis waarvan zij handelen. Evaluatiemethoden die dit heterogene en *grounded* karakter van de implementatie en het management van PPS-infrastructuurpro-jecten negeren, creëren er geen realistisch begrip van.

De laatste bouwsteen is tijd-asymmetrie, ofwel *time-asymmetry*. Dit betekent dat het verloop van infrastructuurprojecten uni-directioneel en onomkeerbaar is; causaliteit wordt gekenmerkt door emergentie en is non-lineair. Uitkomsten in/van implementatieproces-sen kunnen achteraf het logische gevolg zijn van sequenties van gebeurtenissen, maar die sequenties waren niet kenbaar a priori, toen projecten werden gepland. Implementatiepro-cessen hebben te kampen met onzekerheden en onvoorziene en ongeplande gebeurtenissen. Die gebeurtenissen worden gemanaged. Evaluatiemethoden die dit belang van tijd nege-ren, creëren geen realistisch begrip van de implementatie van PPS-infrastructuurprojecten en dreigen te focussen op ineffectieve of strategische risico-identificatie en -calculatie in plaats van leren.

3.2. QCA als complexiteit-geïnformeerde evaluatiemethode

De vier bouwstenen van complexiteit stellen eisen aan de evaluatiemethode. Deze eisen zijn de volgende (zie Paragraaf 8.4 in Hoofdstuk 8):

1. Niet-desintegreerbaarheid: de methode moet kunnen evalueren hoe combinaties van elementen uitkomsten verklaren.
2. Contingentie: (a) de methode moet kunnen evalueren hoe zowel de uniekheden als de gelijkenissen of patronen tussen casus bijdragen aan het verklaren van uitkomsten, en (b) de methode moet voldoen aan de eis van beperkte generaliseerbaarheid.
3. Niet-compressibiliteit: de evaluatiemethode moet de heterogeniteit van projectrealiteiten herkennen en erkennen.
4. Tijd-asymmetrie: de evaluatiemethode moet (a) de tijdsdimensie kunnen vatten in het verklaren van uitkomsten, en (b) herkennen dat implementatieprocessen niet perfect voorspelbaar zijn.

Op basis van de toetsing van QCA aan deze vereisten is geconcludeerd dat QCA een complexiteit-geïnformeerde methode is. Aan de eerste eis wordt voldaan. QCA is configurationeel: het analyseert hoe combinaties van elementen een uitkomst verklaren. QCA voldoet ook aan de tweede eis. De systematische kwalitatieve vergelijkende analyse wordt gekenmerkt door iteraties tussen het identificeren van casus-uniekheden en patronen tussen casus. QCA slaat daarmee een brug tussen een focus op details en context aan de ene kant en patroonontdekking aan de andere kant. De patronen die worden gevonden met QCA hebben een beperkte generaliseerbaarheid. Dit betekent dat ook aan de derde eis wordt voldaan. QCA is een casus-gebaseerde onderzoeksmethode. Aan de start van het onderzoeksproces wordt de complexiteit zo min mogelijk versimpeld door een *grounded* benadering te hanteren. Dit laat de heterogeniteit van projectrealiteiten toe in de evaluatie. Aan de vierde eis wordt deels voldaan. QCA is in essentie een vergelijkende, statische methode die slecht in staat is tijd, temporaliteit of dynamiek een plek in de analyse te geven. QCA herkent wel de onvoorspelbaarheid van implementatieprocessen: in QCA wordt expliciet herkend en erkend dat patronen contradictoire uitkomsten kunnen hebben, dat relaties niet lineair zijn en dat generalisatie beperkt is.

De implementatie en het management van PPS-infrastructuurprojecten kunnen op verschillende manieren worden geëvalueerd met QCA. In het proefschrift worden drie dimensies van leren met QCA voorgesteld (zie Figuur 8.2 in Hoofdstuk 8). De eerste dimensie is leren tussen projecten of projectimplementaties door deze met elkaar te vergelijken (zie bijvoorbeeld Hoofdstuk 7). Op deze manier kunnen lessen uit een succesvolle casus worden toegepast op een vergelijkbare maar minder succesvolle casus. De tweede dimensie is leren binnen een project of projectimplementatie. Door gebeurtenissen of situaties binnen een project met elkaar te vergelijken (zie bijvoorbeeld Hoofdstukken 4, 5 en 6) kunnen managers binnen een project leren wat voor soort gebeurtenissen om wat voor managementstrategie en publiek-private samenwerking vragen. De derde dimensie betreft het leren over de perspectieven van actoren binnen een project. Elke deelnemer aan de evaluatie is dan een casus. Door deze met elkaar te vergelijken wordt duidelijk waar perspectieven tussen actoren verschillen en waar ze overeenkomen. Dit biedt mogelijkheden voor het vinden van wederzijds begrip en consensus.

