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Governance of institutional complexity in megaproject organizations

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Abstract

A significant research gap exists in our understanding of how to govern institutional complexity in megaproject organizations. In this paper, we conduct a case study of the Hong Kong-Zhuhai-Macao Bridge project in order to elaborate on whence institutional complexity emerges and how institutional complexity affects project outcomes and shapes actors' behaviors. We find that institutional complexity stems from both external (macro-level) environments and internal actors (micro-level environments), and consists of regulatory, political, and social complexity and cultural, evolutionary, and relational complexity, respectively. In addition, we find that institutional complexity from the macro environments will result in constraint conflicts in megaproject organizations, whereas the different practices and identities of the project's various micro-actors will create organizational conflicts. We also find that actors within the megaproject organizations choose different responses when faced with different types of institutional complexity. Our approach offers conceptual refinements and a new sensitizing framework for guiding studies of how, in practice, to govern institutional complexity of megaproject organizations.

Keywords: Megaprojects; Institutional logics; Institutional complexity; Governance framework

1. Introduction

Megaprojects are large-scale, complex infrastructure projects that take many years to develop and build and involve multiple stakeholders (Davies et al., 2009; Flyvbjerg, 2014; Liu et al., 2016; Ma et al., 2017). Their fundamental purposes are to ensure national security, increase economic development, improve people's lives, and promote social progress (Chen et al., 2018; Flyvbjerg, 2014; Zeng et al., 2015). It is no wonder that the importance of megaprojects has attracted the attention of an increasing number of scholars from different disciplines. The studies that have been accumulated offer insights on topics ranging from the governance of a megaproject (Liu et al., 2016; Sanderson, 2012), the innovation of a megaproject (Brockmann et al., 2016; Davies et al., 2014), and the risks and costs of a megaproject (Flyvbjerg, 2014; Kardes et al., 2013) to the decision-making of a megaproject (Priemus et al., 2008), and so on.

Megaprojects are closely related both to political systems and governments (Giezen, 2012), and to private business sectors, such as construction companies, design companies, and other business sectors (Zeng et al., 2015). From the perspective of neoinstitutional theory, institutional logics are defined as "the socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality" (Thornton and Ocasio, 1999: 804). Obviously, we can see that the megaproject organizations are involved with at least

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two types of institutional logics simultaneously: governmental logic, which notes that they should conform to the government's laws and regulations, and business logic, by which the actors in megaproject organizations view themselves as a type of company, with the goal of ensuring profits and the like.

Recent attempts to come to terms with the implications of megaproject management have refocused attention on the application of institutional theory in understanding the behaviors of actors in a megaproject organization (e.g. Biesenthal et al., 2018; van Marrewijk and Smits, 2016). The literature provides a useful framework for starting to explore institutional knowledge and institutional logic in managing megaprojects (e.g., Javernick-Will and Levitt, 2010; Orr and Scott, 2008). However, by providing a primarily institutional framework from which to analyze the structure and processes of megaprojects, the literature reveals little about how to weave one's way through the institutional contradictions and logics that lead to institutional complexity that affects the success or failure of a project (Biesenthal et al., 2018; Javernick-Will and Scott, 2010). As Biesenthal et al. (2018) have suggested in their review of the institutional theory in the megaproject management, several questions have not been addressed adequately in existing megaproject management literature, including the sources and impacts of institutional complexity. Specifically, what is missing is a clearer picture of what elements shape institutional complexity in the context of a megaproject, as well as how the different actors within the megaproject organization respond to the different types of institutional complexity. Therefore, to better understand the sources of institutional complexity and the organizational outcomes of institutional complexity within the megaprojects, two research questions are formulated:

1) Where does institutional complexity emerge from in the context of megaproject organizations?
2) How does institutional complexity influence the governance mechanisms of megaprojects and the behaviors of various megaproject actors?

To do so, we conduct a case study of the Hong Kong-Zhuhai-Macao Bridge (HZMB) project that extends across the Hong Kong Special Administrative Region, the Macao Special Administrative Region, and the Chinese mainland. The cost of billions of dollars makes it one of the largest and most ambitious infrastructural projects ever undertaken, and it is high-profile and socially and politically sensitive. A number of arguments make this case interesting to study. First, the project is located within three regions, and the necessary involvements of four governments increase the difficulty of decision-making and cooperation. Second, the project's large scale, high level of standards, and unique structure require all of the embedded actors to adjust their traditional institutionalized practices in order to innovate and create new production and construction processes and to cooperate with others. All of the irreconcilable institutional pressures from the external environments and the organizational conflicts from the internal actors lead to two levels of institutional complexity: a macro-level of institutional complexity and a micro-level of institutional complexity. Third, the project attracts much public and political attention due to a parliamentary inquiry into environmental protections, time delays, and the like. Therefore, we argue that it represents a typical type of megaprojects and is ideal for investigating our research questions.

Our study finds that conflicting institutional logics arise because megaprojects are (a) highly embedded in a diverse set of sociopolitical environments, and (b) closely associated with multiple actors within one single megaproject organization. By examining the HZMB case, we find that institutional complexity in a megaproject comprises six types: (a) regulatory complexity, because the different regulations and policies may have conflicting requirements simultaneously; (b) political complexity, because multiple governments' interests and expectations on the project may differ; (c) social complexity, because the public's concerns about and understanding of megaprojects are diverse; (d) cultural complexity, because many actors are involved, resulting in a set of cultural elements; (e) relational complexity, because the multiple actors interact with and influence each other; and (f) evolutionary complexity, because megaprojects are dynamic during their entire life cycle. In addition, we find that different sources of institutional complexity have different types of organizational outcomes. Institutional complexity from macro-environments will lead to constraint conflicts in megaproject organizations, whereas institutional complexity arising from micro-actors will result in conflicts among organizational practices and identities. We conclude that four principles can be used to solve the conflicting institutional demands: (a) setting up system leaders, (b) localizing practices, (c) building a collaborative network that underlies the collaborative hierarchies, and (d) implementing a flexible design to allow the multiple actors to reach a consensus.

This article starts with an overview of institutional complexity in megaprojects as they are identified in the literature. It relates megaprojects to issues of complexity and conflicts because different institutional pressures are the manifestation of logics associated with those issues in this type of project. The subsequent section focuses on an explanation of how the six types of institutional complexity influence the governance of megaprojects. In the section after that, we discuss our research methodology. The subsequent section presents the case study and an analysis of the mechanisms that lead to a successful pathway to coping with institutional complexity. The section that follows that gives the main implications of our research findings for megaproject managers and performing organizations. The final section discusses the opportunities and risks of the approach that we identified and considers our findings in the light of existing literature.

2. Theoretical background

2.1. Institutional logics perspective and institutional complexity

Early institutional theorists consider organizations as institutions that are infused with meaning, value, and legitimacy by their members and leaders (Jay, 2013). They define

institutions by the rules of the game that govern social exchanges undertaken by individuals and organizations (North, 1991). Later, the neoinstitutionalism perspective criticizes the earlier arguments and argues that society is made up of inter-institutional systems, wherein multiple institutional orders coexist simultaneously, and each institutional order differentially influences individuals' and organizations' actions (Friedland and Alford, 1991). That shift results in the emergence of the concept of institutional logics, which are defined as "the socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality" (Thornton and Ocasio, 1999: 804).

Recent emphasis on institutional logics has, however, largely focused on how organizations respond to the multiple and even conflicting institutional logics that lead to institutional complexity (Durand and Thornton, 2018). Institutional complexity is the antagonism in organizational arrangements caused by those incompatible and conflicting institutional logics (Durand and Jourdan, 2012; McPherson and Sauder, 2013). In other words, when organizations are confronted with incompatible cognitive systems, institutional complexity emerges that makes it more difficult for those organizations to achieve a high consensus. Biesenthal et al. (2018) see "megaprojects as the sites of conflicting logics brought to bear on their processes as the social and material constructors attending to them bring their life worlds to bear on the processes undertaken and forgone" (Biesenthal et al., 2018: 44). For example, in the context of megaprojects, institutional complexity comes from the institutional differences among actors, groups, political regimes, and the macro-environments that can bring about conflicts and uncertainty. Zelli (2011) argues that the conflict is a particular type of institutional interplay within institutional constituents, and it has become more frequently discussed in governance literature. Coincidentally, Klijn and Teisman (2003) suggest that the institutional fragmentation of projects could create enormous barriers that could exacerbate the complexity of decision-making and call for a huge managerial effort.

Recent studies on institutional complexity from multiple disciplines have largely investigated the mechanisms by which institutional complexity affect organizations, and how organizations respond to institutional complexity. Institutional conflicts may lead to organizational breakup or paralysis (Pache and Santos, 2010). Durand and Jourdan (2012) have outlined that conflicting demands in such a complex institutional environment are imposed upon organizations in order to meet the needs of the conflicting resource holder. Similarly, Raaijmakers et al. (2015) find that institutional complexity leads the decision makers to delay compliance, and usually not passively. Thus, the conflicting pressures in such an environment are imposed upon organizations by various institutional constituents who take different institutional logics and create incompatible demands, but hold the critical "material" and "symbolic" resources in the organizations (Misangyi, 2016). In short, Raaijmakers and colleagues (2015) consider institutional complexity to come from particular conflicts that arise from differing institutional demands. When those different demands are incompatible or uncertain, the organizations may have difficulty maintaining institutional support (Pache and Santos, 2010). Recent studies also have investigated the predictive factors of organizational responses, including the increasing social or economic returns for complying with the institutional demands (Greenwood et al., 2011; Oliver, 1991), the dependence of institutional constituents (Raaijmakers et al., 2015), the multiplicity of institutional demands (Martin et al., 2016), the consistency between institutional pressures and organizational goals (Kodeih and Greenwood, 2014), whether demands are legally coerced or voluntary (Lee and Lounsbury, 2015), and the uncertainty of the context (Ramus et al., 2017).

