

Yi HU, Yun LE, Xinglin GAO, Yongkui LI, Mingqiang LIU

Grasping institutional complexity in infrastructure mega-projects through the multi-level governance system: A case study of the Hong Kong-Zhuhai-Macao Bridge construction

© The Author(s) 2018. Published by Higher Education Press. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0>)

Abstract This study analyzes the design and operation of multi-level governance system for the smooth delivery of infrastructure mega-projects with high institutional complexity caused by market transition. From an institutional perspective, this study scrutinizes the structure, elements, and dynamics of the governance system of infrastructure mega-projects and then proposes an integrative framework based on the inductive case study of the Hong Kong-Zhuhai-Macao Bridge mega-project. Multiple evidences of archives, field studies, and interviews related to the case project are triangulated to further analyze the institutional effects, specifically those with government logics and market structures, on the design and operation of the three-level governance system. Results reveal that the co-evolution between governments and markets in China has shaped the vertical levels of the mega-project governance system and has further affected their evolution and operation across various stages of project development. This study contributes to the rapidly emerging research on complex system governance by proposing a systematic model of three-level mega-project governance

to enhance the timely delivery of infrastructure mega-projects within budget.

Keywords institutional complexity, multi-level governance, infrastructure mega-project, China

1 Introduction

How to govern multilateral infrastructure mega-projects in a complicated institutional environment is an interesting question in organizational research given that the contemporary societies pose a significant challenge of governing institutional complexity derived from the ever-changing environment (Scott et al., 2011). This case is particularly true in developing countries that undergo market transition and need to involve domestic and international suppliers with different institutional backgrounds in infrastructure mega-projects. In the current rapid urbanization, managing infrastructure mega-projects (e.g., dams, highways, airports, and bridges) in China not only faces increasing internal complexities as a result of large size and significant technical difficulty, but also the external institutional complexity caused by the ever-changing environment (Hu et al., 2015a). The inability to recognize institutional complexity in these projects can result in project underperformance such as cost overruns, delivery delays and negative social impacts (Orr and Scott, 2008). For developing countries such as China, institutional complexity can immensely affect the determination of the mega-project governance system's structures (e.g., vertical levels) and processes and their operational effectiveness in project execution (Miller et al., 2000; Chi and Javernick-Will, 2011). Scott et al. (2011) emphasized the intelligence of institutional analysis in addressing institutional effects on project organization issues, thereby providing a powerful tool to explore the

Received September 30, 2017; accepted December 13, 2017

Yi HU (✉), Yun LE, Yongkui LI

Department of Construction Management and Real Estate, School of Economics and Management, Tongji University, Shanghai 200092, China

E-mail: yi_hu@tongji.edu.cn

Xinglin GAO

Hong Kong-Zhuhai-Macao Bridge Authority, Zhuhai 519060, China

Mingqiang LIU

Research Institute of Complex Engineering and Management, School of Economics and Management, Tongji University, Shanghai 200092, China

This work was funded by the National Natural Science Foundation of China (Grant Nos. 71501142, 71390523/71390520 and 71471136) and Shanghai Pujiang Program (Grant No. 17PJJC101).

governance system's structures and processes in infrastructure mega-projects and gain further insights for improved planning and execution.

The Hong Kong-Zhuhai-Macao Bridge (HZMB), which is a recently completed transportation mega-project, provides an opportunity to examine the aforementioned issue. The 55 km long HZMB is one of the longest offshore bridges in the world, and it comprises bridges, roads, undersea tunnels, two artificial islands (eastern and western), and three cross-boundary linking facilities that connect the Hong Kong Special Administration Region (HKSAR), Zhuhai City of Guangdong province and Macao Special Administration Region (MSAR). The main body of HZMB was a multilateral transportation infrastructure mega-project jointly funded by the aforementioned three local governments of the HKSAR, MSAR and Guangdong province. To implement the main-body project (the case), a multi-level governance system involving the HZMB Task Force (organized by the State council), the Joint Works Committee of the Three Local Governments (JWCTLG), and the HZMB Authority (project client and legal agent) was established. JWCTLG and the HZMB Authority, which operate similar to a board of directors and its company, are regarded as an organizational innovation to deal with the institutional complexity of the multilateral infrastructure project across two different political systems within the country and facilitate the smooth execution of the project. Over the past seven years, the project has been implemented smoothly and will be completed by the end of 2017. This study uses the success of this organizational innovation to conduct an inductive case study and propose a three-level governance system for multilateral infrastructure mega-projects in China that involves governmental governance, project legal agent governance, and major market supplier governance. Furthermore, this study reveals the institutional complexity caused by market transition that shapes the hierarchy and dynamics of the governance system during the project execution. Recognizing the increasing need to deal with institutional complexity in infrastructure mega-projects, research on this issue will advance existing knowledge on institutional analysis in project organization research. Moreover, this study contributes the Chinese experience to the establishment of a body of knowledge on complex system governance in the ever-changing society.

2 Theoretical base

2.1 Multi-level project governance

Project governance has been increasingly recognized as a key to successfully delivering projects (Müller, 2009; PMI, 2013), particularly infrastructure mega-projects (Miller et al., 2000; Winch, 2010). The Office of Government Commerce (2003) stated that in managing mega-projects

(e.g., programs) a sponsoring group should be established as the top decision maker to supervise different project management organizations within the project to direct project execution and improve the overall outcomes. Winch (2010) emphasized the importance of transaction governance in dealing with relationships between the client and its major suppliers (e.g., major designers and contractors). Müller (2009) stated that project governance is embedded in the company context and needs to serve the best interests of internal stakeholders, external stakeholders, and the company itself. By reviewing project governance research between 1979 and 2013, Biesenthal and Wilden (2014) further conceptualized project governance as a multi-level system and emphasized the roles of two governance levels in the system: the one linking a parent organization to projects (e.g. project management office) and level of parent organization (e.g., the corporate governance). Flyvbjerg et al. (2016) stated that multi-level project governance can improve the accuracy of project estimates and control cost overrun risks. However, these western research studies seldom completely address the impacts of various institutional environments (e.g., regulative, normative and culture-cognitive) on the stratification of a project governance system for infrastructure mega-projects (Scott et al., 2011), especially those with developing countries. This idea is pivotal to multi-level project governance research.

