

University of Groningen
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BACHELOR'S THESIS



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How Institutions Affect, Delay and Hamper Infrastructure planning
and implementation processes;
*An Analysis on the Effect of Institutional Complexity on Project
Performance in Germany and the Netherlands*

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Abstract

Major infrastructure developments are supported by many parties and actors, but there are always disputes of interest and tensions between institutions involved and affected in the development. These megaprojects are frequently impeded by extensive cost and time overruns due to their complexity. Previous literature has studied institutional complexity and also cost and time overruns in large infrastructure projects. Yet there is a research gap in how this institutional complexity is impacting project performance in terms of cost escalations and delays. This research focuses on two megaprojects, Stuttgart 21 and the Zuidasdok project in Amsterdam, and finds that institutional complexity from macro and micro-level sources has a significant effect on cost and time overruns.

1. Introduction

1.1. Background:

There is a constant demand for mobility, from a sustainable city perspective people should be able to move from one location to another as quickly and comfortably as possible, without requiring a private vehicle. Therefore, great urban design quality is needed, which demands a solid and cohesive infrastructure for public transport arranged in a practical way; it is the foundation for sustainable mobility and accessibility (Banister, 2008). The demand for such infrastructure becoming higher than ever, however common access to it is insufficient (Virág et al., 2022). This lack in quality is due to increasing numbers of people using public transport resulting in overloads and congestion within the networks, which exposes the capacity (Ministry of Infrastructure and Water Management, 2019). Hence, improving and expanding infrastructure are the means to a higher level of mobility. Therefore, transport infrastructure developments have become bigger and more frequent. Planning processes and decision-making for big transport infrastructure projects and expansions are complex and involve many stakeholders as well as environmental concerns, thus they are institutionally complex. Especially citizens demand to get involved in decision-making processes (Steininger et al., 2020). As transportation infrastructure is not only driving economic growth but also social development, facilitation should be one of the major national priorities in public policies and planning. Decent connections between cities (economic cores and hubs) are essential for spatial and economic structures and for meeting social needs (Ministry of Infrastructure and Water Management, 2019).

Looking at rail infrastructure, current networks need to be maintained and expanded. In Germany and in the Netherlands, this is a pressing challenge, as rail developments are lagging, and the volume of travel is increasing in both countries. As a result the public sector undertakes huge major railway projects, expanding the network and optimizing connections and capacity. In the past many of these railway megaprojects have turned into planning disasters due to delays and cost overruns. Infrastructure interventions like the Channel Tunnel, a railway underwater tunnel linkage between France and the UK with a cost overrun of 80%, or the TGV Paris North line exceeding its initial budget by 25% are only two examples. Cantarelli et al. (2010) came up with four different explanations and related causes for cost overruns in infrastructure projects, technical, economic, political, and psychological explanations. Additionally, major infrastructure projects are often delayed. Looking at previous studies this phenomenon is rather common in the procurement of large-scale infrastructure developments, as more than half of them exhibit cost overruns and delays (Flyvbjerg et al., 2003). Based on the studies of Flyvbjerg et al. (2003), which covers examples from all around the world, it can be assumed that Germany and the Netherlands refer to these research analyses as well (Cantarelli, 2011).

Two well-known railway megaprojects prove this claim, Stuttgart 21 (including Wendlingen – Ulm line) and the “Zuidasdok” at Amsterdam Zuid Station (including the North-South Metro line) which have been in development for over two decades already. Both cases represent one of the most challenging infrastructure projects in their respective national history. The projects can also be labeled as megaprojects, which are defined as compound infrastructure projects, taking multiple years until implemented and serving economic and social purposes (Qiu et al., 2019). Another study claims, to avert time and cost overruns it is important to widen the knowledge fundament

of project administration among railway organizations and to improve institutional collaborative learning by sharing experiences from major infrastructure projects (Abbas et al., 2022). Rye et al. finds that better collaboration between the formal and informal institutions as combined governance modes increases efficacy and resolves critical interfaces in the policy domain of transport infrastructure. Especially highly complex infrastructure projects like Stuttgart 21 and The Amsterdam North-South Metro, should consider high synergies between the formal and informal institutions, as the informal institutions complement the statutory institutions (Rey et al., 2018). Although the interdependencies of institutions and governance modes are discussed, it does not address institutional complexity in rail transport infrastructure projects specifically. There is a major research gap in how large-scale infrastructure projects are affected by institutional complexity and if it has an adverse impact on project performance in terms of delays and cost overruns. This is also noticed by Qui et al. (2019) who investigate how institutional complexity arises, affects development outcomes, and defines stakeholders' behavior based on an infrastructure project in Hong Kong. They find several governance approaches to solve institutional complexity. Yet there is little known about how institutional complexity influences project performance. This research builds on these studies and investigates institutional complexity in major transport infrastructure projects based on two European countries with similar institutional frameworks, the Netherlands and Germany and if they have an effect on delays and cost overruns.

1.2. Research problem:

The institutional design to govern transportation infrastructure exposes several issues that thwart and hamper practical implementations. Vaguely defined administrative procedures, stakeholder abundance, unclear responsibilities, and insufficiently controlled processes are some of the reasons why infrastructure projects turn out to be filled with institutional obstacles and barriers, and other complications, bureaucracy hinders fast actions and innovation. An additional problem is the systematic underestimation of costs leading to cost overruns (Kostka & Anzinger, 2016). Both time and cost overruns are predominantly the results of "poor project design and implementation, inadequate funding of projects, bureaucratic indecision, and a lack of coordination between enterprises" and stakeholders (Canatrelli et al., 2011 p.18).