In het proefschrift wordt voorgedragen dat QCA ook kan worden toegepast als een collaboratieve en interactieve evaluatietool. Voor elk van de drie dimensies biedt QCA een vier-stap structuur waarin de deelnemers op collaboratieve en interactieve wijze het evaluatieproces kunnen doorlopen (zie Figuur 8.3 in Hoofdstuk 8). Hierbij is het belangrijk dat de heterogeniteit van actoren is geborgd door zowel publieke als private actoren deel te laten nemen aan het proces. Op deze manier wordt de kennisbasis van de evaluatie vergroot, intensiveert de publiek-private samenwerking en worden geleerde lessen gemakkelijker teruggekoppeld naar de praktijk van de implementatie van PPS-infrastructuurprojecten.

3.3. Management en publiek-private samenwerking in projectimplementatie

Tijdens de projectimplementatie treden er in de projectcontext onvoorziene gebeurtenissen op van uiteenlopende aard. Deze gebeurtenissen zijn sociaal of fysiek van aard. Gebeurtenissen met een sociale aard betreffen stakeholders in de context van het project die reageren op de projectuitvoering. Fysieke gebeurtenissen hebben hun oorsprong in het fysieke systeem waarin wordt geïmplementeerd. Deze gebeurtenissen worden gemanaged. De managementstrategie die wordt gekozen is intern- of extern-georiënteerd. Het verschil is dat de tweede zich kenmerkt door een oriëntatie op de sociale projectomgeving: oplossingen voor gebeurtenissen worden gezocht in interactie met stakeholders. Dat is bij de intern-georiënteerde strategie niet het geval. Daarnaast kiezen publieke en private managers ervoor om samen op te treden in het management van de gebeurtenis (coöperatie) of juist de publiek-private grenzen te benadrukken en verantwoordelijkheden en taken te scheiden (non-coöperatie). De uitkomst van het management van gebeurtenissen is vanwege de heterogeniteit van publieke en private managers – zij hebben verschillende achtergronden, taken en verantwoordelijkheden – niet eendimensionaal te definiëren. De uitkomstmaat 'tevredenheid' ('satisfactie') is in het proefschrift gebruikt. Het is een multidimensionaal concept dat meerdere uitkomsten vat, zoals: kostenoverschrijdingen, tijdsoverschrijdingen, sociale onvrede en onenigheid en de publiek-private samenwerkingsrelatie.

De QCA-evaluaties wijzen uit dat er verschillende managementstrategieën zijn in PPS-projectimplementatie die (on)bevredigende uitkomsten opleveren (zie Paragraaf 8.4 in Hoofdstuk 8). Twee resultaten zijn:

1. Een intern-georiënteerde managementstrategie voor gebeurtenissen met een sociale aard resulteert in onbevredigende uitkomsten.
2. Een extern-georiënteerde managementstrategie voor gebeurtenissen met een sociale aard resulteert in bevredigende uitkomsten.

Op basis van deze resultaten kan worden geconcludeerd dat een extern-georiënteerde managementstrategie te verkiezen is boven een intern-georiënteerde strategie in implementatieprocessen. Twee andere resultaten zijn de volgende:

3. Een intern-georiënteerde managementstrategie door de private partner resulteert in onbevredigende uitkomsten.
4. Een intern-georiënteerde managementstrategie, coöperatief of door de publieke partner, resulteert in bevredigende uitkomsten.

Deze resultaten tonen aan dat een intern-georiënteerde managementstrategie ook bevredigende uitkomsten kan opleveren, indien de publieke en private partners hierin samenwerken. Het kan geconcludeerd worden dat een coöperatieve strategie valt te verkiezen boven een non-coöperatieve strategie. Maar coöperatie is niet noodzakelijk in het geval van een extern-georiënteerde managementstrategie. De resultaten laten dus zien dat de effectiviteit van intern-georiënteerd management en van non-coöperatie kan worden verhoogd door respectievelijk coöperatie en extern-georiënteerd management.