2.2 Organizational management in Chinese market transition

Outstanding economic achievements in China over the past three decades have attracted increasing concerns from organizational scholars around the world regarding the secret of China's economic success (Tsui et al., 2004). One of the most popular explanations is that institutional development is the key to enhancing constant economic growth in the country (Yao, 2008). Meanwhile, such circumstances pose an interesting question to scholars on how business and development organizations deal with the institutional complexity faced during market transition. The current study extended Zhou (2004)'s lens of co-evolution between politics (governments) and markets, which was used to explore institutionalization processes in China's urbanization, to analyze institutionalizing processes of the governance system of infrastructure mega-projects in China.

Since the 1990s, scholars in Chinese organizational analysis have focused on the interplay between politics (government) and markets (Zhou, 2004). The reason is that the co-evolution between governments and markets is regarded as a key in shaping market transition (Zhou, 2004; Yao, 2008). In a perspective of new institutionalism, governments and markets are not antithetical and the government is crucial in formulating institutional rules that affect market operation (Campbell and Lindberg, 1991).

The market, particularly for countries with a traditional culture of authority, cannot evolve alone without the appropriate intervention of governments (Hamilton and Biggart, 1988; Stark and Bruszt, 1998). During the co-evolution process of governments and markets in these countries, the government plays a pivotal role in undertaking economic activities with its own interests and preferences (Zhou, 2004). The current study used the normative-cultural institutional analysis framework of political culture and industrial structure (market structure) of Chi and Javernick-Will (2011) as basis to conceptualize the government-market co-evolution as an institutional analysis framework of government logics and market structures. Government logics refer to the beliefs and values of the government and its subordinates who determine and shape associated practices (e.g., decision making, and control) in public services (Scott et al., 2011; Dobbin, 1994). Market structures refer to “an elaborated relational and regulatory framework under which sets of organizations in industries interact” (Chi and Javernick-Will, 2011). Evidently, these two institutional environment elements have a significant impact on the stratification of the megaproject governance system in China.

3 Research context: Co-evolution between governments and markets in the Chinese construction sector

Since the early 1980s, China has been undergoing a market transition from a traditionally centrally planned economy since the adoption of the opening-up and reform policy (Nee, 1992). In contrast with other countries under state socialism, China has conducted a series of reforms with a pattern of gradualism (Shirk, 1994). A similar situation exists in the Chinese construction sector. The following section presents the analyses of the developments and changes in the government logics and market structures in the Chinese construction sector.

3.1 Government logics

Government logics are twofold, namely, the state’s regulatory logic and local governments’ action logic (Zhou, 2010). The regulatory logic involves the legislative frameworks that constraint the central government’s choice. In the past three decades, the regulative logic of China’s central government experienced two rounds of transformation in governing the construction sector. The first round refers to the efforts of the central government since the late 1980s that introduced the competitive markets into the construction sector and established a national-wide construction market through legislation. The second refers to the effort of the central government from the late 1990s to the present, which aimed to promote infrastructure development through public-private partner-

ships (PPP) to increase infrastructure market maturity (e.g., electricity, transportation, and energy). This study mainly discusses the first round of transformation in the regulative logic regarding the case background.

During the construction of the Lubuge hydroelectric power station undertaken in the 1980s, an international contractor first won the construction bidding in China and introduced the competitive market mechanism to execute the project. The success of the project (e.g., productivity improvement, cost effectiveness and timely delivery) promoted the central government to promote market transition in the construction sector by promulgating a series of new laws and regulations since the early 1990s. These laws include the *Interim Regulation of Establishing the Legal Agent Responsible Mechanism for Construction Projects* in 1992/1996 (for project client), *Construction Law* in 1997 (for construction supervision), *Contract Law* in 1999, and *Bidding and Tendering Law* in 2000 (approved in 1999). These laws significantly facilitated the establishment and development of the construction market in the country. The development and elaboration of these laws and regulations were achieved based on relevant pilot studies in the Phase I project of the Three Gorges Dam construction in the 1990s. In 2004, four fundamental elements of the competitive construction market mechanism, namely, establishing project legal agents (client), contract management, project bidding and tendering, and third-party construction supervision, were clearly written into the regulation titled the *Decision of the Reform of the Investment System Management* in 2004. This regulation was issued by the State Council, particularly for infrastructure mega-projects that can produce profit. Thereafter, a competitive construction market has gradually developed in the country.

In addition to the regulatory logic, the action logic of local governments (local action logic) should be considered in understanding the governance system of an infrastructure mega-project at certain locations (Zhou, 2010). This logic can be reflected through execution flexibility (variation) due to imbalanced political, social and economic developments across various regions of China (e.g., the Eastern China, Central China, and Western China) when implementing the unified state policies. The local action logic refers to the beliefs and values of local governments that affect rule-setting, monitoring and sanctioning activities in public projects and services (Henisz et al., 2012). The construction sector also experienced a similar situation. Project characteristics and local action logics will determine the governance system of a specific infrastructure mega-project. For example, Guangdong province implemented the highway construction within the region through the Guangdong Communications Group (GCG), a stated-owned investment and development enterprise. GCG has a registered capital of 26.8 billion CNY and invested 67% of highways in the region by the end of 2015. Compared with other

infrastructure sectors (e.g., ports and docks, railways, and airports), highway and road development is the pioneer in using social capital and international funds through PPPs. Thus, project clients are relatively open to using market resources.

3.2 Market structures

Driven by the top-down reform and rapid urbanization demand, the construction market in China has rapidly developed over the past two decades and the market's output has increased from 1.3 trillion CNY in 2000 to 18.1 trillion CNY in 2015 (National Bureau of Statistics, 2017). The market structure has likewise significantly changed. Before the 1980s, nearly all construction units (e.g., contractors, designer, and material suppliers) had a state or collective ownership. After adopting the opening-up and reform policy in the 1980s, only a few large construction units, mainly designers and contractors, have maintained ownership by the central or provincial governments. The residual units passed their ownership to listed or private companies. Although the output of state-owned construction companies increased from 505.3 billion CNY in 2000 to 2176.7 billion CNY (National Bureau of Statistics, 2017), the ratio of the total output of state-owned enterprises among the construction sector decreased from 40.4% in 2000 to 12.0% in 2015 as shown in Fig. 1.