My research studies how institutional complexity is hampering major railway project performances and risking their success, based on two major infrastructure projects that are still under construction, "Zuidasdok" at the Amsterdam Zuid Station and "Stuttgart 21". Both projects encounter institutional complexity and management issues, which have plagued them with several problems over the years. I will analyze existing research and both cases' contexts, organizational processes, and institutional frameworks, to subsequently see whether and how institutional complexity is causing or influencing the experienced delays and cost overruns. As a result, I came up with the following research questions:

How is institutional complexity causing delays and cost overruns in large-scale transportation infrastructure projects?

- What is institutional complexity and what is causing it in infrastructure projects?
- What is causing time and cost overruns (factors) in megaprojects?
- How are cost overruns and delays related to institutional complexity?

1.3. Structure:

This research starts with a theoretical framework, examining existing literature and theories relevant to this study and compiling a conceptual model explaining the theories (see Section 2.3). Subsequently, in the third section the methodology, thus the applied research method data collection methods will be described. After that, the chosen cases will be described and analyzed in the fourth section of the case studies. Logically, the data Analysis and its results are followed by a discussion of the results in section five. To round off the thesis there will be a conclusion in the sixth section towards the end, and the attached references in section seven.

2. Theoretical framework:

2.1. *Institutional Complexity (independent variable) in Megaprojects:*

Institutional complexity in existing literature has been defined as the situation of institutional pluralism and different institutional logics that create an incompatible environment, where organizations need to engage with multiple, distinctive institutions, that are embedded in different and often conflicting “sets of normative orders – institutional logics” (Raynard, 2016, p.310; Matinheikki et al., 2021). Institutional logics more specifically are series of ordering principles, that direct the way of perceiving and conceiving organizational reality and impose how organizations act and react in a tolerable way (Greenwood et al., 2011; Matinheikki et al., 2021). Whenever organizations have to cope “with multiple, competing demands” or encounter contradictory orders from various institutional logics, they need to deal with institutional complexity, which impedes reaching a high consensus (Greenwood et al., 2011, p.317).

“In order to reach the railway system performance goals of safety, reliability, and interconnectedness, the separate system entities need to be smoothly integrated in increasingly complex projects” (Jakubeit, 2023, p.8). The inter-organizational character of megaprojects, contributing to institutional complexity, has revealed large cost and time escalations in the past (Jakubeit, 2023). According to Jakubeit’s research, railway expansion or upgrade projects are becoming increasingly complex, as they involve various parties with unaligned interests, different responsibilities, and risks. The governance and navigation of railway project processes are being impeded by complexities, which are often related to institutional differences between the abundance of involved stakeholders, as they miss a profound understanding of each other’s angle on the problem at hand. As a result, one must deal with disagreements that call for collaboration and mutual understanding to attain a collective consensus on decision-making (Jakubeit, 2023).

In light of frequent fragmentation in the governance of major infrastructure projects, another previous research paper investigates the relationship between formal and informal institutions. Formal institutions refer to law-anchored governance, whereas informal institutions’ governance is not anchored in law. They turn out to be highly complementary, as in particular, informal institutions spark the delivery of infrastructure and contribute to higher efficacy in public transport project implementations. Informal institutions accomplish to equalize the condemning interfaces emerging through institutional changes. Therefore, it is essential to work and act more corporate within the formal structure via the integration of policy fields and better coordination of processes to maintain a comprehensive administration throughout the project. Formal institutions and their regulative framework, containing explicit policies and approaches, together with the informal standards and methods shape the way a project is being managed and steered (Rye et al., 2018).

Complexity has a great link to uncertainty, as increased complexity diminishes our comprehensiveness on the effect of certain interventions within the institutional and physical environment (Salet et al., 2012). The management of megaprojects has shown to be difficult and complex, because “it overarches different, often fragmented policy domains and territories, and institutionally unbundled utility (sub-) domains (Monstadt & Schmidt, 2019, p.2353).

Further previous literature in the context of major infrastructure projects discusses how to govern institutional complexity in megaprojects. It takes upon the research gap of how to move through and manage institutional conflicts and institutional logics that cause project-risking institutional complexity. (Qiu et al., 2019).

The sources of institutional complexity and differing organizational outcomes arise from both macro-level and micro-level elements, “including regulatory, political, and social complexity (macro complexity), and also cultural, relational, and evolutionary complexity (micro complexity) (Qiu et al., 2019, p.440). *Regulatory complexity* can be defined as the multiple heterogeneous regulatory domains,

with distinct levels, regimes, and measures, which combined play a significant factor in compounding institutional complexity. Secondly, there is *political complexity*, which emerges through conflicts between dissimilar governmental organizations (multiple institutional logics) that create contradictory institutional requests and interests. Thirdly, in case of diverging expectancies and interests in the public, that hamper decision-making processes, *social complexity* arises and contributes to increased institutional complexity as well. The micro-level reveals complexities that add up to overall institutional complexity, too, starting with *cultural complexity*, which emerges from distinctive cultural mindsets and conflicts in multi-actor scenarios. Not only differences but also dependencies and relationships among different actors and organizations can create complexity, as *relational complexity* depicts “interactive uncertainty” emerging among different actors (Qiu et al., 2019, p.440). In other words, relational complexity emerges when involved actors or associations mutually affect one another in settings of insufficient firmness of institutional management (Qiu et al., 2019). Lastly, evolutionary complexity is a term referring to the evolution of the institutional framework, as the “organizational structure and composition” (Qiu et al., 2019, p.436) is dynamic and changing over time, and possibly confronting “existing institutions within the megaproject group that arise from conflicting institutionalized practices” (Qiu et al., 2019, p.440). Overall, they argue incompatible institutional logics are the root of the issue of institutional complexity and its adverse effects on megaprojects’ performances (Qiu et al., 2019).