When faced with institutional complexity, how do organizations respond to the conflicting logics? Decision-makers' interpretation of institutional complexity and their personal beliefs can influence their choices, and the complexity can create ambiguity that forces the organization to adapt to it or act on it (Raaijmakers et al., 2015). When an organization is facing such institutional pressures, the ways to appropriately respond to institutional complexity could be the sources of competitiveness (Ahmadjian, 2016; Greenwood et al., 2011). The organizational responses to institutional pressures can vary from passive conformity to active resistance, depending on the nature and characteristics of the pressures (Oliver, 1991). From the perspective of comparative institutional analysis, complementary institutions shape a firm's strategy, innovation, internal structure, and external relationships, which are the sources of competitive advantage (Ahmadjian, 2016). Thus, how an organization deals with institutional complexity will be highly relevant to its comparative institutional advantages and will help the organization gain sustainable competitiveness.

2.2. Institutional complexity in megaproject organizations

Early studies focusing on institutions and projects highlight the role of institutional context in megaproject management (e.g. Javernick-Will and Levitt, 2010; Javernick-Will and Scott, 2010; Mahalingam and Levitt, 2007; Morris and Geraldi, 2011; Orr and Scott, 2008). Morris and Geraldi (2011) advocate that scholars incorporate institutional contexts into areas of research in project management, where the project is situated, with authors arguing that the institutional environments can contribute to a project's success or failure. Some scholars have suggested that institutions perform and operate on different levels, ranging from conscious to unconscious, and proposed a three-layered classification of institutional knowledge — cognitive-culture, normative, and regulative — that is crucial for global projects to achieve long-term performance (Javernick-Will and Scott, 2010; Scott, 1995).

Whereas most of the research on institution and project has focused only on the role of institutional factors in project management, with a few exceptions less attention has been paid to the role of institutional complexity on megaproject organizations' behaviors (Biesenthal et al., 2018; Dille et al., 2018; Dille and Söderlund, 2011). For example, from the

institutional logics perspective, Dille and Söderlund (2011) propose three concepts — isochronism, timing norms, and temporal fit/misfit — to manage the institutional factors in projects. Koivu et al. (2004) draw from the institutional theory and propose ways that the cultural diversity from different countries interacts and influences global projects. Dille et al. (2018) find that actors within a megaproject organization adopt three strategies to cope with temporal institutional requirements: temporal avoidance, temporal splitting, and temporal matching. Despite this consensus that institutional factors influence megaprojects, we still know very little of how institutional logics manifest and act in megaprojects, and how institutional complexity impacts organizational behaviors (Biesenthal et al., 2018; Scott et al., 2011). A recent paper published by Biesenthal et al. (2018) have largely suggested that the elements of the institutions, institutional conflicts, and institutional complexity can be useful for developing a theory on megaproject management. They also propose that the question of how actors respond to institutional complexity within a megaproject organization has been largely ignored in previous literature on project management.

2.3. The role of governance in megaproject organizations

From a project governance perspective, governance refers to all of the mechanisms within a project organization that broadly determine how resources are used and distributed in order to make the project move forward and resolve conflicts among its various embedded actors (Ahola et al., 2014; Pitsis et al., 2014; Sanderson, 2012). As Ahola et al. (2014) have documented in their research work, previous studies about project governance include two streams: one focuses on the internal activities made by a project-based firm on a focal project, while another stream concentrates more on the governance arrangements that define the shared practices among project-based firms and (non-project-based) firms embedded in one focal project (Ahola et al., 2014). Scholars studying megaprojects have highlighted the different types of governance mechanisms that assist project teams in making decisions about the procedures and structures of megaproject organizations, including societal governance (Ma et al., 2017), cultural governance (Clegg et al., 2002; van Marrewijk and Smits, 2016), governmentality (Müller et al., 2016), and the like.

Scholars acknowledge that governance is important in the context of a megaproject, because it acts as a framework from which to define and regulate the roles, practices, accountabilities, and decision-making that are related to projects, in order to achieve a centrally coordinated project planning and control function (e.g., Ahola et al., 2014; Too and Weaver, 2014). However, the prior research predominantly examined governance from the perspectives of agency theory and stakeholder theory (Ahola et al., 2014), without considering the significance of institutional logics in project governance (Biesenthal et al., 2018).

In sum, according to the literature, megaproject organizations operating with conflicting institutional logics differ substantially from single organizations (Biesenthal et al., 2018). Despite research on how institutional factors influence megaproject performance, we still know little, in the context of a megaproject organization, about the governance of institutional complexity that is intended to resolve institutional contradictions. Our empirical study of the Hong Kong-Zhuhai-Macao Bridge project brings to light a specific complexity of institutional settings that we call "institutional complexity". The answers to these empirical questions will allow us to develop a fine-grained understanding of where the different types of conflicting logics come from and how megaproject organizations can navigate institutional complexity.

3. Research methods and research context

Our research is based on a case-study approach for three reasons. First, the case-study approach can provide a level of in-depth investigation that survey methods miss and can capture less visible processes from multiple points of view (Eisenhardt, 1989). Second, a case study is an ideal mode of inquiry for addressing research questions regarding how institutional complexity influence the internal governance mechanisms in which we are interested. Third, prior literature has called for the use of case studies to examine the institutional factors that influence project organizations (Orr and Scott, 2008). As such, our empirical study contributes to theory development by grounding the governance mechanisms that we identify.

In this paper, we selected the case of the Hong Kong-Zhuhai-Macao Bridge (HZMB) project because we had unusual research access to the top executives and managers of the HZMB Authority. That access offered us many opportunities to deepen our understanding of whence institutional complexity arises, and provided conceptual insights into how the project actors respond to conflicting institutional logics.

3.1. The Hong Kong-Zhuhai-Macao bridge megaproject

The HZMB project was located at the crossroad of the Lingdingyang Sea and the mouth of the Pearl River and was carried out to connect Hong Kong, Macao, and Chinese mainland. It was a large-scale infrastructure project that was aimed at solving the transportation problems between Hong Kong, Chinese mainland (especially the west bank of the Pearl River Delta), and Macao. The HZMB started from Shiwan Bay in Hong Kong, went across the mouth of the Pearl River, and stopped at the Zhuhai-Macao artificial island. The infrastructure complex is approximately 35.6 km long, with a bridge and tunnel combination design. The tunnel program is approximately 6.7 km long, and the remaining section is a bridge program that is roughly 22.9 km long. The upper part of the bridge structure was designed as a steel structure and aimed to meet a design requirement of 120 years, in accordance with the British BS standard. The budget for this project was approximately 9.2 billion US dollars. The planned timeline was from 2009 to 2017, approximately 8 years.

Compared with other general projects, the HZMB project generated several new decision-making problems because of its special characteristics, such as its "cross-sea," "one bridge and three locations," and cross-border and large-scale nature. First of all, the HZMB project extended across three regions that each has its own authorities, thus resulting in the port design and management problems (Chen et al., 2018; Zhang and Qiu, 2018). Second, the cross-border feature also offered us another insight into considerations of management problems, due to the three different political systems involved. In addition, due to its special geographical position, the HZMB project had to put more emphasis on ecological problems, such as the movement of sediment in the Pearl River and the problem of critical protection for the local Chinese dolphin.

3.2. Data collection

Data collection started in 2009 when we gained access to the top managers of the HZMB Authority, the government agency established to develop and manage the Hong Kong-Zhuhai-Macao Bridge project after the general decision had been made. The top management team of the HZMB Authority included a chairman, a chief engineer, two assistant directors, and three deputy directors. This team reported to the Central Government, the HKSAR Government, and the MSAR Government. Data collection comprised three parts: semi-structured interviews, archival data, and observation of participants, as summarized in Table 1.

3.2.1. Semi-structured interviews

Between 2009 and 2015, we used the access granted to the senior managers of the HZMB Authority to gain information through semi-structured interviews. First, we interviewed the top executives and managers of the HZMB Authority at least once. We also conducted several interviews with the ordinary staff at the HZMB Authority in order to understand the daily working processes and their communication procedures within the HZMB project. Second, we endeavored to interview a representative from some of construction and design companies that were engaged in the HZMB project. Since each company has its own institutionalized practices in different stages, their comments should be extremely important in the effort to understand how they respond to the institutional complexity.

Each interview aimed to understand the emergence of the conflicting institutional logics from external environments and internal actors, as well as the organizational outcomes of institutional complexity in a mega-infrastructure project. We developed the interview protocol based on the previous literature focusing the institutional complexity and the organizational practices in the mega-project construction industry. The interview protocol contained a number of questions structured around three themes (i) the perceptions about the conflicting institutional pressures from external environments; (ii) the perceptions about the conflicting organizational pressures from internal participants or cooperative actors; (iii) how to respond to those conflicts from internal and external institutional contradictions. Example questions were: a). Could you please tell us whether you were faced with some conflicting institutional pressures emerging from external environments, such as the governments, laws, and social concerns? b). Did you engage in some organizational conflicts emerging from the internal actors? c). How did these conflicts affect your work? d). How did these conflicts influence the daily processes of the HZMB project?