Nevertheless, the performance of leading state-owned contractors and designers in China performed well in the international market. A few of these companies even developed into the world-class ones. The Engineering News-Record (ENR) (2017) reported that the number of

Chinese state-owned enterprises among the top 250 international contractors increased from 48 in 2005 to 57 in 2015 and that the number of global design firms in another ranking increased from 9 in 2007 to 18 in 2015. These improved rankings indicate that Chinese state-owned contractors and designers have developed strong technical expertise and international competence in certain areas. However, in ENR's 2015 Top 50 Program Management Firms, a leading professional service for large project clients, China lacked management consultants who could provide comprehensive and full-process services to clients in managing infrastructure mega-projects.

4 Research methodology

To develop a framework of the multi-level mega-project governance system that fits in the Chinese environment with government-market co-evolution existing, this study adopted an inductive case study suggested by Eisenhardt (1989). The reason is that the case study can ascertain the dynamic relations between an observed phenomenon (i.e., elements, structures, processes, behaviors, and dynamics of the polycentric governance entity) and its institutional environments (Yin, 2009). In light of Eisenhardt's (1989) case study methodology and a pilot work in this area by Chi and Javernick-Will (2011), the research process was formulated as shown in Fig. 2.

In Step 1, this study defined the research question and selected six potential research cases. This study is a part of a long-term research program started from 2014 that aimed to develop a unified governance system framework for

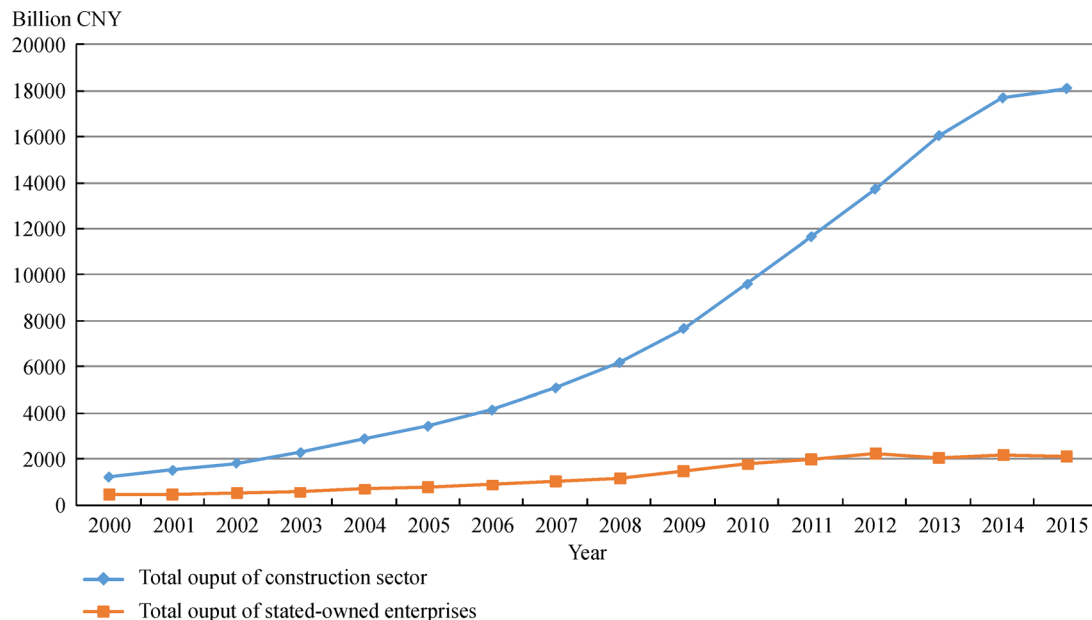


Fig. 1 Total output of the construction sector and stated-owned enterprises in China between 2000 and 2015¹⁾

1) <http://www.stats.gov.cn/tjsj/tjgb/ndtjgb/>

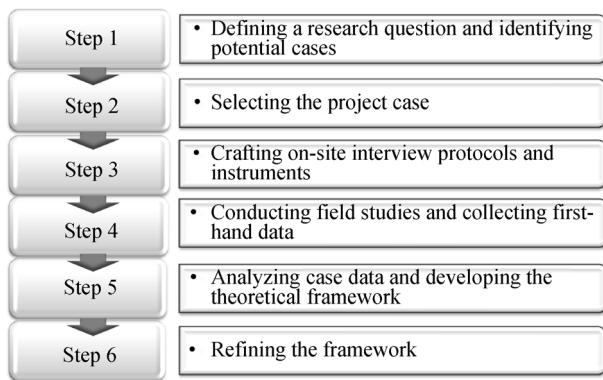


Fig. 2 The research process

infrastructure mega-projects in China. The authors first selected six national infrastructure mega-projects in China after a preliminary survey of more than 200 mega-project cases in the database of mega-projects case study and data center (www.mpcsc.org), and then made an in-depth investigation of these six cases through desktop research. In addition to the HZMB, other five cases are the Qinghai-Tibet railway, Beijing-Shanghai high-speed railway, central route of South-to-North Water Transfer Project, West-East gas pipelines and Three Gorges Dam. Multiple rounds of desk searches were conducted to collect relevant information (e.g. archival documents, media reports, etc.) from hundreds of online sources regarding the six cases.

In Step 2, the HZMB mega-project was selected after evaluating the six potential cases. This is because the project is a recently completed mega-project that involves the three local governments under the two different political systems, which may provide more insights across various institutional systems for future development in the area. Before making a final decision on case selection, the authors made a field study on the HZMB site and interviewed one of the leading management consultants involved. These first-hand data helped the determination of the case selection in this step.

In Step 3, interview protocols and instruments were developed for the second field study. Analyzing the data collected in Steps 1 and 2 produced the interview protocols and instruments (e.g., a list of potential interviewees, and interview outlines) for further field study.

In Step 4, the second field study was conducted on the HZMB site to collect more data such as face-to-face interviews, archives, and other materials. Although the authors first visited the site in September 2015, most data regarding the research question was collected in June 2017 in terms of the developed protocol and instruments.