2.2. *Delays and Cost Overruns (dependent variable):*

Large-scale transport infrastructure projects almost inevitably exhibit cost overruns, occurring due to underestimation of the cost of an intervention, meaning the cost exceeds the asserted budget set by a governmental contract (Dictionary, 2023). There is an extensive accumulation of previous literature that studies the causes, explanations, attributes of cost overruns, and analysis of cost performances in large-scale transport infrastructure projects, some of them focusing on railway projects. Delays and cost overruns have become a common attribute of public infrastructure projects. (Cantarelli, 2011). The study of various transport infrastructure projects across different parts of the world has identified a structured underestimation of cost during the early-stage phase of project planning. Moreover, the cost calculations have not improved throughout the last eight decades, which indicates that the lesson is not really being learned (Cantarelli, 2011). Cost overrun is highly dependent on the duration of the implementation period, thus delays in implementation are one of the most significant factors causing cost escalations. Furthermore, cost overruns in large infrastructure projects seem to be persistent and almost imminent, with growing project size cost escalations increase which is why out of 86 percent of the projects exceed their calculated cost by nearly 30 percent on average. Cost overruns can cause delays and additional cost excess, as projects often require renegotiation and new agreements when facing cost escalations. Besides that further funds need to be raised, which in turn risks the implementation of other infrastructure projects that use the same pool of financial resources, most often a settled budget (Cantarelli et al., 2010). Previous literature of Cantarelli et al. (2010) studied the most significant explanatory factors of cost overruns and delays in infrastructure projects, which, according to their research can be divided into a technical, economic, political, and psychological domain.

Technological explanations of cost overruns and delays comprise forecasting errors like price rises/fluctuations, incomplete and inaccurate estimations, deficient project planning, and poor project design. Moreover, there are scope changes, overall uncertainty of future occurrences, inappropriate organizational structure, unclear administration, and lacking planning and decision-making procedures, that are all of technological nature.

The economical explanations are characterized by structured underestimation of cost, which is driven by the rational choice theory of keeping the costs as low as possible to safeguard the project endorsement and realization, as deliberately setting out lower costs indicates higher “benefits” of the project, through the lens of economic rationality. As a result, there is no inducement of precise cost estimation. Through this strategic behavior and poor contract/finance management infrastructure

projects most often encounter underestimation of the total costs, which additionally entails insufficient incentives/finances and resources, and inefficient use of resources. The economical category is in many cases connected to the political and psychological explanations (Cantarelli et al., 2010, Steininger et al., 2020).

The political explanations for cost overruns and delays are concerned with deliberate underestimation of costs, too, as they report whether political and stakeholder interests systematically bias the estimates. Thus, they elucidate cost and time overruns by manipulation of forecasts and strategic misinterpretation of project costs, but also by redundant bureaucratic control and verification measures.

Psychological explanations deal with “distortion of perception by project management and experts”, like “optimism bias and cautious attitudes towards risks” (Steininger et al., 2020, p.267). Further detected causes accounting for project delays and cost escalations are redundant bureaucratic control and verification measures, deficient project designs and execution, insufficient financing, vaguely defined contract terms, unclear administration procedures, poor stakeholder coordination, and “insufficient geotechnical investigations at the feasibility stage” (Cantarelli, 2011, p.19). Optimism bias occurs during the assessment of projects, as result of rational/cognitive misrepresentation among local project officials, which create the “phenomenon whereby experts and project management estimate costs too low and benefits too high”, hence the connection to the economic domain (Steininger et al., 2020, p.267).

2.3. Conceptual Model:

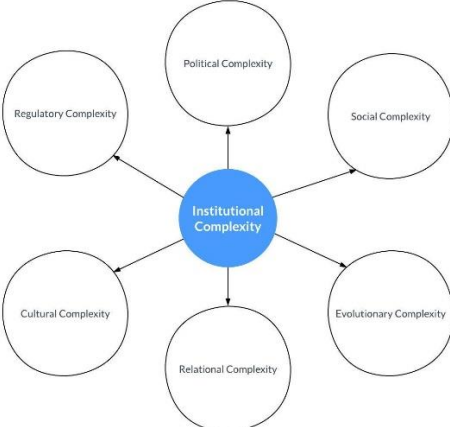


Figure 1: Sources of Institutional Complexity

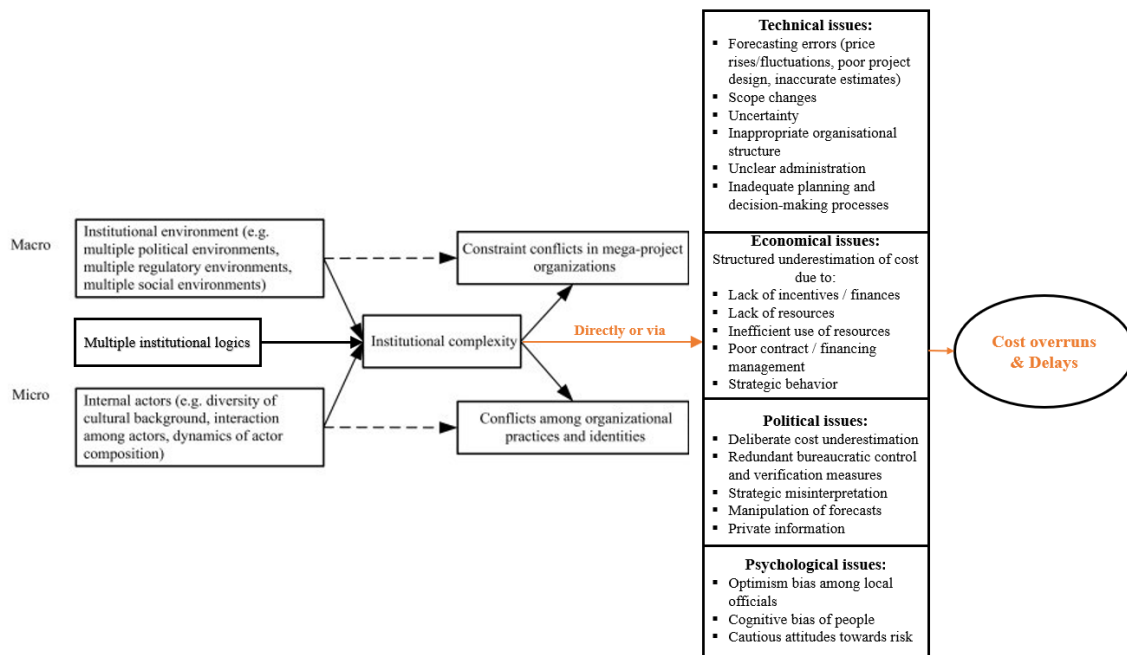


Figure 2: Modified model of "The ways of how institutional complexity forms and works over life-cycle" (Qiu et al., 2019, p.438)