Een verklaring voor een externe managementoriëntatie ligt in de integraliteit van infrastructuurprojecten. In integrale projecten worden verschillende ruimtelijke functies in de uitvoering in samenhang aangepakt, wat betekent dat meerdere stakeholders betrokken zijn. Het voordeel van de nauwe betrokkenheid van stakeholders is dat hun belangen worden geïnternaliseerd in project. Dit zorgt voor minder weerstand vanuit de stakeholderomgeving en de belangen van stakeholders zijn kenbaarder voor het projectmanagement. De uitdaging die samenhangt met de nauwe betrokkenheid van veel stakeholders is dat het mogelijk zorgt voor ingewikkeldere (gepercipieerde) uitvoeringsprocessen en de noodzaak van intensief en kostbaar stakeholdermanagement. Omgekeerd zorgt het op afstand houden van stakeholders voor minder ingewikkelde (gepercipieerde) processen, maar mogelijk ook voor meer weerstand uit de omgeving en een mindere kenbaarheid van de stakeholderbelangen. Dit kan zorgen voor sociale onvoorziene en ongeplande gebeurtenissen in de projectimplementatie, met mogelijk nog hogere kosten als gevolg.

Verklaringen voor een interne managementoriëntatie en non-coöperatie liggen in de contractvorm. In concessionele vormen van PPS, zoals DBFM, hangt het succes van het project samen met het halen van scherpe tijdsplanningen. Deze tijdsdruk creëert een blik naar binnen. Kenmerkender nog is dat concessionele PPS een contractuele focus kent en een scherpe scheiding van publieke en private systemen. In DBFM zijn de verantwoordelijkheden voor de projectimplementatie in handen van de private partner; de publieke opdrachtgever legt zich toe op het monitoren van de opdrachtnemer. Het voordeel van deze scherpe scheiding is transparantie in de samenwerking. De zwakte is dat samenwerking over de publiek-private grenzen heen bemoeilijkt wordt. Deze samenwerking is wel belangrijk, bijvoorbeeld op het gebied van stakeholdermanagement. Publieke opdrachtgevers beschikken vaak over sterkere en langdurigere relaties met, en betere toegang tot, de stakeholders in de projectomgeving. In DBFM is het gevaar dat deze relaties niet worden aangewend door de publieke partner vanwege de scheiding van de verantwoordelijkheden, terwijl het juist kan bijdragen aan een effectievere projectimplementatie. Alliantie-achtige vormen van PPS kenmerken zich daarentegen door coöperatie over de publiek-private grenzen heen, maar daar kan het bewaken van transparantie in de samenwerking de

uitdaging zijn. Het optimum ligt mogelijk in het midden, bijvoorbeeld door stakeholder-management te organiseren in een alliantie binnen een DBFM contract. Verder onderzoek kan de effectiviteit van deze mogelijkheid verkennen.

Summary in English

1. MOTIVATION, RESEARCH AIM, AND RELEVANCE OF THE RESEARCH

This thesis is about managing complex implementation processes of public-private partnership (PPP) infrastructure projects and the evaluation thereof with the method qualitative comparative analysis (QCA).

Against the background of the often disappointing performances of infrastructure development, such as cost overruns, time overruns, and social discontent, the practice and literature in the field of (PPP) infrastructure development often apply a risk-perspective. This perspective assumes a reality that is knowable and calculable. Risks are identified, calculated, and allocated to the public or private partner best able to manage the risk. Following this perspective, evaluations of infrastructure projects often point to ineffective or strategic risk identification, risk calculation, or risk management as causes of the disappointing performances. However, the reality of infrastructure project implementation is not perfectly knowable and calculable. It is fundamentally complex.

A lot of attention is devoted in practice and in the literature to the planning of projects. However, no matter how carefully they are planned, when projects are implemented – 'once the shovel hits the ground' – events occur that were often unforeseen and unplanned. If this complexity is recognized and acknowledged, then the attention in project evaluation can be focused on what can be learned from previous experiences with managing such events, so as to manage future ones more effectively. Contributing to this is the first aim of this research. The fundamental complexity of infrastructure development also imposes requirements on the evaluation method to be used. The method needs to acknowledge the complexity; it should be complexity-informed. Evaluation methods that are not create an unrealistic understanding of implementation processes with the consequence that evaluations tell us little about what works and what does not, in which contexts, and why. This hampers learning from evaluations. Identifying the requirements for a complexity-informed evaluation method, and assessing the extent to which QCA meets these requirements, is the second aim of the research.