In Step 5, a theoretical model was developed based on an in-depth analysis of triangulated data in various forms. In particular, the institutional processes of the governance system of the selected case project were streamlined by

analyzing the collected data, which yielded a rough idea of the mega-project governance system that involved the government, the legal agency (project client), and key market suppliers. An institutional analysis was then conducted and used to assess the effects of government-market co-evolution on the project governance system at various levels and different project phases.

In Step 6, the preliminary model was first refined by unfolding latest literature on multi-level project governance (Biesenthal and Wilden, 2014; Flyvbjerg et al., 2016), and then presented at a research seminar, with the senior executives at HZMB Authority present. The comments from the senior executives helped determine the model presented in this work.

5 Data collection

Archival documents were used as main data in this study because they are advantageous in tracing timelines, changes, elements, processes, and actions and interpretations of institutionalization processes (e.g., decision-making processes) (Ventresca and Mohr, 2005; Colyvas and Powell, 2006). In addition, two field visits were conducted to help collect archival documents. The main archival documents (Table 1) were used as bases to perform content analysis to gain insights into the governance issues of the selected case. The content analysis can systematically provide data-based inferences in exploring and structuring a specific phenomenon (Downe-Wamboldt, 1992). To reproduce the project planning and execution processes of the selected project, the content analysis focused on major decisions, critical events, institutional changes and rationales behind them that take a chronologically organized form (Miles and Huberman, 1994).

To improve the validity of the archival research, eight interviews were conducted with five senior executives at the Authority and a management consultant. The six interviewees include: (a) the director (once), (b) associate director (2 times), (c) assistant director (once), (d) head of a functional division (once), (e) lawyer at the Department of Project Planning (once), and (f) the management consultancy director (two times). The triangulated use of archival evidences from multiple sources and subsequent interviews can facilitate the improvement of the research findings' validity (Eisenhardt, 1989; Yin, 2009). The reiterating process between case data and preliminary findings (competitive explanations) can build reliability for qualitative research (Eisenhardt, 1989; Yin, 2009). On the basis of the preceding data and analyses, this study identified the project governance system and its institutionalization processes through which the co-evolution between the government logics and market structures determined governance arrangements. This

Table 1 Main archives and their sources

Types	Details and sources
Archives	Minutes of the HZMB Task Force Minutes of the HZMB Advanced Work Coordination Group Minutes of the joint works committee of the three regional governments State Council's approval on the preliminary project design
Online information	Website of the HZMB Authority (www.hzmb.org, assessed on August 2015–August 2017) Website of the HZMB-related HKSAR projects (www.hzmb.hk, assessed on August 2015–August 2017), established by the Highways Department, HKSAR Government More than 20 news reports published in practitioner-oriented journals, Chinese newspaper databases and online news portals (e.g., xinhua.net, Chinanews.com)
Open publications	Issues 1–37 (March 2010–April 2017, 5–6 issues per year), Hong Kong-Zhuhai-Macao Bridge Magazine published by the HZMB Authority
Journal papers, reports and book	17 papers authored by senior executives and staff of the HZMB Authority (obtained from China National Knowledge Infrastructure databases, www.cnki.net) About 10 papers, reports and books published by major management and technical consultants

process enabled the development of the conceptual model and provided the explanations enumerated in the Discussion section.

6 Case data analysis

HZMB was first proposed in 1983 by Sir Gordon Wu Ying-Sheun, the chairman of the board of Hopewell Holding, Ltd. based in HKSAR. Eventually, the bridge construction was approved after over two decades of joint efforts for project feasibility analysis and preliminary project planning by the HKSAR, MSAR, and Guangdong provincial government. The main body of HZMB became a joint public project because a public-private partnership would have been costly and difficult to coordinate. Given that this project involves three local governments with two different political systems, the HZMB Authority assumed the main body of the bridge consisting of two artificial

islands, bridges and tunnels, connecting Zhuhai and the artificial islands. HZMB Authority was jointly established by the three local governments and the residual sections of HZMB were executed by the local governments involved. According to the feasibility analysis report, 38.1 billion CNY was budgeted for the main body of HZMB. The construction of the main-body project started from December 2010 and will be completed by the end of 2017.

Table 2 shows that the project was implemented in three phases, namely, project initiation, project planning and preparation, and project execution and closing-out.

Table 3 and Fig. 3 provide operation mechanism, tasks and relationships of the main elements of the multi-level governance system in the case project. As shown in Fig. 3, the project initiation involved two governmental committees at the national and local levels, which constituted the governmental governance at this phase. As these two committees were temporary, a standing office was established by ACWG to manage project feasibility