The models combined present the sources of institutional complexity and how it causes technical, economic, political, and /or psychological issues that are responsible for cost overruns and delays in large complex infrastructure projects. So, in other words, it shows the effect of institutional complexity, arising from the micro and macro level, on cost overruns and delays. In that sense, institutional complexity is the independent variable that tries to explain cost overruns and delays in megaprojects – the dependent variable, which in turn is explicated by the variables of the technical, economical, political, and/or psychological domain embedded in the existing literature of Cantarelli et al. (2010).

3. Methodology:

My research is based on a quantitative multiple-case study method, which is deemed the most suitable research method, as this paper analyzes two cases (data points) with similar characteristics on the same phenomena – how is institutional complexity causing delays and cost overruns in large-scale transportation infrastructure? The multiple-case method allows investigation of the gathered data within each case's setting and across dissimilar affairs (Gustafson, 2017)

Furthermore, a multiple-case analysis assumes proper case selection, with a proper, logical criteria. The chosen criteria for the case selection is partly suggest by Guo et al., with the first criteria being data accessibility. Secondly, the cases must contain information admissible to the research question and goal. Also, they should feature similarity regarding their institutional structure.

The analysis of my research is entrenched in an analysis of two major railway projects [units of analysis], that share common goals, Stuttgart 21 in Germany and the Zuidasdok project at Amsterdam Zuid Station in the Netherlands. Profoundly investigating and assessing the institutional patterns of these two megaprojects is essential to attain a decent understanding of how institutional complexity affects delays and cost overruns in large infrastructure projects. Thus, the primary interest of this research is to infer the meaning of the analyzed cases and its similarities.

The multiple-case study analysis is based on the key parameters of institutional complexity and causes of cost overruns and delays (see theoretical framework) in the two selected infrastructure projects. It will analyze what effect institutional complexity has on cost and time overruns.

The data collection was conducted with secondary data, that included the following methods, for the Stuttgart 21 case: Governmental reports, project-organizational reports and documents from the Deutsche Bahn, a working paper of the Deutsch-Bahn partner 'Ingenieure22' as well as four case studies on the project.

For Zuidasdok I used several semi-annual reports of the government and the program organization 'Zuidasdok', case studies, news paper articles, a discussion forum, and article from the mentioned program organization 'Zuidasdok'.

In the following section, I am going to analyze and present the findings of both cases, separately. First, I will give a case description, subsequently, the institutional complexity of the project is identified and linked to the different explanations of cost and/or time overruns in the third case paragraph 4.1.3. and 4.2.3., respectively.

4. Case Studies

4.1. *The Stuttgart 21 project*

4.1.1. *Project Description:*

Stuttgart 21 is one of the most ambitious infrastructure projects in Europe, with the objective of modernizing, rearranging, and extending the Stuttgart rail hub and creating a subterranean through-station in order to increase travel speed and capacity. Travel times will be shortened and travel comfort, as well as suburban, regional, and long-distance connections optimized. The project is part of the wider Stuttgart – Ulm rail project and accounts for 57 kilometers of new rails, of which half are laid underground in tunnels (33 kilometers), and 22 kilometers are going to be high-speed tracks. Furthermore, it comprises four new train stations, 16 tunnels and cuttings, and eight bridges (Bahnprojekt Stuttgart – Ulm e.V., 2019; Steininger et al., 2021). Stuttgart 21 has been divided into seven sub-project sections in accordance with the formal planning approval procedures (PfA). The project's geographical outline and the PfAs can be seen in Figure 3 below.

The total investment value for Stuttgart 21 has initially been set at EUR 4,526 billion, as agreed in the finance contract of 2009, including regular funding of EUR 3.076 billion and EUR 1.45 billion worth of risk buffer. The amount is financed by the seven contract partners that share the funds as followed: Deutsche Bahn (hereafter referred to as DB) accounting for EUR 1,563 million, the Federation and the EU accounting for EUR 1,413 million. the state of Baden-Württemberg contributing EUR 931 million, the city of Stuttgart contributing EUR 292 million, Stuttgart Airport accounting for EUR 227 million, and Verband Region Stuttgart injecting EUR 100 million into the project (Bahnprojekt Stuttgart – Ulm e.V., 2019). As of March 2022, the newly calculated finance framework more than doubled to EUR 9.79 billion in total. This shows the extreme underestimation of costs which gave rise to internal stakeholder conflicts (DB Projekt Stuttgart – Ulm GmbH, 2016). The project was officially presented in 1994, with construction starting after a 16-year-long pre-construction period in 2010, and still, the project is not finished and is plagued by large cost escalations and delays. The new station and tracks are expected to be taken into operation by the end of 2025 (DB Projekt Stuttgart – Ulm GmbH, 2023).