Following these aims, the central research question is: *how can the implementation and management of PPP infrastructure projects be understood and evaluated from a complexity*

perspective using QCA, what management responses in project implementation yield (un) satisfactory outcomes, and how can this be explained?

By investigating this question, the intention is to contribute to different fields of literature. These are briefly discussed below.

1.1.   Complexity and QCA

The complexity literature tells us that complex systems, such as implementation processes of PPP infrastructure projects, emerge from the interaction between a multitude of elements within the system and with the system's context. Understanding complex systems thus requires that their details and context are studied. Case studies are an appropriate means for this. The complexity literature also tells us that, because systems interact in a partly-shared context, similarities or patterns between systems can be recognized. These patterns are important to make lessons from case studies relevant to other cases. However, it is hard to uncover generalizable patterns from case studies. This thesis adds QCA to the complexity literature as a suitable method to combine the study of details and context with the need for pattern recognition.

1.2.   Evaluation and QCA

QCA is a method on the rise. Literature reviews show that the number of QCA applications, including in the Public Administration literature, has strongly increased. QCA is also increasingly discussed and applied in the evaluation literature where it is, inter alia, conceptualized as a suitable method for theory-driven, realistic evaluation. In this thesis, QCA is conceptualized as a complexity-informed method. In doing so, it is added to the QCA and evaluation literature as a more grounded approach. As such, QCA recognizes and acknowledges the complexity of project implementation, and the heterogeneity of the public and private partners and project stakeholders involved in implementation. This makes QCA, as a complexity-informed method, suitable for learning from evaluations. The empirical studies in this doctoral thesis also introduce QCA in the field and literature of (PPP) infrastructure projects.

1.3.   Project management and infrastructure projects

The literature about the management of infrastructure projects is dominated by approaches that understand project management as a rational process. In those approaches, projects are closed systems that are implemented according to predefined protocols and planning schedules. This is, however, not a realistic understanding of project management. Projects are not implemented in isolation; they interact with the socio-physical context in which they are constructed. Projects are open systems. Although the fundamental complexity of project implementation is increasingly recognized and acknowledged, this is yet insufficiently acted on in understanding and studying project implementation.

This thesis answers to the call in the project management literature for more situational, contextual approaches in project management research. This is done by conceptualizing project implementation and management from a complexity perspective, and applying this in empirical studies.

1.4. Public-private partnerships and infrastructure projects

Public-private partnerships are not a new phenomenon, but they are increasingly popular with governments as means to improve the performance of infrastructure development. A lot of attention is devoted in practice and in the literature to the planning – the spatial and public planning and the procurement – of PPP projects. The implementation – construction and delivery – that follows the planning phase receives less attention. This is unfortunate: if the implementation process is ineffectively managed, anticipated or obtained gains in the planning might be lost in implementation. This doctoral thesis answers to the call in the PPP literature for more research into the management of implementation processes of PPP infrastructure projects. Additionally, by means of an empirical study of a DBFM project, it contributes to the yet little available knowledge about the functioning and results of DBFM contracts – a specific type of PPP – in the Netherlands.

The next section explains how the central research question was studied and how this thesis is structured. Thereafter, the conclusions are presented.

2. STRUCTURE OF THE THESIS

Besides the introductory and concluding chapters, this doctoral thesis consists of six articles. These articles provide the building blocks to answering the research question (see Section 1.3 and Table 1.1 in Chapter 1).

The first two articles (Chapters 2 and 3) form the basis for the empirical studies. They address the first part of the research question. Based on complexity literature, a perspective is outlined as to how reality is understood. This perspective is then focused on infrastructure development, and the implementation processes in PPP infrastructure projects specifically. The complexity perspective results in methodological prerequisites for evaluation, after which it is assessed to which extent the method qualitative comparative analysis meets these requisites.

The other four articles are empirical. In the first two (Chapters 4 and 5), the implementation processes of two Dutch transportation infrastructure projects are separately analyzed: the A2 Maastricht and the A15 Maasvlakte-Vaanplein. Based on qualitative open interviews, a number of unforeseen events is identified. These events have a physical or social nature. For each event it is assessed: (1) how it was managed (a project-internal or project-external orientation), (2) how public and private managers cooperated herein (cooperation or non-cooperation), and (3) with what outcomes (satisfaction or dissatisfac-

tion). Next, the events were analyzed with QCA. This resulted in management patterns associated with either satisfaction or dissatisfaction in the implementation processes of PPP projects.