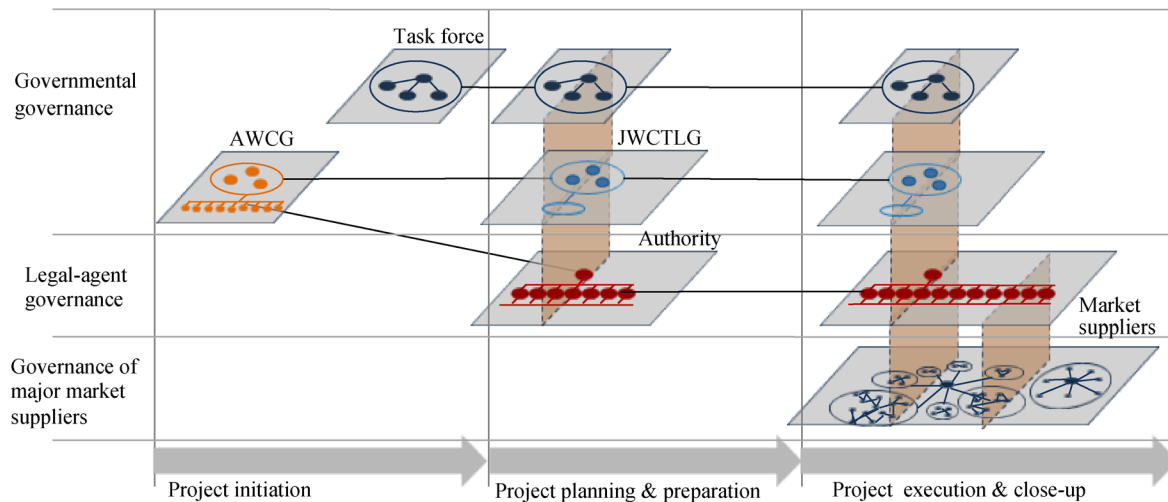
Table 2 List of key project milestones

Phase	Date	Project milestones
Project initiation	2003 (July)	NDRC and HKSAR Government completed the study on the transport connection between HKSAR and the west side of the Pearl River
	2009 (March)	The bidding for the preliminary design of the bridge main-body project was determined
	2009 (October)	The State Council approved <i>The Feasibility Analysis Report on the HZMB Construction</i>
Project planning and pre-preparation	2010 (February)	Governments of HKSAR, MSAR, and Guangdong province signed <i>The Agreement on the Construction, Operation, Maintenance, and Management of HZMB</i>
	2010 (March)	Ministry of Transport issued the official reply on the preliminary design documents of the bridge main-body project
	2010 (May)	The biddings for major contractors and consultants of the main-body project were started
Project execution and closing-out	2011 (January)	Ministry of Transport approved the construction start request of the bridge main-body project
	2016 (September)	All main bridge structural components were installed
	2017 (July)	All main undersea tunnel components were installed
	2017 end	The bridge main body was completed

Table 3 Major institutions of governmental governance involved

Date	Institutions and event details	Operation mechanism	Tasks
2003 (August)	HZM Bridge Advanced Work Coordination Group (AWCG) established by the State Council Convenor: representatives of the HKSAR government Members: NDRC and HKMOSC representatives and representatives from the three local governments	a) Having 1 – 2 meetings per year b) All the decisions should be agreed by all three local governments; if not, the issue will be sent to the central government for coordination	Conduct project initiation works, such as the feasibility analysis, project finance plan and project development planning
2004 (March)	An affiliated office established by AWCG	A standing body including about 13 persons	Assist AWCG's works and execute the decisions if necessary
2006 (December)	HZM Bridge Task Force established by the State Council Director: NDRC's associate director Associate director: Vice minister of the Ministry of Transport Members: NDRC representative, Ministry of Transport's representative and representatives from the three local governments	Having a meeting every year	Establish a high-performing organization and coordination systems for improving decision efficiency and promoting project development
2010 (May)	Joint Works Committee of the three local governments (JWCTLG) established by the central and three local governments Convenor: representatives of Guangdong provincial government Members: representatives from the HKSAR and MSAR governments	Having 2 – 3 meetings every year	a) Take the following works of AWCG and b) Monitor the execution of the bridge main body undertaken by HZMB Authority
2010 (September)	An affiliated office established by JWCTLG	A standing body including 7 – 8 people	Assist JWCTLG's works and execute the decisions if necessary
2010 (July)	HZMB Authority established by the JWCTLG	A standing office with a staff of about 100	Take charge of the construction, operation, maintenance, and management of the project

Note: NDRC – National Development and Reform Commission; HKMOSC – Hong Kong and Macao Offices of the State Council.

**Fig. 3** Evolving process of the Multi-level Governance system

analysis works and provide support for the decision making of major issues. In the project planning and preparation phases, governmental governance still existed and maintained the role as the top decision makers for the project, but the AWCG was replaced by the JWCTLG, a more professional working committee with relevant government agency officials from the three local govern-

ments. Meanwhile, HZMB Authority was established as the legal agent to look after the construction, operation, maintenance, and management of the project. In the project execution and closing-out phases, the two levels of governmental and legal-agent governance continued their duties. To implement on-site construction activities, dozens of major project suppliers (e.g., major designers,

contractors, and material suppliers) were selected through market biddings; thus, a level of governing these suppliers emerged. Figure 3 illustrates the entire evolving process of the multi-level governance system in the case project across the three phases of the project.

6.1 Governmental governance

The purpose of establishing governmental governance is to achieve the multi-level (e.g., central and local governments) and cross-functional integration of government agencies involved to ensure multi-lateral decision-making efficiency. This governance level usually takes a form of temporary committees and is implemented through a top-down institutional design through political orders. In the case project, the governmental governance level involves the ACWG and HZMB Task Forces during the project initiation phase and the JWCGLG and Task Force during project planning and execution phases, respectively. Given that the case project involves three local governments with the two different political systems, ACWG or JWCGLG was a temporary multi-lateral negotiation and coordination mechanism to enhance project decision-making. To improve the efficiency of multilateral decision-making, the Task Force convened by a NDRC's associate director was established.

In the project planning phase (2003 – 2010), two temporary governmental committees that involved the central government and three local governments were established to cross-function integration among governments at various locations and levels. The objective of this action was to achieve timely multilateral collective decision-making. In AWCG, HKSAR government chaired

the committee, which played a central role in the decision-making related to project initiation and planning. The only standing organization in this phase was an office affiliated to AWCG, which played an important role in promoting project development. The office proposed that the HZMB could be divided into four projects and executed by different local governments and clients. This idea was accepted by AWCG during its 8th meeting in February 2008. This decision led to the final project finance and project implementation plans and initiated the design bidding of the Bridge main-body project one year later. This organizational design indicated that the permanent organization design in multi-lateral public development could result in high work efficiency.

In the project execution phase, the three-level project governance system was established and operated (Fig. 4), most of which would continue to operate after the project is completed. In JWCTLG, the central role was moved from the HKSAR government to the Guangdong provincial government. The reason is that funds from the latter and the central government accounted for more than half of the registered capital of the HZMB Authority that directly funded the project. The Bridge Authority was established in terms of the trilateral government agreement signed in 2010 to execute the detailed design and procurement and to control construction works on site. The director of AWCG Office, Mr. Yongling ZHU, was appointed as the director of this newly established client organization. In addition, most staff members at the AWCG office joined the Authority after it was established in 2010. This arrangement could prevent the hazard of “displaced agency” (Henisz et al., 2012) and improve project development efficiency thereafter.