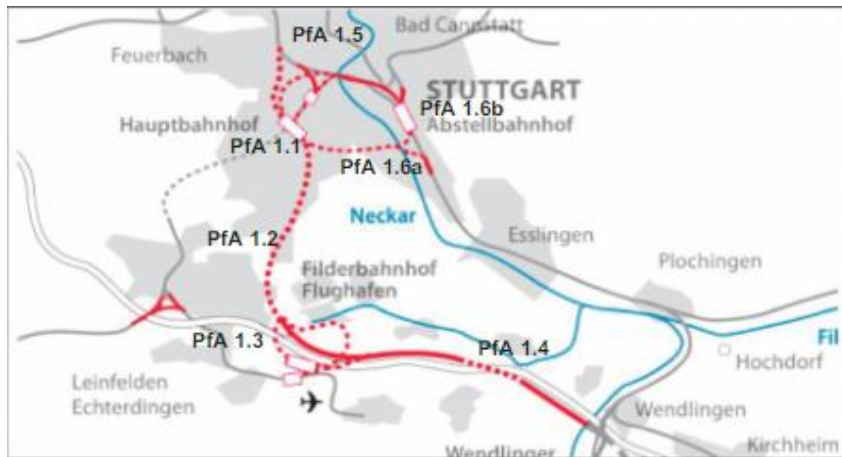


Figure 3: Route of Stuttgart 21 railway hub and sub-sections PfAs (Source: Deutsche Bahn [<https://www.bahnprojekt-stuttgart-ulm.de/en/>])

4.1.2. Institutional complexity from the macro-level and its effect on cost and time overruns:

Starting with *regulatory complexity*, Throughout the project, the intergovernmental complexity has shown itself in the differing authoritative power relations. National authorities and other formal institutions ruled out the initiated citizen involvement efforts by the city council of Stuttgart (Michel, 2020). Furthermore, the project developers must get a building permit in accordance with the planning approval procedure (PfA), which takes multiple years to be verified, the duration is hard to influence because merely the federal rail authority has the right to give the green light for construction (Steininger et al., 2020).

The regulatory differences between the actors of Stuttgart 21, present an optimism bias and inappropriate organization of the leading authorities as the democratic movement of the citizens later on caused extensive time and cost overruns. The procedure of approving construction involves high bureaucratic control and confirmation measures that depend on one institution and cause inevitable delays (Steininger et al., 2020).

Continuing with *political complexities*, the project Stuttgart 21 involves three different governmental actors, the federal state of Germany (including the EU), the state of Baden-Württemberg, and the municipality of Stuttgart which are all financing partners. Yet, the partners' interests are not all aligned, resulting in conflicts, for instance between the city council and the privately organized partner DB (100 percent state-owned) concerning additional funding, as Baden-Württemberg refused to adhere to their contractual agreement to collectively come up for additional finances (Steininger et al., 2020; DB Projekt Stuttgart – Ulm, 2016). Also, during the early approval and planning phase the project was at risk of being shut down, as the DB perceived it as too expensive. However, the public actors of the state of Baden-Württemberg and the city of Stuttgart wanted to push through the approval and implementation of the underground through-station as they had an interest to construct new first-rate properties on top of the station area and in place of the old rail tracks (Michel, 2020). To get the DB on board again, they strategically biased and falsified information, claiming the old terminus station attained its maximum performance level and that the new station would do as twice as well (Schmidt-Eisenlohr, 2018). Also, financing has been made a priority by entrepreneurial-promoting policies (strategic behavior) (Michel, 2020).

These events show how disputes of interest and contradictory institutional demands between different governmental actors in Stuttgart 21 expose strategic misrepresentation, and inadequate decision-making and planning processes as decisions were taken too fast. Costs were underestimated, deliberately by strategic behavior, and due to forecasting errors (technical), and the falsified information caused optimism for the realization of the project among the local

officials. All in all, this institutional complexity contributed to massive cost overruns and delays due to renegotiations (see Section 2.2)

The most striking event during the approval and construction phase of Stuttgart 21 was the constant public controversies resulting in great *social complexity*. The opposition of citizens, supported by the green party and other organizations, requested higher participation in the decision-making process. So, they tendered “four petitions for a referendum at the city level” but the authorities and executive partners of the project declined their demands as inadmissible. They did not authorize any democratic participation of the citizens in the decision-making, they merely consulted the citizens. Additionally, they upped their regulative approach against the protesters. The “Action Alliance against Stuttgart 21” criticizes the unfair public treatment, the poor project design, the ecological loss, the overambitious, expensive concept, with barely any advantages, as well as the immense underestimation of costs (Novy & Peters, 2012; Steininger et al., 2020, p.262). The opposition refers to the elite managing the project as the ‘Stuttgart 21 cartel’ (Novy & Peters, 2012). There have been huge conflicts of interest between the citizens and the leading officials of the project. This also shows the tension between formal and informal institutions. Despite the obvious and constant escalations of costs, and public resistance, the authorities went through with their interest and strategy.

This institutional complexity generated delays and cost overruns due to insufficient planning and decision-making processes, lacking in transparency, accountability (technical), and democratic legitimacy, as well as due to the cognitive and optimism bias of the leading officials (psychol.), who underestimated the informal social movement (Novy & Peters, 2012; Schmidt-Eisenlohr, 2018)

4.1.3. Institutional complexity from the micro-level and its effect on cost and time overruns:

When it comes to management culture, values and mindsets differ towards other cultures involved in large infrastructure projects. In the case of Stuttgart 21, the values and demands between the financing partners and the engineering culture did not correlate, which generated *cultural complexity*. Over the years, engineers attempted to invite both the DB and the officials of the project to participate in technical discourses regarding the fundamental deficiency of the designed system, which all have been denied (Schmidt-Eisenlohr, 2018). Thus, diverging cultures caused institutional complexity which resulted in cost escalations and delays (reevaluations) due to poor project design and associated forecasting errors, inadequate planning and decision-making procedures (technical), as well as optimism and cognitive bias, that made officials underestimate the costs of Stuttgart 21.