Thereafter, the patterns in the A2 Maastricht and A15 Maasvlakte-Vaanplein projects are compared in Chapter 6. The two projects are characterized by, inter alia, different management orientations, public-private cooperation, and outcomes. The project comparison offers explanations for the differences. In Chapter 7, the implementation processes of twenty-seven transportation infrastructure projects are analyzed with QCA. Qualitative and quantitative data were used from the Rijkswaterstaat project database, which were collected by being a visiting researcher at Rijkswaterstaat. By means of this medium-n comparative case analysis, the patterns and explanations from the two project studies are corroborated and further generalized.

3.   RESULTS AND CONCLUSIONS

In this section, the results and conclusions of the research are summarized. First it is specified what the four building blocks are of the complexity of project implementation, after which QCA is assessed against these building blocks, so as to be able to conclude how, and to what extent, QCA is a complexity-informed evaluation method. This concerns the first part of the research question. Thereafter, the results of the empirical studies are summarized to draw conclusions with respect to the management and public-private cooperation in the implementation processes of PPP infrastructure projects.

3.1.   The four building blocks for complexity-informed evaluation

Learning from evaluations requires that the evaluation method is complexity-informed. This complexity does not just refer to the fact that implementation processes are very difficult. Reality is fundamentally complex. It consists of nested, interrelated systems. This implies that the implementation and management of PPP infrastructure projects can be understood on the basis of four building blocks of complexity: non-decomposability, contingency, non-compressibility, and time-asymmetry (see Section 8.2 in Chapter 8).

Non-decomposability means that the implementation and management of PPP infrastructure projects cannot be understood by separately studying the individual elements. Indeed, implementation processes emerge from the interaction between the project elements (inter alia, management strategies and PPP contracts) and with the context of the system (inter alia, stakeholders and the physical environment). Evaluation methods that are focused on isolating the effect of single variables on an outcome do not create a realistic understanding of implementation processes.

The second building block is contingency. This means that, because projects interact with social-physical contexts that are dynamic and particular for projects, implementation processes are unique. At the same time, similarities or patterns can be recognized because

projects are embedded in contexts that are partly stable and shared. Whilst similarities can be managed with known strategies, the unique aspects of projects require a situational approach. The implication for evaluation is that methods that try to establish universal laws do not create a realistic understanding of implementation processes.

Non-compressibility refers to the fact that it is fundamentally not possible to simplify reality: implementation processes and outcomes emerge from the interaction between systems in systems in systems (nestedness). However, to be able to comprehend the complex reality, public and private managers simplify their project reality. They have different simplifications, because they are nested in different systems, on the basis of which they act. Evaluation methods that ignore this heterogeneous and grounded nature of implementing and managing PPP infrastructure projects do not create a realistic understanding of it.

The final building block is time-asymmetry. This means that the development of infrastructure projects is unidirectional and irreversible; causality is characterized by emergence and non-linearity. Outcomes in/of implementation processes can be the logical results of sequences of events in hindsight, but those sequences were unknowable a priori, when projects were planned. Implementation processes have to contend with uncertainties and unforeseen and unplanned events. These events are managed. Evaluation methods that ignore this importance of time do not create a realistic understanding of the implementation of PPP infrastructure projects, and they impend to focus on ineffective or strategic risk identification and calculation instead of learning.

3.2.   QCA as a complexity-informed evaluation method

The four building blocks of complexity impose requirements on the evaluation method. These are the following (see Section 8.4 in Chapter 8).

1. Non-decomposability: the method has to be able to evaluate how combinations of elements explain outcomes.
2. Contingency: (a) the method has to be able to evaluate how both peculiarities and similarities or patterns between cases contribute to explaining outcomes, and (b) the method has to be capable of limited generalization.
3. Non-compressibility: the evaluation method has to recognize and acknowledge the heterogeneity of project realities.
4. Time-asymmetry: the evaluation method should be able (a) to include the time dimension in explaining outcomes, and (b) to recognize that implementation processes are not perfectly predictable.