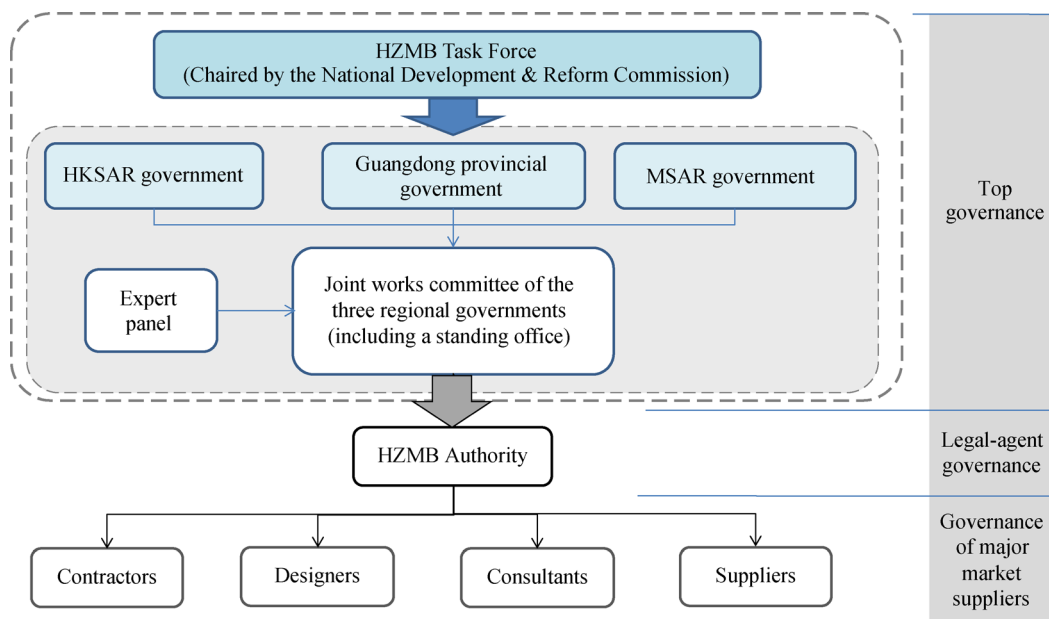


Fig. 4 Multi-level governance system during the project execution and closing-up phases

6.2 Legal-agent governance

In the case project, the Bridge Authority should be established as the project legal agent to fill in the gap between governmental governance and governance of major market suppliers, which served as the core of the multi-level megaproject governance system. This organization was registered as a non-profit organization (NPO) with enterprise-based operation rules in Guangdong province and took charge of the construction, operation, maintenance, and management of the HZMB main body. This situation is uncommon in terms of the existing legislative requirements (logic) in China. That is, the legal agent of development projects should take a registration form of companies and assume overall responsibility of project planning, project finance, construction execution, production and operation, loan payment, and asset management charge. Thus, the Bridge Authority as the NGO with enterprise-based operation rules is an uncommon practice compared with the legislative and local action logics. The Guangzhou provincial government often opts to establish a state-owned enterprise (e.g., GCG) to assume similar responsibility. The reason is that the HKSAR government believed that the project was a publicly-funded project and most of the project investments were from the three local and central governments, although part of the investment used bank loans through the Bridge Authority. Thus, the project legal agent should have been registered as an NPO. For the bridge-related Hong Kong projects, the HKSAR government established an HZMB management division under its Highway Department. The State Commission Office of Public Sectors Reform advocated for the registration of the project legal agent (client) as an NPO through the coordination of HZMB Task Force. The registration was finally accepted and approved by the local Commission Office of Public Sectors Reform of Guangdong Province.

Recognizing the technical and management difficulties of the case project and the action logic of the Guangdong provincial government, the three local governments decided that the Bridge Authority could adopt enterprise-based operation rules to maximize the use of market resources and maintain required execution efficiency. This decision was specified in the trilateral government agreement. The details include: (a) global recruitment, (b) relatively attractive salary (with reference to that of the state-owned enterprise GCG), (c) staff requirements, and (d) management processes and procedures. Evidently, the relatively high salary enabled the client to recruit competent staff members. In addition to the staff from ACWG office, the residual staff members at the Authority were selected through a globally open recruitment. However, similar to public institutions (e.g. government agencies), HZMB Authority had a staff quota of approximately 100 persons specified by the agreement.

6.3 Governance of major market suppliers

The aim of governing major market suppliers is to identify, select and monitor the appropriate major project suppliers to maximize the use of market resources (e.g., major designers, consultants, contractors, and material suppliers). As major market suppliers (first-tier suppliers) hold the top position of various project supply chains, the good governance of these suppliers can help clients reduce inter-organizational coordination burden and increase the use of market resources. The governance process is executed through the selection of project procurement/contracting methods and governance of the contract implementation process with these suppliers in terms of contract requirements, which was usually termed as transaction governance in the literature (Winch, 2010). The case project adopted a mixture of design-bid-build and design-build methods to procure the project due to the premature market structure and the tradition for self-sustaining (Spence, 1999). According to the interview evidence, HKSAR government took a lead of the AWCP in the project initiation and recommended the adoption of Hong Kong design standard. Thus, the designed service life of the bridge main body project is 120 years, which was determined based on HKSAR design standards and much longer than that of 100 years specified in Chinese design standards. This allowed the client to adopt innovative construction techniques and the design-build method in the project.

In the case project, DBB method was used to procure the construction of a 29.6 km bridge on the sea, which involved 10 various designers, component manufacturers, contractors and subcontractors. By contrast, the design-build method was used to procure the design and construction of the two artificial islands and the undersea tunnel between them. The interview evidence indicated that, in addition to the requirement on the designed service life of 120 year, the client also set up three objectives that might have positive effects on industrial development: (a) promoting the use of industrial manufacture techniques in construction production, (b) boosting construction components and products from the low-end market to the high-end market in terms of the output values, and (c) changing the construction site from an open environment to a relatively closed environment (e.g., factories). Thus, these targets allow the client to adopt the DBB method to force the suppliers to adopt semi-automated production methods, not the traditional hand-made one, for steel bridge components.

The main body construction posed a world class technical challenge because the construction plan required that tunnel components should be manufactured on land and installed on the sea floor at a depth of 40 m (Li and Chen, 2011). This challenge required the Bridge Authority to adopt the innovative design-build method to select a

joint venture that could maximize the use of domestic and international resources. Eventually, a joint venture that involved five Chinese designers/contractors and two foreign consultants won the contract. This method is an innovative practice in the transportation sector as a result of the lack of institutional and market support (Zhang et al., 2012). According to the interview evidence, this method helped the client to transfer its risks to the design-builder, although the use of this method did not receive much support from institutional support (e.g., budget constraint, lack of qualified design-builders, etc.).