3.2.2. Archival data

To improve the accuracy of our data and the robustness of the conceptual insights, we also obtained the archival sources from the governments and the HZMB Authority, including the technological and management reports and the technological and construction reports that were used to demonstrate the rationality and feasibility of this project from 2002 to 2015. That detailed information is presented in Table 1. We also examined records from the preliminary coordinating group

Table 1
Data sources between 2009 and 2015.

Sources		Numbers
Interviewees		
Executives and staff at HZMB Authority		10
Government officials		6
Consultants of HZMB project		3
Design and construction engineers		11
Managers and staff at service providing companies		15
Archival records		
Management structure design and white papers		4
Feasibility research reports		5
Specific research reports by different research institutes		46
Patent application files		10
Interviews made by newspapers		50
Observations		
Design review meetings	Sporadic	3
Technological review meetings	Sporadic	6
Construction plan review meetings	Sporadic	11
Observation at the construction sites (2–5 h)	Sporadic	30 (days)

Note: The total number of interviewees was 45. Archival records totaled 125, and observations, 50.

meeting, the project task force meeting, the agreement of the preliminary design, and the design-change logs. In addition to the information in the internal project documents and the interview reports, we gathered other facts from articles and interviews with top managers in professional outlets and newspapers, and academic papers published by the engineers and managers.

3.2.3. Observation of participants

We conducted participant observations within the HZMB project organization from 2009 to 2013. This meant participating in meetings as a note taker and carrying out dozens of informal conversations that served as unstructured interviews. As we gathered these data about the decision-making for design plans and technological and construction plans, we were also able to gain information about the communication structure and to learn more about the institutional obstacles that influenced the project's performance.

4. Data analysis

Our analysis followed the traditional qualitative analysis tactic and proceeded inductively. First, we imported all materials into a database using Atlas.ti (version 7), which enabled us to code passages with documents, query and visually map relationship among those codes. Then, we conducted our analysis in two steps as follows:

4.1. Stage 1: Identification of the competing logics

During the first stage of analysis, we attempted to validate the argument that the HZMB project was embedded in multiple and competing logics. We further attempted to characterize those logics. As a first step in identifying the logics that influenced the behaviors of the actors involved, we read and coded the archival materials, expert interviews, and conference program. During this inductive phase, our work was driven by broad questions focused on the characteristics of the conflicts experienced by organizations (e.g. conflicts about the governments' goals toward HZMB project, organizational tensions about the ways to resolve the technological or managerial problems). As we clustered the themes of the project's logics, we observed different types of institutional logics that affected the actors' behaviors. Finally, we found that six types of main sources resulted in organizational tensions or conflicts (all the codes about the institutional conflicts could be assigned into six families in our database): the differences between the laws and regulations, the different political environments and different goals of the governments, the different socially embedded environments, the cultural diversity among the project actors, the relational interactions among the project actors, and the evolutionary relationships during the project's life cycle.

To confirm that the multiple logics that we had identified characterized the macro-micro level of logics accurately, we triangulated this analysis with research material describing the institutional context of the megaproject (e.g., Biesenthal et al., 2018; Mahalingam and Levitt, 2007). Finally, to cross-validate our analysis, we asked two experts to confirm the description of the logics that we identified.

4.2. Stage 2: Identification of the organizational outcomes and the governance patterns of the competing logics

Building upon our prior analysis, we then conducted an in-depth analysis to identify the differences and similarities among those types of institutional logics. At first, we proceeded to identify the outcomes of each logic. Due to competing logics that existed simultaneously, we built reports for every type of institutional logic, describing in detail the history and tensions of the organization on the basis of the six types of main sources we had identified during the previous stage. As we built our reports, we paid attention specifically to the organizational tensions on both an inter-organizational level and an intra-organizational level, in order to identify the outcomes of those institutional settings. We discovered that the various types of conflicting logics imposed different types of conflicts on the megaproject organization. For example, when coding the outcomes of these conflicts, we found that some of the cultural conflicts reduce their efficiency in their decision-making in HZMB project and the conflicts from the political environment results in the goal constraints in their decision-making.

Again building upon the prior analysis, we next conducted a subsequent round of analysis to uncover how the actors responded to conflicting logics. To do so, we compared the different types of institutional conflicts and identified differences and similarities across the response patterns. The data revealed that the actors chose different types of response patterns when they were facing different types of institutional complexity. For example, faced with the competing institutional demands from governments, the decision team chose to balance the demands of three governments, whereas some of the contractors chose to innovate when faced with competing logics. In particular, we found that the ways they responded to the same types of competing logics varied according to each actor's personal characteristics and power level. The decision-makers and top-level managers were more likely to balance their institutional complexity in a political type, whereas other contractors and designers chose to conform to those different institutional logics. Then, we identified the governance mechanisms that were used to resolve the negative effects of institutional complexity in this case. To provide a clear map of how we develop our arguments, the Atlas.ti software was employed to systematize the coding, establishing the relationship between institutional complexity and the governance mechanisms, as shown in Appendix.

5. The institutional complexity of the HZMB project

From its inception, the HZMB project organizations were characterized by multiple institutional logics: from three governments, from three political and social systems, and from the diverse actors within the single megaproject organization. To more clearly describe the relationships among the governments, designers and contractors, supervisors, and equipment

providers, from the decision stage to the design and construction stages, we created Fig. 1, showing a macro-micro model of the actors involved in the various HZMB project organizations.

As is shown in Fig. 1, the four governments — the Central People's Government of the People's Republic of China (Central Government), the People's Government of Guangdong Province (GDP Government), the Government of the Hong Kong Special Administrative Region (HKSAR Government), and the Government of the Macao Special Administrative Region (MSAR Government) — were the funders and also the leaders during the decision-making stage. Because of China's examination and approval requirements, the State Council of the PRC, the National Development and Reform Commission, the Ministry of Transport of the PRC, and other government departments were involved in this megaproject, in an effort to undertake the decision tasks and produce the new construction standards. During the decision stage, the four participating governments established the HZMB Pre-Coordination Group, the HZMB Task Group, the HZMB Joint Working Committee, and the HZMB Authority, to fulfill the project's demands in its different stages. Also during the decision stage, experts from the construction companies, design companies, construction consultant companies, public research institutes, and government officials were invited to form an expert group to provide plans and advice for the governments. On one hand, they had to cooperate with three sets of regulations and standards. On the other hand, no one had ever had any similar experience building such a massive and long cross-sea bridge. This made the HZMB project much more specific than other ordinary projects.

5.1. Different regulations and construction standards among the three regions

As Fig. 1 shows, the HZMB project was a cross-border public project involving three regions: Chinese mainland, Hong Kong, and Macao, each of which had different regulatory environments. Within these three regions, each had their own administrative rules and procedures for the processes of project establishment, project investment and financing, and other major issues. Thus, it was much harder to reach a consensus on the decision-making for all of the governments, given the regions' own independent authorities. During the decision-