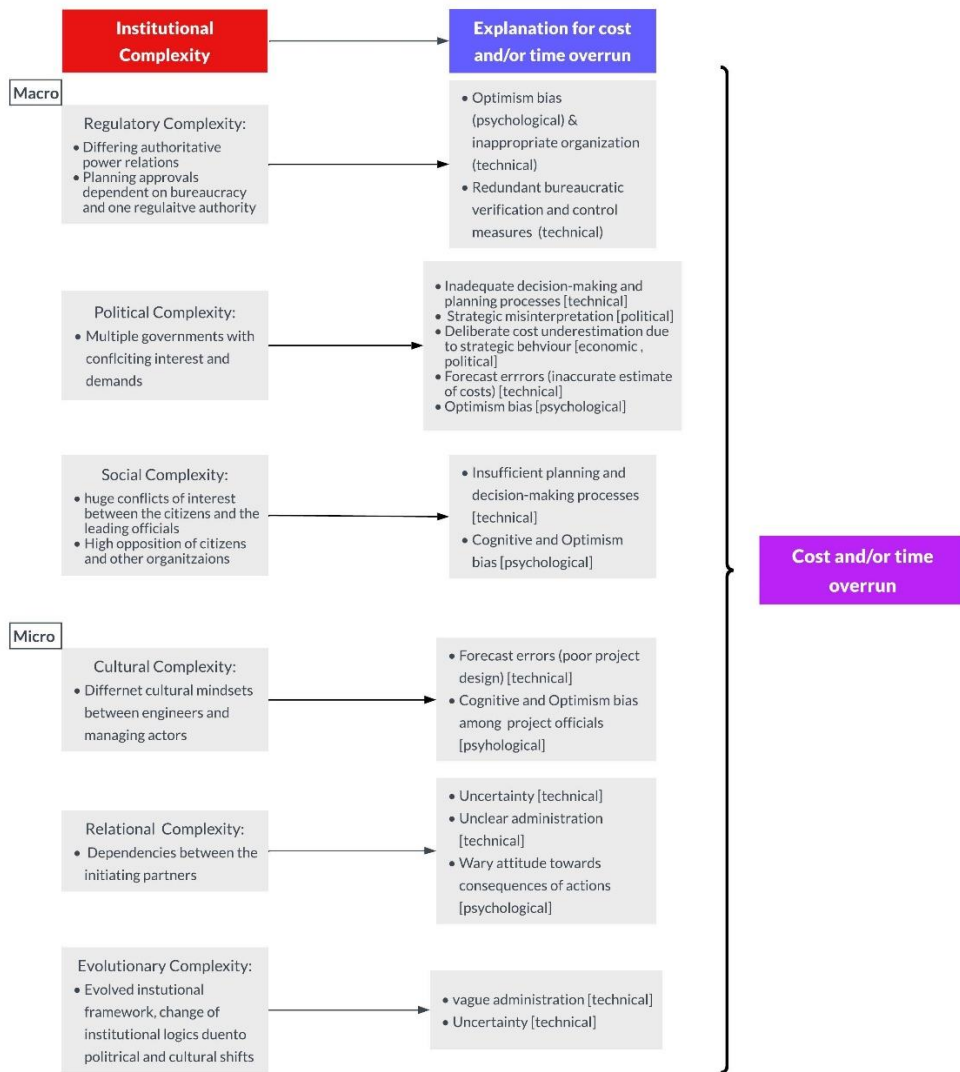
The detected *relational complexity* refers to the change of government in the state of Baden-Württemberg in March 2011, where the governmental responsibility switched from the Christian Democratic Union (CDU) to a coalition of the Green Party and the Social Democrats Party (SPD). The new coalition allowed the issued state-wide referendum, by the opposition of Stuttgart 21. However, a majority of 58,9 percent voted against withdrawing from financing Stuttgart 21. Although that is not what the Green Party stood for before taking over the government, they decided to continue as an exit would have been problematic and extremely expensive due to the dependencies with the DB and their irrevocable contracts for the megaproject. The changing political composition and institutional structure also caused skepticism on the side of the DB, who temporarily stopped the entire project until the government was set up (Spiegel International, 2011; Hsieh, 2012).

Apparently, the two partners mutually affect each other in the delivery of the project, which creates relational complexity, unlocking great uncertainty, unclear administration, and a wary

attitude towards the risks and consequences of certain actions from both actors, resulting in time overruns and further costs.

Due to nearly three decades of ongoing planning and development, Stuttgart 21 has experienced considerable political as well as cultural shifts. Next to altering political compositions and changing governmental priorities, thus an evolving institutional framework, also a new generation of citizens took over with different values and circumstances (Michel, 2020). This means there have been organizational structure and institutional logic changes, causing *evolutionary complexity*, which in turn generated vague administration and technical uncertainty responsible for overall cost and time escalations of Stuttgart 21.

Table 1: Effects of Institutional complexity on Cost overruns and Delays in Stuttgart 21.



4.2. Zuidasdok Amsterdam Zuid Station (including North-South Metro line)

4.2.1. Project Description:

With the aim of modifying Amsterdam’s southern Zuidas axis into a vibrant business and residential pivot, the Zuidasdok infrastructure project becomes the nation’s biggest civil engineering development. The megaproject shall enhance accessibility and connectivity for the Zuidas urban business area, especially between the north and south region, but

also internationally. Additionally, the proximity to the center of Amsterdam and its airport Schiphol will make it a crucial transport hub to meet future needs (Zuidasdok, 2022). The ambitious project comprises the renovation and extension of Amsterdam Zuid Station, the “widening and partial tunneling of the A10 South motorway”, the respective renewal of the motorway intersection at De Nieuwe Meer and Amstel, and the restoration of the open space around the station (see figure 6) (Zuidasdok, 2023).

Like Stuttgart 21, the Zuidasdok project is plagued by problems, among which are substantial cost and time overruns. The concept of the megaproject was initiated in 2000. In 2002, the central Dutch government and the municipality of Amsterdam approved to develop the ‘dock model’ including the underground laying of the A10, metro, and rail lines.