7 Discussion

Figure 5 shows that a three-level mega-project governance system model in market transition can be induced through the case study. The multi-level governance system involves three levels, namely, governmental governance, legal-agent (client) governance, and governance of major market participants. Theoretically, this three-level project governance framework makes good response to the threefold institutional environment framework of projects noted by Scott et al. (2011). Each of these governance levels can deal with the institutional complexities caused by the regulative (through governmental governance), normative (through legal-agent governance), and culture-cognitive environment (through governance of major market suppliers), respectively. Meanwhile these three governance levels can work together as a whole through cross-level interactions to create superior competence for project survival under significant institutional complexity.

The multi-level governance system of development projects in China is significantly shaped by the power of co-evolution between governments and markets in the country. On the one hand, the construction market has rapidly emerged and grown in China since the 1990s (Fig. 1), thereby indicating the essential role of the competitive market mechanism in delivering construction projects. This institutional development led to transaction governance tasks of major market suppliers for construction project investors, who usually opt to establish a project company (client) as a legal agent to take this duty. On the other hand, the premature market structure and common use of the DBB method led to significant management burden for the project client, who cannot transfer these tasks to the market suppliers because of the lack of relevant resources on the domestic market. In addition, the tradition of self-sustaining and limited budget led project legal agents to build a strong management capability either by directly recruiting competent staff members or by collaborating with management consultants who can help take limited duty on behalf of the clients only (Spence, 1999). To satisfy the requirements of infrastructure mega-projects, the project legal agent would choose to register as a business company in terms of market rules to make use of

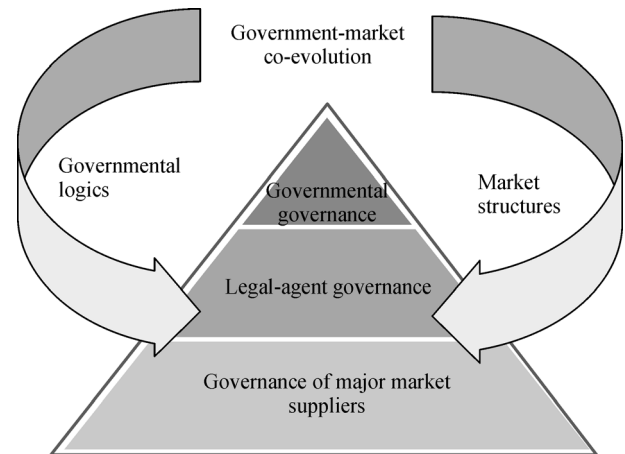


Fig. 5 Multi-level project governance model under government-market co-evolution

limited market resources and maximize its own management capability.

The institutional impacts of government logics on the three-level project governance system mainly reflect on all the three governance levels. First, compared with that in public project organizations (e.g., construction headquarters) under the centrally planned economy before the 1980s, governments significantly changed in their roles in project planning, execution and operation, and they only need to approve project initiation and objectives, review major project decisions, monitor project planning and execution and provide necessary support. Such changes indicate a development in government logics in terms of market evolution by promulgating a series of new laws and regulations. Second, changes in government logics have a significant impact on the establishment and operation of the multi-level governance system, particularly on the organizational innovation with project legal agents (e.g., organizational forms and operation rules) that may fit in the project requirement but are not clearly addressed in the existing legislative framework. Under such circumstances, strong support from the central government is the key to achieving organizational innovation. Third, government logics also establish the rules for transaction governance with major market suppliers by specifying the requirements in relevant laws and regulations, particularly with the procurement method and process (e.g., bidding and tendering, and contract standards). According to the interview evidence, the client invited some government officials from HKSAR governments to attend major bid evaluation meetings and other key events in project procurement. The project bidding and tendering process and requirements of the main body project generally complied with the competitive market rules used in HKSAR public procurement, although minor variation existed in the detailed procedures.

The institutional impact of market structures on the three-level project governance system can also be three-

fold. First, the premature market structure in the country requires project legal agents to use enterprise-based operation mechanisms to develop its management capability. This situation indicates that the organizational operation mechanism can be separated from its organization form and ownership. This case provides support for Chinese experiences that is different from some Western research perspectives with a focus on the corporate governance theories (e.g., the agency theory, transaction cost economics, stewardship theory) (Müller, 2009; Biesenthal and Wilden, 2014). This study has introduced governmental governance theory in project governance research and further emphasized the synthesis effects of governmental governance in combination with corporate governance and transaction governance in the multi-level mega-project system, especially for China. Second, the premature market structure asks legal agents to deal with procurement arrangements and subsequent execution issues on site, particularly in mega-projects. Maximizing the use of local procurement policies may allow project suppliers in the country to promote technological innovations and product upgrades across the sector and develop international competence for future development in the international market. Third, the premature market structure leads to additional coordination burden for governmental governance during project execution, such as cross-functionality among government agencies and suppliers. For example, the installation of undersea tunnel components required the authority to collaborate with several government agencies and institutions that involve the weather observatory, maritime affairs bureau, and contractors.

8 Conclusions

This work used the case study of the HZMB main-body project as a basis to propose a three-level governance system for transportation and other infrastructure mega-projects in China. In particular, through an institutional analysis lens, this work suggests the innovative use of the multi-level mega-project governance system to deal with the institutional complexity during market transition. The institutional effects of co-evolution between governments and markets on the design and operation of the three-level mega-project governance system were further analyzed. The findings of this study may provide useful references for other infrastructure mega-projects not only in China, but also in other developing countries. In addition, the theoretical framework obtained from this study provides useful insights into the complex system governance research through which multilateral collaboration on infrastructure mega-projects with significant institutional complexity can be achieved.

The main limitation of this work lies in the fact that the single case study might not fully reveal the element types,

operating processes and evolving dynamic of each governance level and their cross-level interaction mechanism in the multi-level mega-project governance system in China, which still requires a large-sample validation. Moreover, relationships between the multi-level mega-project governance system and mega-project organizational capabilities (e.g., contextual, integrative and motivational) are still unclear (Hu et al., 2015b; Davies et al., 2009), which deserve further investigation.