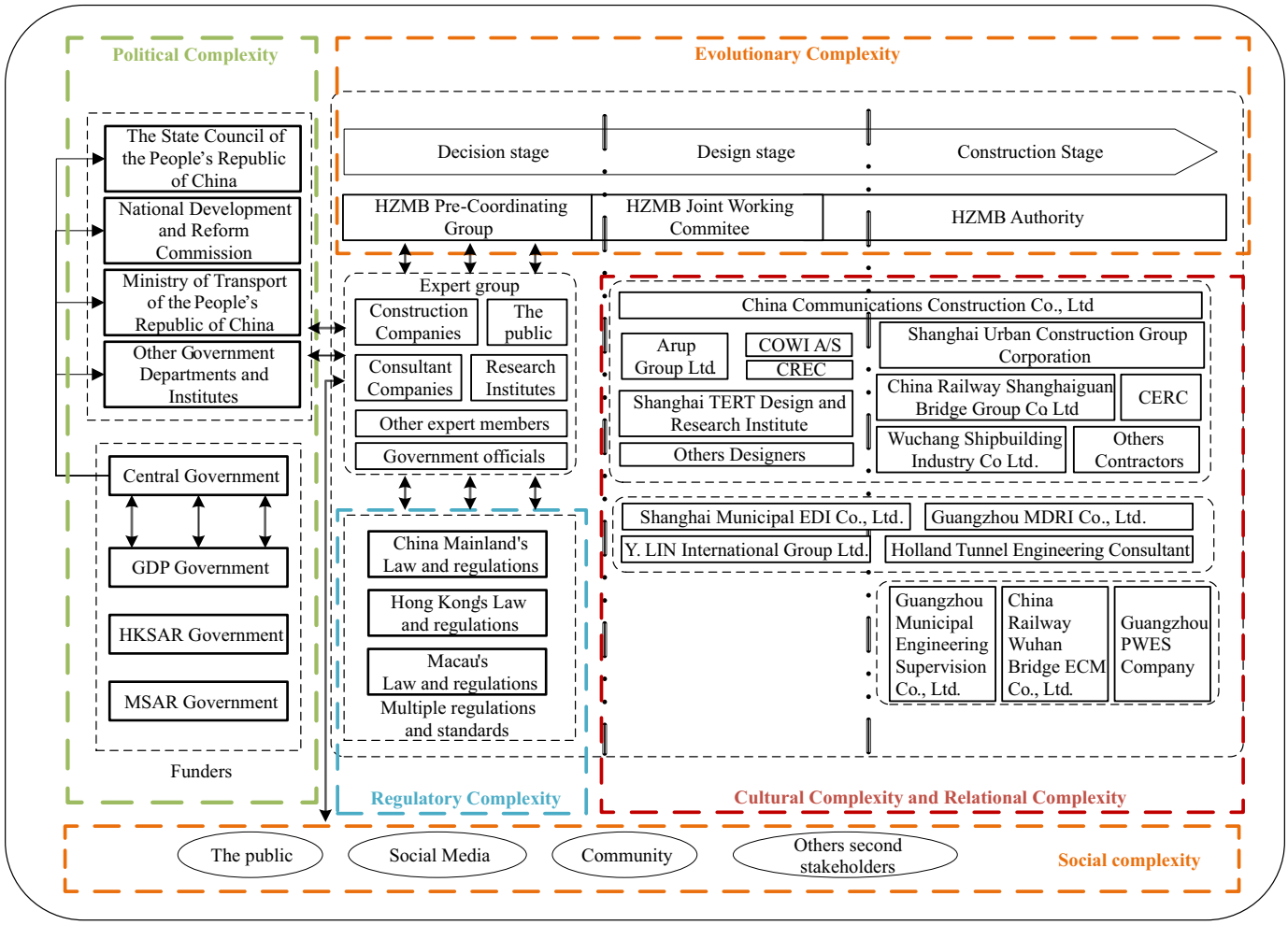

Fig. 1. The institutional complexity in the megaprojects. Note: The 'expert group' is composed of experts from construction companies, the consultant companies, the research institutes, government officials. They offer the advice for the HZMB Pre-coordinating Group to make decisions on the project financing, the port plans, the location plan, the route selection, the bids, and etc.

making stage, the various goals, processes, and values among them inevitably led to project conflicts and especially prompted the need for more mutual communication and explanation.

As was argued above, the four governments in the three regions each had their own specific laws and regulations governing the project approval process for public megaprojects and for investing in and financing megaprojects, and all of that brought about multiple, sometimes incompatible logics in the regulatory type and thereby shaped a regulatory complexity. The decision-making processes for the HZMB project were also different for these governments. Moreover, there were huge differences among the construction management entities in these three regions. Engineers from the three regions discussed the complexity of regulations and described the standards that this project took:

HKSAR Government takes the credit management approach to qualify the contractors, while Central Government and GDP Government undertake their unique qualification management. As for the construction and technical specifications and standards, there are still big differences among these three regions.

Central Government and GDP Government promulgate their own complete highway and bridge design standard[s], construction technical specifications, and construction management standards, such as *Highway Law of PRC, Bidding and Tendering Law of PRC, Regulations on Quality Management of Construction Projects of PRC*, etc. In Hong Kong, there are no such codified regulations used to manage and guide the construction processes. The main legal bases in Hong Kong for construction management are the *Road Engineering Ordinance* and the *Project Environmental Protection Regulations*. The relevant technical standards of this project are usually determined by the similar practical project experience in Hong Kong construction market.

Macao is based on the Portuguese technical specifications for engineering design, mainly based on the *Public Project Contract* (74/99/M).

In sum, different regions promulgated their own standards and regulations, resulting in incongruent regulations among the three regions' project standards. The involvement of multi-regulatory environments increased the complexity of communicating information and the difficulty of information disclosure. Judging by the practical experiences of the Shenzhen Bay Bridge that connects Hong Kong and the Shenzhen district, and the Lotus Bridge that connects the Macao and Zhuhai districts, it would have taken a long time to agree on a unified standard for the design and construction, and the workload of the HZMB project could have doubled, ceteris paribus. Therefore, the differences among the specific calculation methods in construction design, experimental methods, and technical parameters in these three regions (Hong Kong, Chinese mainland, and Macao) were one of the sources of incompatible institutional logics that constrained the processes and procedures of successful construction of the HZMB project. We named the organizational outcomes of the regulatory complexity as a "constraint conflict" because the competing regulatory logics influenced their decision-making on the standards and on the construction procedures. Thus, the majority of the impacts from the regulatory complexity constrained the project's scope and their actors' behavior.

5.2. Different political environments and goals of the governments

As we discussed in the previous section, the HZMB project involved four governments, each of which had its own expectations and goals for implementing and supporting the HZMB project (see Fig. 1 for detailed information). Moreover, they might also have understood the same alternatives differently, thereby resulting in a higher level of institutional complexity than would be the case with general projects. This divergence could have come from their knowledge pools, their technical backgrounds, their values and norms, and the public demands they represented. It was acknowledged that even the different departments within the same government would have different perspectives and attitudes based on their own interests. Therefore, the situation in which four governments were involved in the HZMB project created an army of conflicting demands for their decision-making processes.

In this specific case, the HKSAR Government and the GDP Government had different opinions about whether the project should choose the One-Y model or the Two-Y model. One government official from the GDP government had this to say:

… At first, one of the plans is to build a Two-Y model plan, connecting Shenzhen [and] Hong Kong in the eastern region, and Zhuhai [and] Macau in the western region. [The] HKSAR Government frown[ed] on this plan, saying that it's costly to build Two-Y model, while the GDP government strongly advocated this Two-Y model plan due to the economic agglomeration between eastern and western regions. …. After the mediation and efforts of China's central government, they chose the One-Y model, connecting Hong Kong, Zhuhai, [and] Macau. Therefore, the city of Shenzhen was abandoned in this HZMB project.

The different demands between the HKSAR Government and the GDP government lay not only in the connection model of the HZMB bridge but also in the costs and expenses that they should accept. We can briefly summarize the constraints of the decision choices that constituted the balance among those four governments' demands and goals.

5.3. Different social environments among the three regions

The understanding and attention of the public also varied among the three regions. To illustrate, some residents in Hong Kong criticized and protested this project because of their concerns about the environmental damage, the increased competition with Zhuhai City, and so on. For example, an elderly female resident, Zhu, referred to the judicial review of the HZMB environmental evaluation, showing a resulting loss of $6.5 billion.

Another typical example is that the residents of Hong Kong held different attitudes toward the decision about the site of the artificial island in Hong Kong. At the same time, some of the

NGOs from Hong Kong were afraid of the pollution triggered by the construction. Three government officials expressed that the public in the different regions held different opinions, and said

> Person 1: We have to deal with some of the social issues when we push the project into progress … About 1000 residents from Tung Chung in Hong Kong protested about the site decision of the artificial island. They think it's harmful to their life quality and will increase the air pollution due to the increase of the car[s] around this area.
>
> Person 2: Some representatives from Hong Kong Labor Party are opposed to fusing with Chinese mainland too fast. … Some of the Youth Groups also protest about the same social issues, and [have] said that the agglomeration of Hong Kong and Chinese mainland will decrease their life quality. … Some NGOs from Hong Kong protest against the consequences of the HZMB project, which might accelerate the environmental destruction, extrude the living space, aggravate the air pollution, and threaten the survival of local wild animals.
>
> Person 3: Residents from Zhuhai are all happy about this project, and think this can bring them more opportunities and create more jobs without leaving their hometown. … People from Macao hold a neutral attitude toward this project.

Therefore, the existence of different attitudes from the public toward the HZMB project provoked the actors to consider how to respond to the public, which was a key stakeholder in the project's governance. Although the government was the key leader of the megaproject, in this case, the competing logics from the social environments could constrain the decision-making for the HZMB project due to the project's large impact on the public and the social environment.

5.4. The cultural complexity in the HZMB project

The diverse actors within the HZMB project had their own cultural mindsets and values from which to manage the relational and temporal organizational networks, and that increased the cultural complexity in the HZMB project. The team leader proposed a special framework for managing and guiding the construction of the HZMB project, termed *Large-scale Construction, Factory Construction, Standard Construction, and Assembling Construction. Large-scale Construction* referred to the conditions under which the main body of the HZMB was discomposed into large-scale elements that were prefabricated before being installed by large equipment. For example, the weight of a box girder could be 3000 tons each after the decomposition, and the drainage of a 180-m tube tunnel could reach 80,000 tons each. *Factory Construction* meant that all the components were prefabricated on land before being transported to the construction site, which not only improved the quality of the structure and the working environment but also reduced the negative effects on the natural environment. *Standard Construction* was possible because the structure of the HZMB project could be decomposed into a large number of components, which then could be produced in a unified process, maintaining the quality and stability of the components. *Assembling Construction* referred to the new construction methods with the development of new technology.

In accordance with the interview of the director general of the HZMB Authority:

> We use this specific framework to guide and manage the design and construction of the HZMB project. … This is an original framework that [has been] used in bridge construction project ever since. We require all the contractors to incorporate this new concept into their daily management, including the designers, construction companies, as well as the equipment providers.

However, before becoming involved in the HZMB project, the contractors had never used that kind of construction methods because their construction methods were still site-construction methods. Similar to the "engineering culture" termed by Kunda (1995), the differences in "technological background" among the project teams, designers, and contractors generated conflicts between their institutionalized practices and the required methods, and to some extent led to institutional complexity in cultural artifacts.