With the financial crisis in 2008, experts and the government doubted the financial viability and feasibility of the dock model, so they started exploring realizable alternatives for the Zuidas area. Hence since 2012, there is a revised version of the concept called ‘Zuidasdok’, which waived the underground train station and metro idea and foresees only tunneling part of the A10 motorway (Zuidasdok, 2023). Meanwhile, the megaproject’s total costs amount to EUR 3,6 billion (Halfjaarrapportage Zuidasdok H1, 2022), which merely accounts for the Zuidasdok costs since the reevaluation in 2012, just the North-South Metro line spent EUR 3,1 billion from 2002 until 2018 when it got completed (Solanki, 2018). Since 2010, the project is led by a joint venture, the Zuidasdok Project Organization, composed of the Directorate General of Public Works and Water Management, ProRail, and the municipality of Amsterdam, in order to cope with institutional and economic unpredictability (Triggianese, 2015).



Figure 4: Planning area of Zuidasdok (Source: Ministerie van Infrastructuur en Milieu, 2017)

4.2.2. Institutional complexity from the macro-level and its effect on cost and time overruns:

The Zuidasdok project involves multiple governments, the national regime represented by the Ministry of Infrastructure and Environment, the municipality of Amsterdam, the province of Noord-Holland, and the Amsterdam Transport Region. The initiating authority, the city of Amsterdam had to reformulate the Zuidas project to link economic with national infrastructure interests, in order to make it realizable, back in the late 90s. During this reframing process, the municipality had substantial difficulties to convince the national government to make the dock

model an investment project of national prestige. The conflicting objectives and different interests and priorities of both institutions built up a *political complexity*. Only after the national government changed its goal to promote economic potential, both governments came to an agreement and formed a public-private cooperation with many private actors backing the project (Majoor, 2008). Later intergovernmental financing decisions about extra funding due to shortfalls assessed in 2020 exposed another political complexity issue, as the costs of the contract were higher than expected (due to high complexity, higher risk, and delays) and not calculated correctly beforehand (Halfjaarrapportage H2, 2020).

The detected political complexity caused immense delays in taking up the project development due to differing institutional demands between the national and local regimes involved in the project. First of all, the unintegrated organizational structure which caused the reframing process in the first place brought about a scope change of the project involving higher costs and delays. Combined with the uncertainty of the reformulated project, slow decision-making, and the lack of resources and finances this political complexity accounts for delays of almost 6 years entailing cost overruns (Majoor, 2008). The forecast error and poor contract management made while estimating the project costs for the construction and design contract in 2017 caused an extensive cost overrun of nearly EUR 1,1 billion (Halfjaarrapportage H2, 2020).

Social complexity has been encountered associated with the structural damage on a bunch of houses in the centre of Amsterdam, due to the underground construction work on the North/South metro line. This incident rightfully caused a social disturbance, citizens were annoyed and lost trust in the project team. The increasingly diverging expectancies of the public, now that people were even more affected, caused the project organization to halt construction for a year and regain confidence from the citizens, by better communication, and promoting affected retailers. This shows how tensions and conflict of expectancies between the project actors and the citizens cause uncertainty and cautious behavior to reestablish reputation, which takes time and comes with upped costs, however, a good relationship between formal and informal institutions is also beneficial for the work climate and project performance (Van Wijck, 2012).

4.2.3. *Institutional complexity from the micro-level and its effect on cost and time overruns:*

Zuidasdok entails multiple actors with partially conflicting values and expectancies that create *cultural complexity*. This became apparent in the process of setting up the preliminary design of the project. ZuidPlus, a joint venture of Fluor, Hochtief, and Heijmans was awarded the design and construction contract worth EUR 990 million in 2017. They tendered the integrated preliminary design, which has not been approved by the national Ministry of Water and Infrastructure Management due to lacking quality. As a result, Zuidplus acted resisting and withdrew its 500 workers from the design and construction work. Subsequently, both parties went into a reassessment phase, not entirely halting the project, but significantly slowing down the progress and delaying the project (Blaas, 2019; Koenen, 2019).

This shows how conflicts between actors with different cultural mindsets and backgrounds add to institutional complexity, which has a substantial effect on time overruns, through the created uncertainty, and unclear administration of further actions. These delays caused further costs for the following reassessment and risk management costs.