Acknowledgements An earlier draft of this work was presented at the research seminar on theories, methods and innovative applications of infrastructure mega-project management held in Shanghai in the mid-September 2017, which was supported as an academic activity by the Department of Engineering Management, Chinese Academy of Engineering (CAE). Comments on the earlier draft by Prof. Chongqing GUO (a CAE academician), Prof. Zhanjun GAO, Dr. Jingwen ZHANG and other participants in the seminar are deeply appreciated. Special thanks go to the senior executives and staff accepting interview requests at the Bridge Authority. Data formulation works by Ms. Yixin WANG, a student research assistant, are acknowledged. Finally, the comments from the guest editor and three anonymous reviewers are appreciated.

References

- Biesenthal C, Wilden R (2014). Multi-level project governance: Trends and opportunities. *International Journal of Project Management*, 32 (8): 1291–1308
- Campbell J L, Lindberg L N (1991). *Governance of the American Economy*, vol. 5. New York: Cambridge University Press
- Chi C S, Javernick-Will A N (2011). Institutional effects on project arrangement. *Construction Management and Economics*, 29(6): 595–611
- Colyvas J A, Powell W W (2006). Roads to institutionalization: The remaking of boundaries between public and private science. *Research in Organizational Behavior*, 27(6): 305–353
- Davies A, Gann D, Douglas T (2009). Innovation in megaprojects: systems integration at London Heathrow Terminal 5. *California Management Review*, 51(2): 101–125
- Dobbin F (1994). *Forging Industrial Policy: the United States, Britain, and France in the Railway Age*. New York: Cambridge University Press
- Downe-Wamboldt B (1992). Content analysis: Method, applications, and issues. *Health Care for Women International*, 13(3): 313–321
- Eisenhardt K M (1989). Building theories from case study research. *Academy of Management Review*, 14(4): 532–550
- Engineering News-Record (ENR). The top 50 program management firms. <http://enr.construction.com/toplists/Top-Program-Managers/001-100.asp>, 2017–7-20
- Flyvbjerg B, Hon C K, Fok W H (2016). Reference class forecasting for Hong Kong's major roadworks projects. *Civil Engineering*, 169(6): 17–24
- Hamilton G G, Biggart N W (1988). Market, culture, and authority: A comparative analysis of management and organization in the Far East. *American Journal of Sociology*, 94: S52–S94
- Henisz W J, Levitt R E, Scott W R (2012). Toward a unified theory of project governance: Economic, sociological and psychological

- supports for relational contracting. *Engineering Project Organization Journal*, 2(1–2): 37–55
- Hong Kong-Zhuhai-Macao Bridge Authority (2009). Introduction to Hong Kong-Zhuhai-Macao Bridge. <http://www.hzmb.org/en/bencandy.asp?id=2>, 2017–4–5
- Hu Y, Chan A P C, Le Y, Jin R (2015a). From construction megaproject management to complex project management: bibliographic analysis. *Journal of Management Engineering*, 31(4): 04014052
- Hu Y, Chan A P C, Le Y (2015b). Understanding the determinants of program organization for construction megaprojects success: Case study of the Shanghai Expo construction. *Journal of Management Engineering*, 31(5): 05014019
- Li Y, Chen Y (2011). The importance and technical difficulties of tunnel and islands for Hong Kong-Zhuhai-Macao Bridge project. *Engineering Mechanics*, 28(S3): 67–77
- Miles M B, Huberman A M (1994). *Qualitative Data Analysis: An Expanded Sourcebook*. Thousand Oaks: Sage
- Miller R, Lessard D R, Group I R (2000). *The Strategic Management of Large Engineering Projects: Shaping Institutions, Risks, and Governance*. Cambridge: MIT Press
- Müller R (2009). *Project Governance*. Farnham: Gower Publishing Ltd
- National Bureau of Statistics (2017). *China Statistical Year Book*. <http://www.stats.gov.cn/tjsj/tjgb/ndtjgb/>, 2017–6–20
- Nee V (1992). Organizational dynamics of market transition: Hybrid forms, property rights, and mixed economy in China. *Administrative Science Quarterly*, 37(1): 1–27
- Office of Government Commerce (2003). *Managing Successful Programs: Delivering Business Change in Multi-projects Environments*. London: The Stationary Office
- Orr R J, Scott W R (2008). Institutional exceptions on global projects: a process model. *Journal of International Business Studies*, 39(4): 562–588
- PMI (2013). *A Guide to the Project Management Body of Knowledge (PMBOKGuide)*. 5th ed. Newtown Square: Project Management Institute
- Scott W R, Levitt R E, Orr R J (2011). *Global Projects: Institutional and Political Challenges*. New York: Cambridge University Press
- Shirk S L (1994). *How China Opened its Door: The Political Success of the PRC's Foreign Trade and Investment Reforms*. Washington D C: Brookings Institution Press
- Spence J D (1999) *The Search for Modern China*. 2nd ed. New York: W. W. Norton
- Stark D, Bruszt L (1998). *Post Socialist Pathways: Transforming Politics and Property in East Central Europe*. New York: Cambridge University Press
- Tsui A S, Schoonhoven C B, Meyer M W, Lau C M, Milkovich G T (2004). Organization and management in the midst of societal transformation: The People's Republic of China. *Organization Science*, 15(2): 133–144
- Ventresca M J, Mohr J W (2005). Archival research methods. In: Baum J A C ed. *The Blackwell Companion to Organizations*. Oxford: Wiley-Blackwell, 805–828
- Winch G M (2010). *Managing Construction Projects*. Hoboken: John Wiley & Sons
- Yao Y (2008). *Economic Reforms as an Institutional Innovation Process*. Shanghai: Truth & Wisdom Press
- Yin R K (2009). *Case Study Research: Design and Methods*. 2nd ed. Thousand Oaks: Sage
- Zhang J W, Zhu Y L, Gao X L, Liu G (2012). Design-build contracting model development of islands and tunnel engineering of Hong Kong-Zhuhai-Macao Bridge project. *Highway*, 2012(1): 133–136 (in Chinese)
- Zhou X G (2004). *The State and Life Chances in Urban China*. New York: Cambridge University
- Zhou X G (2010). The institutional logic of collusion among local governments in China. *Modern China*, 36(1): 47–78