Another typical example of cultural complexity for the HZMB project lay in the design of the immersed tunnel structure. One of the engineers talked in a technological communication meeting:

> General[ly] speaking, there are only two alternative plans in the construction industry, which are the rigid tunnel and the flexible tunnel. Both of the two types of the tunnel have difficulty in solving the uneven settlement of the foundation beneath the 40-meter sea in our case. To reduce the impact of the uneven settlement of the foundation on the immersed tunnel, our team wants to develop a new structure for the construction of tube tunnel, that is a half-rigid tunnel. Nevertheless, some of the construction experts and consultants from European countries disagree with our opinions. They [have] said that we should not be over-innovative to develop this new structure, and insist that this new structure would impact the successful delivery of this project. However, our team focused on the development of this half-rigid tube tunnel. Finally, it [has] turn[ed] out to be successful, which solves the problems of the deeply-buried condition and uneven settlement of [the] foundation.

What created these conflicting attitudes on this technological change were the multiple cultural backgrounds from the different organizations, and even from their different nationalities. In this regard, compared with a general project organization, the organizational structure in megaprojects has become temporary and disposable, because the megaprojects that are faced with huge risks, as well as with coordination and integration challenges, are often composed of more diversified actors from different countries and with different cultural backgrounds. The multiple and incompatible cultural logics in this project were the sources of institutional complexity in the cultural type.

Contractors and the accepted practices on megaprojects have evolved with the cultural complexity, under the technological demands. Those conflicting cultural logics might impede the innovation of new technological methods to solve the project problems. Moreover, the institutionalized practices of the actors can interact with each other, creating new or mixed organizational practices to satisfy all of the actors. Therefore, we use the concept of conflict of organizational practices to describe the organizational outcomes of the conflicting cultural logics in our study.

Obviously, the organizational consequences of cultural complexity are totally different from those of regulatory complexity. This project's cultural complexity emphasized the impact that conflicting cultural logics had on internal organizational practices, including on the design and construction methods, the management structures, and the technological innovation, while institutional complexity from the macro-environments highlighted the constraints on the decision-making and on the project design and construction. Thus, the various impacting mechanisms needed project managers to manage the different types of institutional complexity in different ways.

5.5. The relational complexity in the HZMB project

A salient characteristic of the HZMB project was the diversity of actors involved in this single megaproject. Relational complexity arises with the number of actors or groups involved in a project when they interactively influence each other, with a lack of stability at the project level of the institutional regime (Child and Rodrigues, 2011). Relational complexity points to the interactive uncertainty that arises from multiple individuals, teams, groups, and organizations being involved with the delivery of a megaproject, where the interactions and relationships among them become a critical element that shapes the project's successful delivery.

Relational complexity between designers and contractors can be found in the construction of steel bridge structures. During the HZMB construction processes, the complexities and uncertainties of the ocean environment made the previous design change constantly. Consequently, the contractors had to adopt a new design framework and implement new equipment and new processes to guarantee the project's quality. One senior top project manager in the CCCC had the following to say about the dynamic changes during the project's construction stage:

There are almost 90% construction plans that have changed in the course of the construction stage. … The different construction activities span in different sites, and the working hours and processes usually vary, all of which require different working condition[s], temperature, and environment.

Given the dynamic relationship between designers and contractors, the conflicts between the design and construction work had to be solved by their interaction and cooperation. The construction activities were connected with and influenced by each other and required that multiple actors coordinate with each other to overcome the changing conflicts among them. In terms of their institutionalized practices, instability of organizational structures and interactions between actors urged the individuals in the project to adjust their traditional mindsets and thought processes.

5.6. The evolutionary complexity in the HZMB project

Evolutionary complexity arose from the dynamics of the HZMB project group, which was constantly evolving and incorporating new entrants into its proceedings. Different core organizations of the HZMB project were in charge of decision-making in the various stages — the HZMB Pre-Coordinating Group, the HZMB Task Group, the HZMB Joint Working Committee, and the HZMB Authority. These core organizations were formed by the officials from the three regions and were evolving all the time, undertaking the different aspects of decision-making (see Fig. 2).

Moreover, during different stages of the project, an increasing number of actors joined the project group as a result of the need for collaborative development in tackling the complex problems, and that situation introduced conflicting institutional pressures into the project. For example, during the installation of the immersed tunnel stage, the contractors encountered many problems, such as silt refluxing, precision restriction, and tunnel detection. To solve the tunnel detection problem, they enlisted an aerospace company that provided a spaceflight sensor to inspect the tunnel movement under the sea. What's more, to solve the silt-reflux problem, they invited experts from research institutes and manufacturing companies to cooperate with each other to develop new equipment. These kinds of new organizations involved in the project team could generate conflicting institutions within the project, termed evolutionary complexity.

In a nutshell, the HZMB project was embedded in multiple institutional logics stemming from macro-environments and micro-actor conflicts that resulted in institutional complexity in the megaproject, as are described in Table 2. Regulatory complexity arose from the distinct political and regulatory systems in Hong Kong, Chinese mainland, and Macao (depicted in the left bottom of Fig. 1). Political complexity stemmed from the different political environments and different interests and expectations of those governments (left bottom of Fig. 1). Social complexity existed because the public in the three regions had different attitudes and interests (the bottom of Fig. 1). Cultural complexity, relational complexity, and evolutionary complexity were generated from the potential conflicting institutionalized practices embedded in the multi-actors (depicted in the red dotted line of Fig. 1). Because a megaproject is large scale, has diverse actors, is unique, and is temporal, the impact of institutional complexity in megaprojects differs from their impact in other, single organizations.

6. The governance of institutional complexity in the HZMB project

6.1. The evolution of system leaders

When confronted with different external institutional demands, the managers of the HZMB project took many measures to resolve those institutional conflicts. To reduce the

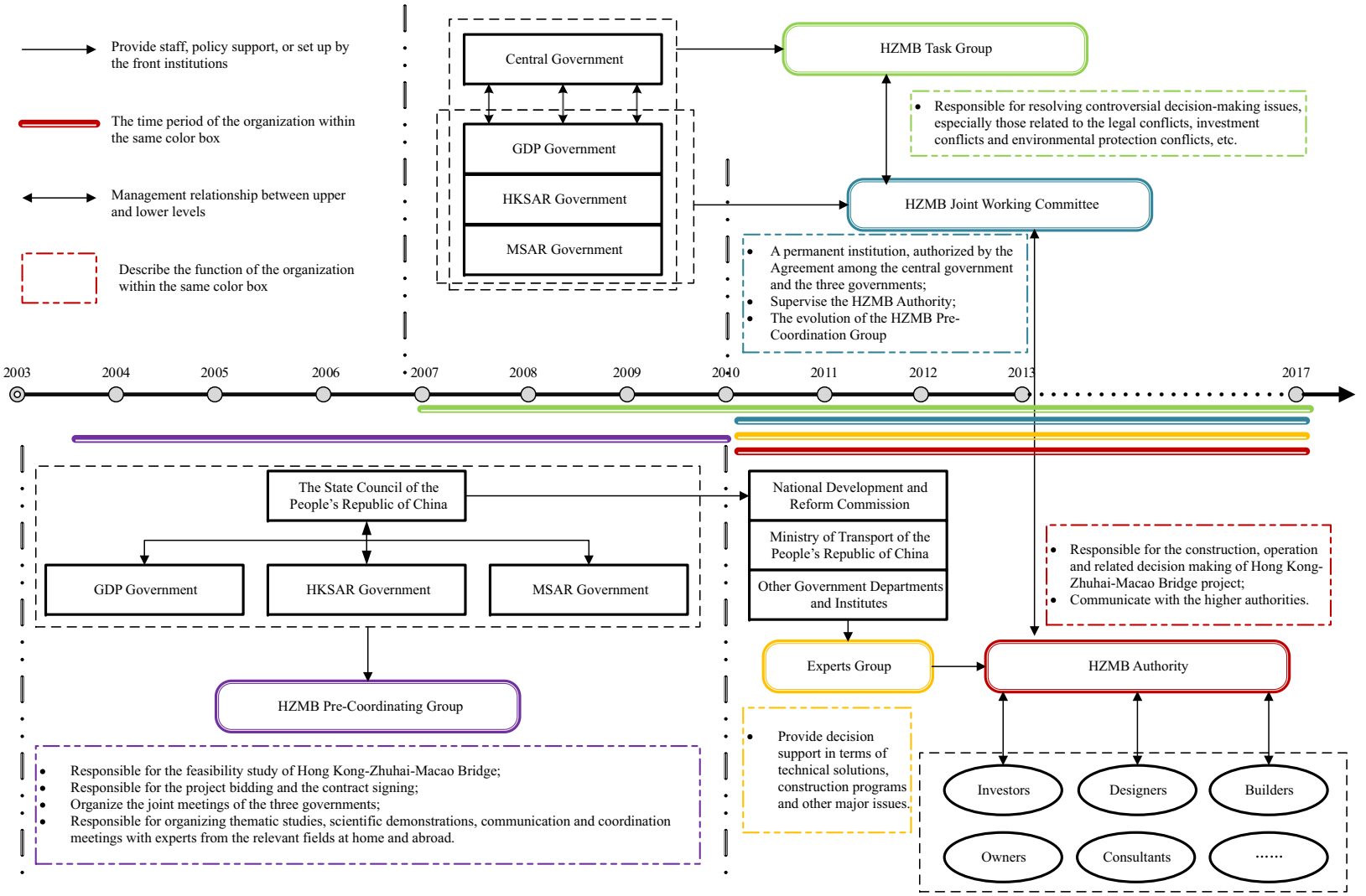

Fig. 2. Evolutionary organizations of the HZMB project.

Table 2
Institutional Logics embedded with the HZMB Project Organization.