Based on the assessment of QCA against these requisites, it is concluded that QCA is a complexity-informed method. The first requirement is met. QCA is configurational: it analyzes how combinations of elements explain an outcome. QCA also meets the second requirement. The systematic qualitative comparative analysis is characterized by iterations between identifying case peculiarities and patterns between cases. In this way, QCA strikes

a balance between a focus on details and context on the one hand and pattern recognition on the other. The patterns that are found with QCA have a limited generalizability. This means that the third requirement is also met. QCA is a case-based research method. At the start of the research process, the complexity is minimally simplified by applying a grounded approach. This gives the heterogeneity of project realities a place in the evaluation. The fourth requirement is partly met. In essence, QCA is a comparative, static method that is not well capable of including time, temporality, or dynamics in the analysis. QCA does recognize the unpredictability of implementation processes: in QCA, it is explicitly recognized and acknowledged that patterns can have contradictory outcomes, that relationships are non-linear, and that generalization is limited.

The implementation and the management of PPP infrastructure projects can be evaluated with QCA in different ways. In this doctoral thesis, three dimensions of learning are proposed (see Figure 8.2 in Chapter 8). The first dimension is learning between projects or project implementations (see, e.g., Chapter 7). In this way, lessons from successful cases can be applied to similar but less successful cases. The second dimension is learning within a project or implementation. By comparing events or situations within a project with each other (see, e.g., Chapters 4, 5, and 6), managers within a project can learn what kind of events require what kind of management strategy and public-private cooperation. The third dimension concerns learning about actor's perspectives within a project. Each participant in the evaluation is a case, and by comparing these with each other it becomes clear where perspectives between actors differentiate and where they are similar. This offers opportunities for finding mutual understanding and consensus.

   In this thesis, it is proposed that QCA can also be applied as a collaborative and interactive evaluation tool. For each of the three dimensions, QCA offers a four-step structure within which the evaluation participants can go through the evaluation process in a collaborative and interactive manner (see Figure 8.3 in Chapter 8). It is important here that the heterogeneity of actors is safeguarded by letting both public and private actors participate in the process. In this way, the knowledge base of the evaluation is strengthened, the public-private cooperation intensifies, and learnt lessons are easier fed back into the practice of implementing PPP infrastructure projects.

3.3.   Management and public-private cooperation in project implementation

During project implementation, different unforeseen events occur in the project context. These events are of a social or physical nature. Social events concern stakeholders in the context of the project that react to the project implementation. Physical events originate from the physical system in which the project is implemented. These events are managed. The management strategy that is chosen is internally-oriented or externally-oriented. The difference is that the latter is characterized by an orientation on the social project environment: solutions for events are sought in interaction with stakeholders. This is not the case with the internally-oriented strategy. Furthermore, public and private managers choose to

work together in the management of an event (cooperation) or to stress the public-private boundaries and to separate responsibilities and tasks (non-cooperation). Because of the heterogeneity of public and private managers – they have different backgrounds, tasks, and responsibilities – the outcome of the management of events is not one-dimensionally definable. The outcome measure of 'satisfaction' is used in this thesis. It is a multidimensional concept that comprises multiple outcomes, such as: cost overruns, time overruns, social discontent, and the public-private relationship.

The QCA evaluations showed that different management strategies in PPP project implementation produce (un)satisfactory outcomes (see Section 8.4 in Chapter 8). Two results are:

1. An internally-oriented management strategy for social events results in unsatisfactory outcomes.
2. An externally-oriented management strategy for social events results in satisfactory outcomes.

On the basis of these results, it can be concluded that an externally-oriented management strategy is preferable over an internally-oriented management strategy in implementation processes. Two other results are the following:

3. An internally-oriented management strategy by the private partner results in unsatisfactory outcomes.
4. An internally-oriented management strategy, cooperatively or by the public partner, results in satisfactory outcomes.

These results show that, if the public and private partners cooperate, an internally-oriented strategy can also yield satisfactory outcomes. It can be concluded that a cooperative strategy is preferable over a non-cooperative strategy. However, cooperation is not necessary in the case of an externally-oriented management strategy. The results thus show that the effectiveness of internally-oriented management and non-cooperation can be increased by cooperation and externally-oriented management, respectively.