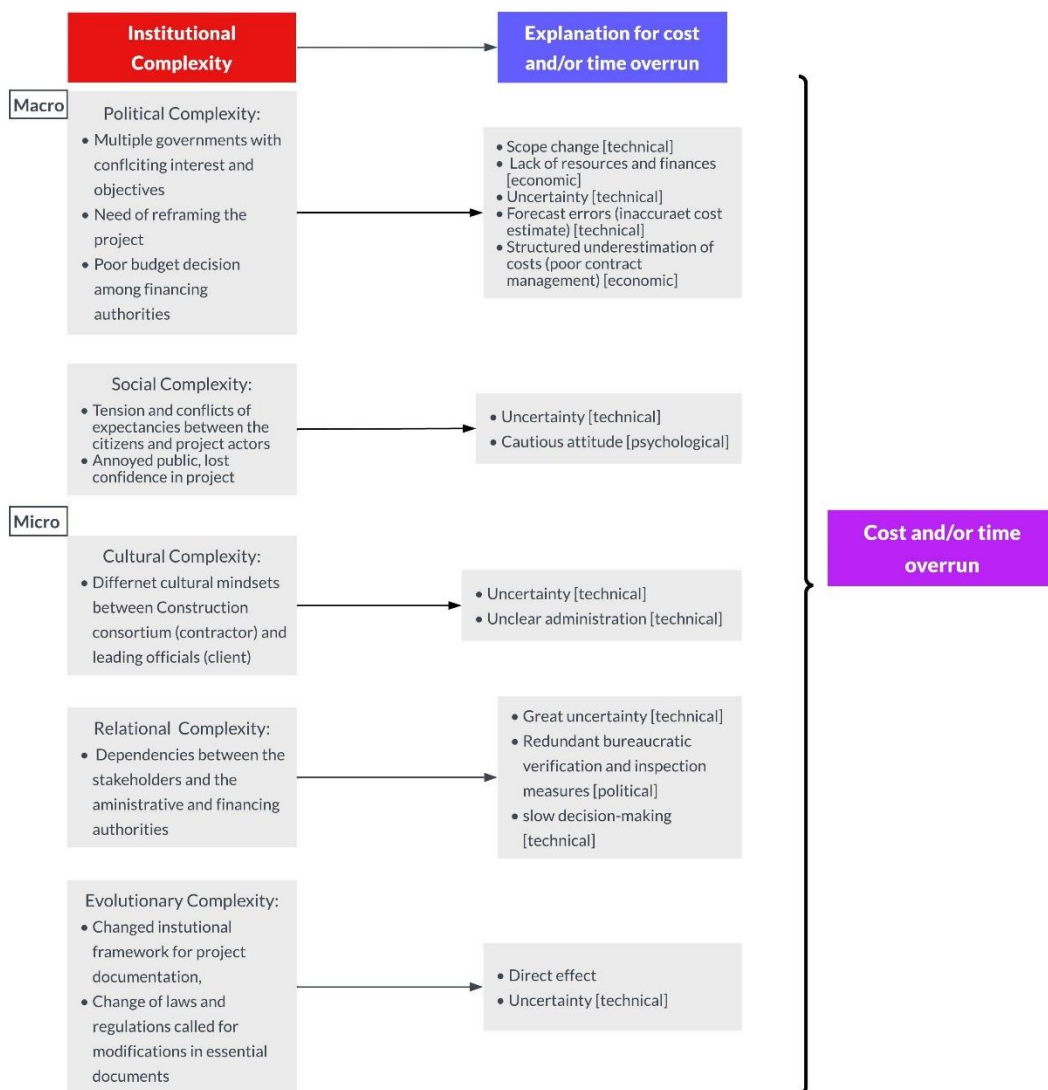
Despite the cultural differences, there are also dependencies present among the Zuidasdok project actors that cause *relational complexity*. Since the beginning of 2019, all stakeholders and several authorities had to be patient while waiting for the third authority of the administrative consultation to finish the corrected evaluation of costs and resulting cost overruns. It took them until mid-2020 to release the new financial prognosis, thus 1 to 1,5 years and another year to decide about the extra amount of financial resources to fill the cost shortfall of the project (Halfjaarrapportage H1, 2019; Zuidasdok, 2021). On the other hand, private stakeholders and other actors are essential for the authorities to keep the project alive too (Majoor, 2008)

Thus, the present institutional complexity induced by interdependencies, caused huge uncertainty about the cost rise of the project and if the financing partners would compensate for it. Combined with the redundant bureaucratic verification and control measures, and slow decision-making, this resulted in hampered overall project performance due to further delays and increasing cost as a consequence (Cantarelli et al., 2010).

Projects that go on for more than a decade are most likely to face *evolutionary complexity*, same goes for Zuidasdok. While going over the old project documentation the Zuidasdok organization noticed that the translation into updated contract information is more voluminous than anticipated. In particular, the old “integrated preliminary design” drafted by the contractor ZuidPlus required a lot of modification, as regulations and laws have changed significantly in the meantime (Bijlage-Halfjaarrapportage H2 2021, p.28).

Therefore, more time and costs for further reviewing power might be required, as the institutional framework in which the documents are embedded changed. This alteration in the institutional logic indicates institutional complexity directly causing time and cost escalations, which could also be explained by the evolutionary-induced uncertainty of the institutional framework, in which the megaproject is anchored.

Table 2: Effects of Institutional complexity on Cost overruns and Delays in the Zuidasdok project.



5. Discussion of Results:

When looking at the results of both cases' examinations, a correlation between institutional complexity and cost overruns and delays becomes clearly apparent. There is substantial evidence that the different institutional complexity domains have a strong effect on causing cost and time escalations in both projects, mostly through the given explanations and causes but also directly (see Tables 1 and 2).

Both megaprojects feature institutional complexity from multiple sources, only for the Zuidasdok project a regulatory complexity, where different regulatory regimes clash could not be identified based on my research. In particular, the politically, and culturally induced institutional complexity is rather similar in both projects, as engaged government composition and the cultural conflicts between the engineers' and leading officials' mindsets correspond in national-significant and technically complex infrastructure projects. In both projects the detected institutional complexity, whether from the macro or micro level can all be allocated to technical, economic, political, or psychological explanations that cause cost and time overruns.

The escalation of costs in both projects has frequently been built up by massive delays, which is another proof that delays in delivery create associated cost rises. Both projects neglected and excluded civil society from the decision-making of the interventions. However, the Zuidasdok organization improved their relation and communication with the public, whereas the officials of Stuttgart 21 declined any requests, acted untransparent, and treated the citizens clearly as inferior, which aggravated the institutional social complexity of the project.

Furthermore, the long development time of the projects, which will be more than three decades in both cases makes evolutionary complexity a substantial issue as the dynamic institutional frameworks give uncertainty on further actions, and the need for adaptation, hence hampering both projects' performance and postponing their implementation.

6. Conclusion:

Major infrastructure projects present highly complex institutional settings and involve various actors, who are embedded in multiple distinctive institutional logics, following different values, interests, and demands. Therefore, conflicts between these different institutions and their contradicting logics causes institutional complexity in multiple domains, regulatory, political, social, cultural, relational, and evolutionary complexities. All of them have hamper the performance of large infrastructure projects based on the Stuttgart 21 and the Zuidasdok in Amsterdam, as they had a strong effect on cost and time overruns within the two projects. They caused them directly or through explanations of cost overruns and delays from the technical, economic, political, and psychological nature. Thus, regarding these two megaprojects, it can be inferred that institutional complexity from different sources is adversely influencing and causing cost overruns and delays, impeding the performance of major infrastructure projects.

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