Level	Types	Origins of the complexity	Examples
Macro-level	Political complexity	Multiple governments involved in megaprojects	Chinese Central government, GDP Government, HKSAR Government, MSAR Government have different expectations.
	Social complexity	Divergent attitudes of the public from the three regions toward this project	The public in three regions holds different attitudes toward the project.
	Regulatory complexity	Multiple regulations on the processes of building and transferring the HZMB project	HK, Macau, and China have different laws and regulation on construction and management.
Micro-level	Cultural complexity	Diverse organizations within the same work, such as in the preliminary design	The companies include from Chinese, Demark, UK, which create a diverse cultural environment
	Relational complexity	Changes of the network structure within the project, and different institutionalized practices within different organizations	During the different stages within the HZMB project, the leaders of different subprojects are changing, from CCCC Highway Consultants Co., Ltd., Shanghai Municipal EDI Co., Ltd., to China Railway Wuhan Bridge ECM Co., Ltd.
	Evolutionary complexity	Dynamics of the organizational structure and composition within the project	From the design, construction, and operation stage, different organizations are included in the HZMB project: HZMB Pre-Coordinating Group, HZMB Task Group, HZMB Joint Working Committee, and HZMB Authority

negative effects of political complexity and regulatory complexity, the HZMB project established the HZMB Pre-Coordination Group, the HZMB Task Group, the HZMB Joint Working Committee, and the HZMB Authority, at different stages, to cope with the project's diverse institutional demands (depicted in Fig. 2). In the pre-decision stage, the HZMB Pre-Coordination Group was established for the decision research work in 2003, and it focused on the pre-decision-making and feasibility of the HZMB project and on ensuring efficiency of decision-making (purple box in Fig. 2). To solve the technological problems, the HZMB Task Group was established in 2006 and was led by the National Development and Reform Commission, in cooperation with the GDP Government, the HKSAR Government, and the MSAR Government, to participate in the decision and construction stages (green box in Fig. 2). The HZMB Joint Working Committee was jointly formed by the three governments in 2010 and aimed at supervising the design and construction for the governments (blue box in Fig. 2). As a leader, the GDP Government was responsible for the main issues related to coordination and supervision for the project's legal parties (owners). The HZMB Authority was established for the design, construction, and operation of the HZMB project in 2010 (red box in Fig. 2). This evolutionary organizational design combined system integration and collaboration (Davies et al., 2009; Davies and Mackenzie, 2014) and made it much easier for all the governments to communicate and transmit their own interests and concerns, thereby increasing the efficiency of the decision-making processes. What's more, the set-up of this organizational design helped all of the actors communicate and collaborate more effectively with each other, thus resolving commission conflicts and goal conflicts from the different stakeholders.

In this context, we label the HZMB Pre-Coordination Group, the HZMB Task Group, the HZMB Joint Working Committee, and the HZMB Authority as "system leaders" who kept evolving throughout the period, according to the stage that the project had reached. The system leaders acted as a conflicting buffer to help actors cope with the institutional contradictions that arose from the institutional aspects. More specifically, the system leaders acted as representatives who communicated and coordinated between the government, the designers, the contractors, and the other actors. The existence of system leaders enabled all of the actors to integrate others' practices on the megaproject systematically and to effectively work in concert with other components or actors in the megaproject organization. Based on the formal contractual agreements and shared goals, the system leaders encouraged close cooperation among the diverse actors involved in the megaproject organization, addressing interdependencies among them and accomplishing their goals. The system leaders penetrated into other groups of actors and established processes for increasing the visibility of data and a full picture of processes that offered actors more opportunities to get involved and to uncover the institutional contradictions and take the actions needed to solve them.

6.2. Localization of practices

In addition, in the context of the governments involved in this project, the managers defined a few basic principles in order to harmonize the legal conflicts, which they termed the "Regional Legal Principle" and the "Coherence of Cross-border Regulations." The Regional Legal Principle referred to the situation in which all the actors should abide by the local laws and regulations and thereby could degrade the conflicting affairs into relatively independent decisions. Otherwise, when two or more groups facing institutional conflicts were in different regions, they might resolve the conflicting pressures with the coordination of the HZMB Authority, which was termed the "Coherence of Cross-border Regulations." In addition, the managers of the HZMB project paid greater attention to social demands and environmental protection. They raised the environmental standards and made the design standards higher than any of the regional environmental standards, as a function of the public's differing social awareness and political reconciliations. Localization of practices was a good way to solve the multiple regulations and standards of the construction that existed simultaneously.

6.3. Coordination hierarchies

Apart from creating system leaders, the managers established a new structure of hierarchical coordination and governance according to the importance and relevance of the activities involved, trying to make sure that the decision-makers were neither overly powerful nor totally devoid of power. The hierarchical structure also allowed actors to identify their own powers and status within the megaproject and offered them opportunities to implement suitable responses to the institutional complexity. This structure of hierarchical coordination and governance consisted of two layers: *Task Hierarchy* and *Organization Hierarchy. Task Hierarchy* indicated that every task should be classified into five levels according to its importance and its impact: Level I included the Agreement-related conflicts when the three governments signed the Agreement, Level II included technologically related conflicts, Level III included public-related conflicts, Level IV included project benefits-related conflicts, and Level V included contact-related conflicts. *Organization Hierarchy* stated that every actor would be classified into four levels according to their authorities: Level I referred to the Central Government, GDP Governments, HKSAR Government, MSAR Government, and the HZMB Task Group, Level II belonged to the HZMB Working Committee, Level III belonged to the HZMB Authority, and Level IV belonged to the designers, contractors, and other actors. Under the constraints of this framework, some of the actors reconciled and chose to balance the institutional logics, including the different demands of local governments, different expectations of the public, and the conflicts among different actors within the HZMB project. Other actors, with low status, chose to aggregate or innovate their own practices with others' practices (e.g., the CRSBG chose to develop a new practice to be consistent with that of the other actors). What's more, some actors with moderate status selectively aggregated their practices according to the higher-status actors' practices in order to achieve a consentaneous situation in the megaproject. By this mechanism, the coordination hierarchy not only helped the managers at different levels to make decisions within their authority, but it also offered them opportunities to choose different responses to resolve the institutional complexity.

6.4. Flexible design

A flexible design refers to the design of the project, which could be modularized by the designers and contractors and used in other construction projects (Gil and Tether, 2011; Gil et al., 2015). The project's flexible design not only could solve the problems that arose from the conflicting demands, but it also helped the actors to build sustainable competitiveness.

The case of CRSBG, one of the contractors for the HZMB steel structure, illustrates how the flexible design solved the conflicts from the multi-actors. Before the HZMB project, the CRSBG had used traditional construction methods to produce steel structures that were far inferior to the quality and due requirements of the HZMB project. The conflicts between their former institutionalized practices and the needs of the new construction methods triggered institutional complexity. To reduce the impact of that institutional complexity, CRSBG at first modularized the project into small components and produced every component in their factory instead of building the bridge on site. To do so, the company integrated an arc-tracking technology with their working experiences to develop their own welding robot for the bridge production, and that innovation guaranteed the quality and increased the production capacity for the steel bridge. The modularized design for the HZMB steel structure not only pushed actors to implement new practices to reconcile the institutional logics but also improved their capabilities, which was the motivation for their compliance. Thus, we argue that the flexibility of a megaproject design creates risk-neutral solutions with higher long-term benefits for project performance and actors' capabilities.

In summary, our analysis shows that the macro-environments and diverse actors are the sources of institutional complexity in a megaproject and thereby create conflicting institutional logics. To attenuate institutional pressures and to maintain high project performance, the establishment of a suitable governance structure is essential for the success of a megaproject. In our study, we uncovered four order mechanisms: (a) setting up system leaders in different stages for the project's design, construction, and operation; (b) localizing the standards and regulations; (c) creating collaborative hierarchies; (d) engaging a flexible design.

7. Discussion and conclusions

Institutional theory, arguably the most influential theory in organizational scholarship, has been a major theoretical lens through which researchers have investigated the behaviors of organizations and how organizations outperform or survive during competition. Nonetheless, the prominence of the phenomena of conflicting institutions has captured the interest of researchers in institutional theory and organizational management literature (Martin et al., 2016; McPherson and Sauder, 2013). Still, to date little is known about from where institutional complexity stem and how conflicting institutions from the macro-environments and micro multi-actors influence megaproject performance. We contend that more attention should be devoted to investigating how conflicting institutional logics arise and their impacts on the responses of megaproject actors (Biesenthal et al., 2018). We stress this because decision-makers and senior project managers are ultimately concerned with who should successfully deliver the megaproject. We address these issues by exploring the different types and the performance implications of the institutional complexity of the megaproject, and we propose a framework for governance of the megaproject. Furthermore, we undertake a case-study approach to illuminate how, on the basis of the HZMB project, institutional complexity forms over a project's entire life cycle and how it works on a megaproject (see Fig. 3). We propose a cross-level of institutional complexity that combines macro-micro elements simultaneously, in the context of a megaproject organization.