An explanation for the externally-oriented management strategy lies in the integrality of infrastructure projects. In integral projects, different spatial functions are combined which means that different stakeholders are involved. The advantage of the close involvement of stakeholders is that their interests are internalized in the project. This makes for less resistance from the stakeholder environment, and the stakeholder's interests are more knowable to the project's management. The challenge associated with the close involvement of stakeholders is that it might lead to more complicated (perceived) implementation processes and the need for intensive and costly stakeholder management. Conversely, keeping stakeholders more at a distance from the project results in less complicated (perceived) processes, but also the possibility of more resistance from the environment and

less knowledge of stakeholders' interests. This can lead to social unforeseen and unplanned events in project implementation, with possibly even higher costs as a consequence.

Explanations for the internal management orientation and non-cooperation lie in the contract type. In concessional types of PPP, such as DBFM, the success of the project is linked to meeting a challenging time planning. This time pressure creates an inward-orientation. Even more characteristic is that concessional PPPs have a contractual focus and a strict separation of public and private systems. In DBFM, the responsibility for project implementation lies with the private partner; the public partner focuses on monitoring the contractor. The advantage of this strict separation is transparency in the public-private relationship. The weakness is that it impedes cooperation across the public-private boundaries. This cooperation is important, inter alia with respect to stakeholder management. Public principals often feature stronger and longer-lasting relationships with stakeholders in the project environment. In DBFM, the danger is that these relationships are not used by the public partner because of the separation of responsibilities whilst it can contribute to a more effective project implementation. Alliance-like types of PPP are characterized, in contrast, by cooperation across the public-private boundaries, with the possible consequence that maintaining transparency in the cooperation is challenging. The optimum possibly lies in the middle, for example by organizing stakeholder management in an alliance within a DBFM contract. Further research can shed light on the effectiveness of this option.

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I dedicate this book to Annemarie and Cor.

Stefan Verweij
Bamberg, May 2015

About the Author

Stefan Verweij (1985) studied Public Administration at Erasmus University Rotterdam, specializing in the governance of complex spatial developments (M.Sc., 2009). During his studies (2004-2009), he also served as a board member of the study association of the Faculty of Social Sciences. In 2009, he joined the Department of Public Administration at Erasmus University Rotterdam (the Netherlands) as a junior lecturer, participating in research projects as well.

Stefan started working as a Ph.D. candidate from January 2011, examining the management of complex implementation processes of public-private partnership projects. He specialized in qualitative research methods and qualitative comparative analysis in particular. He completed the two-year doctorate training program of the Netherlands Institute of Government in 2013. Alongside his Ph.D. research, Stefan was also a visiting researcher at Rijkswaterstaat (2013-2014) and at the Bertelsmann Foundation in Germany (2014). He furthermore taught courses on governance networks and qualitative comparative analysis, and co-supervised master theses. He was also the president of Ph.D. Platform for Public Administration at Erasmus University Rotterdam (2013-2014).

Stefan presented his work at several national and international academic conferences, and chaired panels at some of these conferences. His work has been published in multiple academic journals, including *Evaluation*, *International Journal of Project Management*, *Journal of Critical Realism*, *Public Administration*, *Transport Policy*, and *Public Works Management & Policy*. He also acts as a reviewer for academic journals. He regularly writes about his research in professional magazines as well.

As of March 2015, Stefan works as an assistant professor (Akademischer Rat auf Zeit) at the Department of Political Science at the University of Bamberg (Germany), where he continues his research on complexity, governance networks, infrastructure projects, management, public-private partnerships, spatial planning, and qualitative comparative analysis. He also teaches about these topics.

Much attention is being paid to the planning of public-private partnership (PPP) infrastructure projects. The subsequent implementation phase – when the contract has been signed and the project 'starts rolling' – has received less attention. However, sound agreements and good intentions in project planning can easily fail in project implementation. Implementing PPP infrastructure projects is complex, but what does this complexity entail? How are projects managed, and how do public and private partners cooperate in implementation? What are effective management strategies to achieve satisfactory outcomes? This is the first set of questions addressed in this thesis. Importantly, the complexity of PPP infrastructure development imposes requirements on the evaluation methods that can be applied for studying these questions. Evaluation methods that ignore complexity do not create a realistic understanding of PPP implementation processes, with the consequence that evaluations tell us little about what works and what does not, in which contexts, and why. This hampers learning from evaluations. What are the requirements for a complexity-informed evaluation method? And how does qualitative comparative analysis (QCA) meet these requirements? This is the second set of questions addressed in this thesis.

Information about the author and his research can be found on the website www.stefanverweij.eu.