7.1. Contributions to institutional research on megaproject organization

Our study has implications for research on institutional complexity within a megaproject. Greenwood et al. (2011) suggest that institutional complexity emerges from incompatible

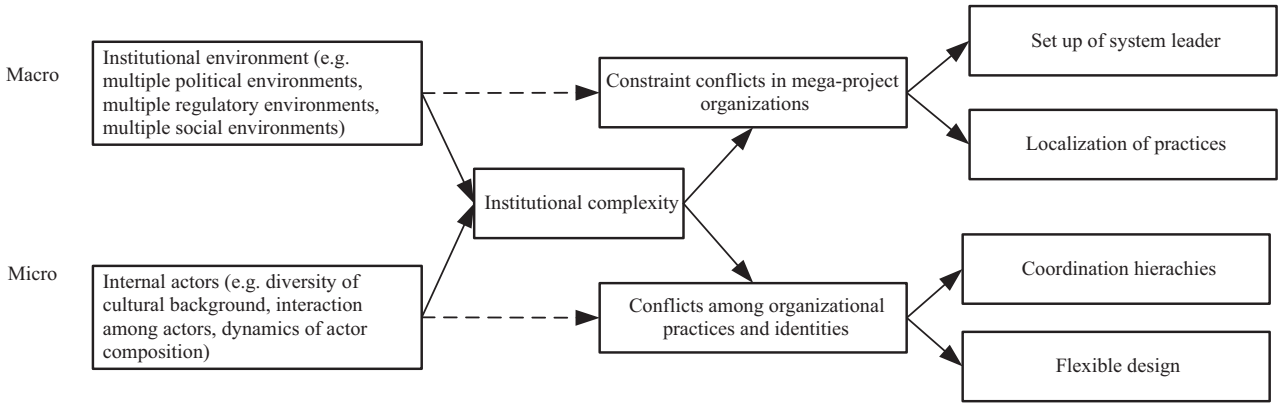

Fig. 3. The ways of how institutional complexity forms and works over life-cycle.

prescriptions from multiple institutional logics. Furthermore, institutional logics are diverse sets of principles and guidelines that interpret and function in social situations (Greenwood et al., 2011; McPherson and Sauder, 2013). Before concluding that institutional complexity is detrimental to megaproject performance, the interpretation of the negative impact of institutional complexity on megaproject collaboration needs to be more refined and elaborated upon in a detailed and parsimonious classification.

Earlier literature showing the goal conflicts and timing conflicts within the activities of megaprojects hints at the existence of conflicting logics within megaprojects (e.g., Dille and Söderlund, 2011; Koivu et al., 2004; Orr and Scott, 2008; van Marrewijk, 2007). This paper, for the first time, integrates the institutional logics into a unified theoretical framework from which to analyze how institutional complexity arises from the macro-environments and from the internal actors' interactions. Specifically, we find that regulatory complexity, political complexity, and social complexity constitute the macro-level of institutional complexity, whereas cultural complexity, relational complexity, and evolutionary complexity make up the micro-level of institutional complexity.

Extending previous studies arguing that sophisticated organizational tensions occur when a single organization has embedded institutional complexity (e.g., Jay, 2013; Kodeih and Greenwood, 2014), we find that different influences are exerted on megaproject organizations with different types of institutional complexity. Institutional complexity emerging from the macro-environments shows “constraint conflicts” on megaproject organizations, including goal conflicts, budget constraints, standard conflicts, constraints of government expectations, and the like. However, institutional complexity that emerges from the internal-level triggers organizational conflicts and relies on innovation, selective aggregation, and synthesis as ways for combining and balancing the prescriptions of conflicting logics.

7.2. Contribution to the governance mechanism of institutional complexity

By disentangling the origins of institutional complexity, this study also offers insights to scholars who are investigating the ways to govern institutional complexity. Taking the HZMB project as an example, we find that several mechanisms are effective for alleviating the impact of conflicting institutional demands on megaproject performance. Such mechanisms include the establishment of system leaders, prioritization of local laws, and the creation of a hierarchal functions structure for tasks and organization. Findings from this study are consistent with previous studies on the governance structure of a megaproject, which agree with the significant role of system leaders (Davies et al., 2009; Davies and Mackenzie, 2014), which are effective to resolve the structural and dynamic complexity in megaprojects (Brady and Davies, 2014). Different from their findings, we find that system leaders evolve during the different stages of the project's life cycle, adapting to its changing roles and functions within the megaproject. What's more, our findings show that the system leaders could also reduce organizational conflicts from political, regulatory and social complexity.

Previous studies have investigated the role of different types of governance frameworks in different contexts or different types of projects (e.g. Brunet and Aubry, 2016; Hueskes et al., 2017). Most governance literature is from the stakeholder management perspective (Derakhshan et al., 2019), the agency theory (Biesenthal and Wilden, 2014), stewardship theory (Ahola et al., 2014), resource dependence theory (Biesenthal and Wilden, 2014; Pfeffer and Salancik, 1978), or the transaction cost economics perspective (Williamson, 1979). Similar to Müller et al.'s (2015) research work, we incorporate the institutional theory into governance literature to explain the governance mechanisms of institutional complexity in promoting organizational outcomes. They argue that organizational enablers could be effective in the governance and governmentality of the realm of project-based organizations, which constitute of normative, regulative, and cultural-cognitive elements (Müller et al., 2015). They emphasize the significant role of the structural flexibility in the governance of project, which refers to the situations whereby organizations adjust their structures to the importance and the scope of their projects (Müller et al., 2015). In our study, we identify four types of governance mechanisms of how to cope with institutional complexity, which consists of macro-level and micro-level of institutional elements. We find that flexible

design not only resolves institutional complexity, but also helps the actors to act in innovative ways.

Extending previous studies of the institutional logics literature that argue institutional complexity can trigger organizational tensions (e.g. Jay, 2013; Pache and Santos, 2013), our study finds that the megaproject organizations choose different responses when they are faced with different types of institutional complexity. We find that when the megaproject organizations are faced with conflicting institutional logics arising from macro-environments, and they choose a system leader to coordinate with the governments and compromise their decision-making to balance institutional complexity (Jay, 2013). Moreover, in our study, the system leaders lead the organizational teams in being creative and innovative. As a result, they create new standards and new practices rather than conforming to existing regulatory logics to resolve social complexity, because the social stability and the social responsibility of the megaproject are critical factors in their decision-making (Ma et al., 2017; Zeng et al., 2015). Facing regulatory complexity, they localize practices in order to alleviate the conflicts among the different regulations and standards of the three different regions. In sum, when the megaproject organizations face different types of institutional complexity from the macro-environments, the leaders implement two governance mechanisms and apply three different responses to resolve the conflicting logics. Their responses are to compromise and balance the logics, innovate new logics, and localize the institutionalized practices.

On the other hand, when the megaproject organization is faced with conflicting logics from micro-actors, some actors adjust their behaviors in order to aggregate, synthesize, or combine their own practices with those of others (Jay, 2013; Pache and Santos, 2010; Ramus et al., 2017), and some actors choose to conform to the practices that are institutionalized by a higher-status actor. To achieve those goals, the megaproject organization team first defines the project's hierarchical roles, and that hierarchy enables all of the actors to know their roles and to coordinate with other actors when facing organizational tensions from cultural, relational, and evolutionary complexity. Through such adjustments, the actors in a megaproject organization can achieve efficiencies and recombinant innovations (e.g. Jay, 2013; Mair et al., 2015) to fulfill the task of the project.

More specifically, we find that the responses to institutional complexity are related to time. Some actors with moderate status (e.g., some medium-status contractors and construction companies) choose to aggregate their practices with others when they first enter into the project. However, when the project has reached an intermediate stage, those actors sometimes choose to innovate by creating new practices in an effort to synthesize their practices with others and to influence higher-status actors. Moreover, because the actors' roles are evolving over time, the composition of the system leaders in the megaproject is also changing with time. That happens because the institutional conflicts are changing over time as a result of the dynamics of the various actors who are joining and leaving the megaproject organization (Brady and Davies, 2014).

From a policy standpoint, this study suggests that, as many scholars have proposed before, the establishment of good communication and coordination mechanisms through which the project's actors and governments can effectively transfer their knowledge and demands is critical for successful delivery of the megaproject. In our case, since establishing the technical standards for the HZMB project requires participants to find a balance among the advanced nature of the project's technology, its difficulty, its reliability, and its constraints in terms of time and capital, the project needs to be carefully studied during the decision-making stage (Zhang and Qiu, 2018). Therefore, our findings suggest that it is critical to establish good communication and coordination mechanisms among the participating governments in order to determine and unify the project's norms and standards.

7.3. Limitations of the study and additional directions for future research

Our study prompts a variety of questions for future research. First, our study advances our understanding of how institutional complexity influences megaproject organizations' behaviors, and the governance mechanisms of institutional complexity. Future research needs to clarify the situations in which the governance mechanisms are more effective to resolve different types of institutional complexity. Second, we find that the participants in megaprojects respond differently to cope with institutional complexity, including setting up advanced standards and adopting new practices. As Biesenthal et al. (2018) suggested in their view of institutional implications on megaprojects, the participants are able to take social norms, cultural beliefs, and preferences to shape the megaproject structures. It would be interesting to investigate the question of why and how megaproject participants respond to institutional complexity. Third, our study finds that the HZMB team leaders proposed a special framework for managing and guiding the construction of the HZMB project, which changed other participants' practices. Future research could focus on how institutional entrepreneurs of megaprojects can successfully create and enact new institutionalized practices to ensure the successful delivery of megaprojects (Biesenthal et al., 2018).

Despite our study's contributions, it has several limitations that should be borne in mind when interpreting a governance framework for institutional complexity. First, we study a single case in our effort to delineate the conditions under which the roles and effects of the macro-environments and of the multi-actors influenced the generation of institutional complexity within the megaproject. Our theoretical arguments and findings are restricted to a specific setting that is characterized by a cross-border bridge construction project, whereas some megaprojects might be located in a single country. Our arguments could differ from what applies in situations where only one government is involved in a megaproject. Second, in our case, we do not randomly select the meetings for interviews. A random selection might provide a full map of how the project team can identify institutional contradictions. Third, two of our

research members are consultants for the HZMB project, which might have led to biased responses about institutional complexity. In future research, it may be necessary to control the role of researcher observers in order to fully understand how actors evaluate and respond to their institutional complexity endogenously.

7.4. Conclusions

To summarize, our study builds on the fundamental idea that actors who are bonded together in a megaproject are embedded in institutional logics that derive from the project's macro-environments and the actors' evolving interactions. Incompatible logics give rise to distinctive expectations, goals, and schemes for the actors that can impede the activities within the megaprojects. Traditional studies of institutional factors in megaproject management have mainly focused on the effect of institutional arrangements on practices of participants. Our study finds that institutional complexity in megaproject organizations stems from macro-level and micro-level components, including regulatory, political, and social complexity (macro complexity), and also cultural, relational, and evolutionary complexity (micro complexity).

Today's megaprojects are becoming more complex as a result of highly sophisticated regulatory environments that involve different regulatory levels, different regulatory regimes, and different regulatory and perhaps non-regulatory measures. The heterogeneity of the multiple regulatory environments further adds to the institutional complexity in megaprojects. It should not be surprising that organizations' responses to regulatory norms are shaped by fear of legal sanctions as well as by social pressure and a sense of social duty (Kagan et al., 2011; Lee and Lounsbury, 2015; Mair et al., 2015). What's more, political complexity arises when different governmental entities are involved in one megaproject holding different or conflicting interests. In other words, political complexity refers to the incompatible institutional demands that derive from diverse government entities who influence the organizations from multiple perspectives (Kodeih and Greenwood, 2014; Müller et al., 2014). Third, social complexity emerges when the normative pressures from the sociopolitical environment exhibit conflicting demands. Social complexity in a megaproject mainly stems from the conflicting social expectations by a public that has differing interests (Flyvbjerg, 2011; Lee and Lounsbury, 2015). In general, megaprojects are considered to be the objects and outcomes of social interactions (Flyvbjerg, 2011; van Marrewijk, 2007), which means that the expectations and attitudes of the public and of other social groups exert a great impact on such megaprojects, especially in the decision-making processes that involve institutional conflicts.

From an intra-organizational perspective, institutional complexity can also derive from multi-actors who participate in a megaproject and who have different cultural mindsets (Koivu et al., 2004; van Marrewijk and Smits, 2016). Cultural complexity can result in conflicts among actors when they cooperate to fulfill the project's goal together, when actors are forced to adjust their institutionalized practices to adopt new practices, or when they are required to reconcile to a new cultural regime or new styles within the project's organization. Second, institutional complexity comes from the relational network, which arises when a number of actors or groups are involved and interactively influence each other, and when there is a lack of stability at the project level of the institutional regime (Child and Rodrigues, 2011). Relational complexity points to the interactive uncertainty that arises from multiple individuals, teams, groups, and organizations being involved with the delivery of a megaproject, where the interactions and relationships among the actors become a critical element in shaping the project and its success. The evolutionary nature of the project would breach the balance among the existing institutional logics within the megaproject. Such an evolution of the organizational structure would challenge the existing institutions within the megaproject group that arise from conflicting institutionalized practices, and this organizational-structure evolution is termed evolutionary complexity.

Under different types of institutional complexity, megaproject organizations are faced with different types of conflicts, including goal conflicts, budget constraints, standard conflicts, cultural conflicts, and so on. Clarifying the existence of macro-level and micro-level institutional complexity within a megaproject deepens our understanding of how and from where institutional complexity arises and how it affects the project's performance. That knowledge helps us build a more comprehensive theory of institutional complexity in megaproject organizations.

In addition, we find that megaproject participants respond differently to different types of institutional complexity. Different from previous studies arguing that complexity impedes the megaproject performance (Brady and Davies, 2014; Davies and Mackenzie, 2014), we find that some of the megaproject participants engage in innovative activities to resolve institutional complexity, which improve project performance. For example, to cope with institutional complexity, CRSBG takes an innovative way to increase the production capacity, resulting in an improvement in its capabilities in the end. We also find that four mechanisms are effective for megaproject organizations to resolve institutional complexity. Our study thus contributes to a substantial body of institutional theory and megaproject management literature, and highlights the need to account for the incompatible institutional logics within one single project.

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Appendix

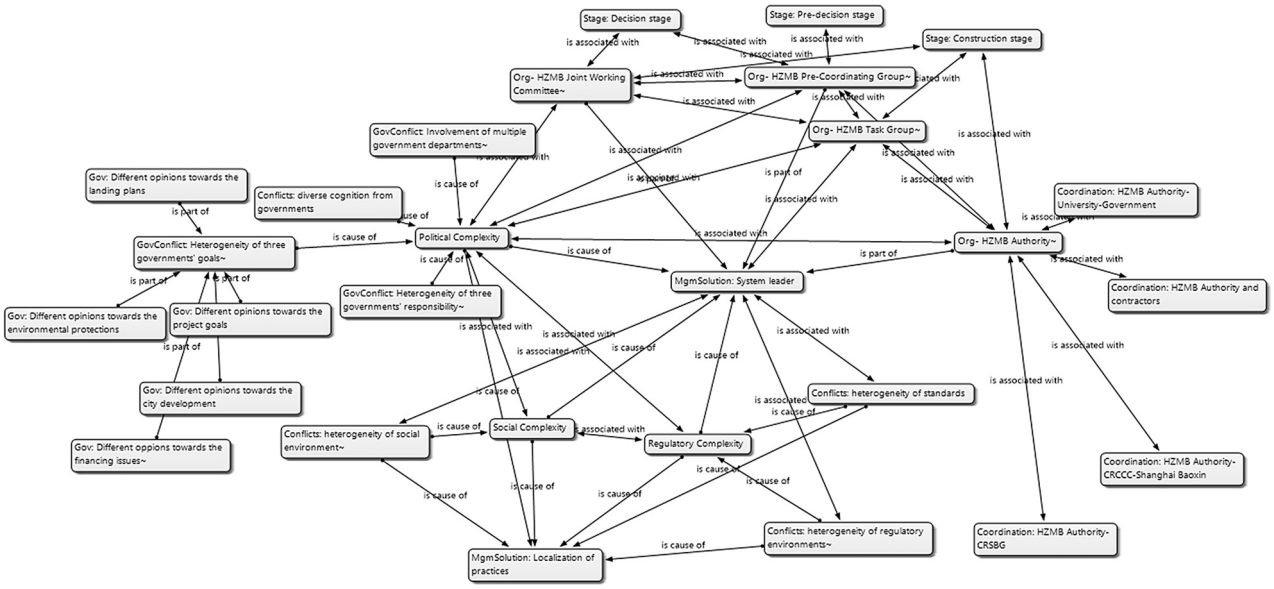

Fig. A1. The code tree: the sources of institutional complexity from macro-level

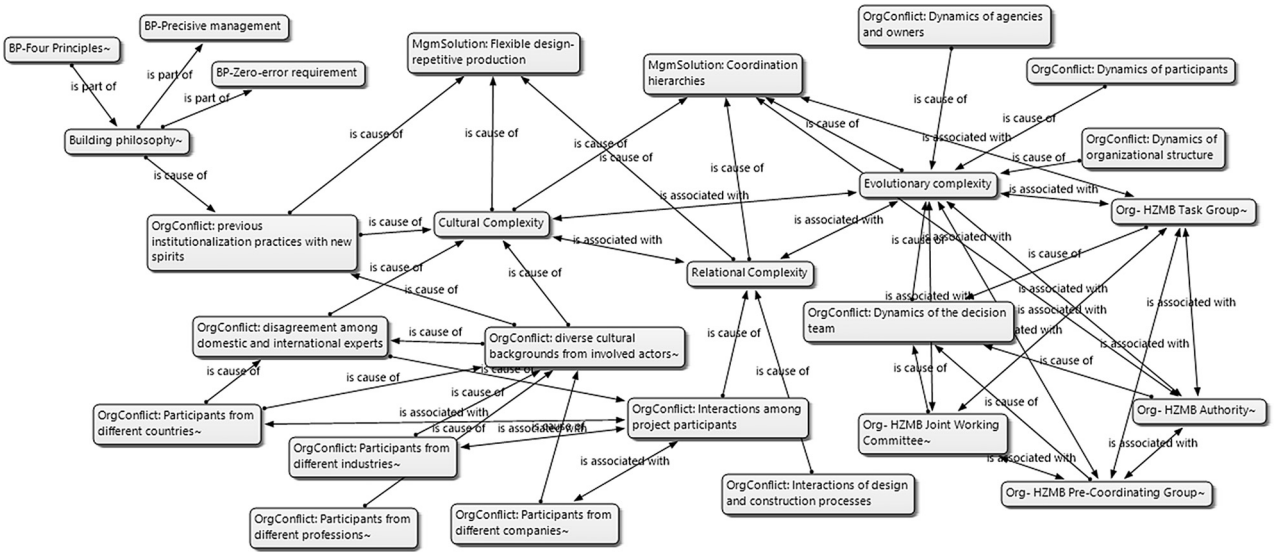

Fig. A2. The code tree: the sources of institutional complexity from micro-level

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