

Geoffrey Qiping SHEN, Jin XUE

Managing stakeholder dynamics and complexity in mega infrastructure projects

© Higher Education Press 2020

Mega infrastructure projects typically comprise massive financial investments, complicated organizational structures and serious technical difficulties, and have a profound impact on national and regional socio-economic development (Mok et al., 2015). China is a major engineering country and is currently carrying out the world's largest scale mega infrastructure projects (Liu et al., 2005), such as the South-to-North Water Transfer, West–East Gas Transmission, West–East Power Transmission, Beijing–Shanghai High-Speed Railway, and the Hong Kong–Zhuhai–Macao Bridge. With greater project complexity than traditional projects, the success of mega infrastructure projects depends more heavily on the active collaboration of stakeholders (Shen et al., 2009). The stakeholder structure in mega infrastructure projects is dynamic and complex: On the one hand, the long-term duration of mega infrastructure projects means that stakeholders continuously join or withdraw at different stages of the project; while on the other hand, a large number of stakeholder interactions occur as they become more deeply involved in complex project-associated issues. It is essential to understand the dynamic and complex nature of stakeholder interactions in mega infrastructure projects in order to achieve better stakeholder management.

The term “stakeholder dynamics” refers to changes of stakeholders throughout the project duration (Aaltonen et al., 2015), which leads to significant changes to the attitudes and actions of stakeholders at various stages of a construction project (Rowley, 1997). Previous studies analyzed stakeholder dynamics from three aspects:

Stakeholder attributes identification, stakeholder influence assessment, and stakeholder management strategies (Olander and Landin, 2005; de Schepper et al., 2014; Aaltonen et al., 2015). However, they lacked a comprehensive approach to analyzing stakeholder dynamics, from identification to assessment and management (Aaltonen and Kujala, 2010). Few studies have investigated stakeholder dynamics at the level of stakeholder issues (Luoma-Aho and Vos, 2010), which limits dynamic stakeholder management in practice (Yang et al., 2009). The bottleneck comes from data availability (Mok et al., 2017b), since the traditional stakeholder attributes model is a static model that relies on cognitive information provided by involved stakeholders (Yang et al., 2009). As mega infrastructure projects are long-term and complex (Mok et al., 2015), it is difficult to trace the changes of stakeholder issues in the dynamic environment through questionnaire surveys, as it requires a large number of samples for statistical evaluation. To address this limitation, a dynamic text-mining model using Topic over Time (TOT) was established to reveal how stakeholder information changed within the development of the Hong Kong–Zhuhai–Macao Bridge (Xue et al., 2020b). With the TOT-based model, 16 stakeholder-associated public concerns were identified and tracked from large quantities of unstructured timestamped project documents. A managerial map was also established from TOT results for dynamic stakeholder management.

Stakeholder complexity is caused by a large number of interactions between stakeholders and their relevant issues, which generates complicated interdependent stakeholder relationships (Yang et al., 2009; Mok et al., 2017a; Xue et al., 2020d). Effective analysis of stakeholder complexity is therefore useful for understanding stakeholder interdependencies and to help achieve stakeholder collaboration in the complex environment of megaprojects. There are three elements of stakeholder complexity that form the underlying network structure: Stakeholders, stakeholder issues, and stakeholder relationships (Yang et al., 2009).

Received December 3, 2020

Geoffrey Qiping SHEN (✉), Jin XUE
Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong, China
E-mail: bsqpshen@polyu.edu.hk

This research was supported by the National Natural Science Foundation of China (Grant No. 71671156).

By prioritizing stakeholder issues using network analysis, various studies have detected a group of project risks and challenges from the perspective of stakeholders in a variety of projects, including infrastructure projects (Mok et al., 2017b), urban-redevelopment projects (Yu et al., 2017), and prefabricated housing projects (Luo et al., 2019). However, existing network-based stakeholder analysis did not provide longitudinal evidence of stakeholder complexities at the various stages of a project (Mok et al., 2017a). To provide such evidence, instead of relying on traditional survey samples collected at a given point in time, it is necessary to have a reliable database to reveal the continuous longitudinal complex environment of mega infrastructure projects (Mok et al., 2017b). To address the research gap, a longitudinal stakeholder-associated network model was developed to analyze and manage stakeholder complexities using the Hong Kong–Zhuhai–Macao Bridge as a case study. After evaluating the complex interactions of 334 conflicts and 32 kinds of stakeholder groups, the three kinds of critical stakeholder-conflicts and most affected stakeholder relationships for five major stakeholder groups were revealed (Xue et al., 2020d). Findings from the study suggest that the advancement of network theories will continue contributing to the analysis of stakeholder complexities in mega infrastructure projects.

Stakeholder interactions evolve with the dynamic and complex environment of mega infrastructure projects. Effective stakeholder management is required to consider the co-effects of dynamics and complexities of a project, bringing new challenges for mega infrastructure project management. Although the aforementioned methods are useful to analyze stakeholder dynamics and complexities separately, there is still a need for innovative analytical tools to evaluate the stakeholder behavior in order to help reduce stakeholder conflicts and improve mega infrastructure project performance. There are new directions that have the potential of bridging the gap in each project phase. At the early stage of a project, the complex adaptive system technique has the potential to simulate stakeholder interactions for predicting weaknesses in stakeholder performance under dynamic and complex project environment (Holland, 1995; Capaldo and Giannoccaro, 2015). At the development stage, advanced information technologies (i.e., Building Information Modeling, Internet of Things, and Blockchain) can be applied to monitor the process of stakeholder management as frequent changes and interactions occur among stakeholders (Xue et al., 2020c). After the completion of a project, a stakeholder management review is essential with machine learning techniques to automatically learn from experience and develop solutions from large quantities of documents relevant to the project (Xue et al., 2020a). These new directions will bring stakeholder management in mega infrastructure projects into a data-driven era, tackling the challenges of

stakeholder dynamics and complexities with reliable data analytics.

References

- Aaltonen K, Kujala J (2010). A project lifecycle perspective on stakeholder influence strategies in global projects. *Scandinavian Journal of Management*, 26(4): 381–397
- Aaltonen K, Kujala J, Havela L, Savage G (2015). Stakeholder dynamics during the project front-end: The case of nuclear waste repository projects. *Project Management Journal*, 46(6): 15–41
- Capaldo A, Giannoccaro I (2015). Interdependence and network-level trust in supply chain networks: A computational study. *Industrial Marketing Management*, 44: 180–195
- de Schepper S, Doooms M, Haezendonck E (2014). Stakeholder dynamics and responsibilities in public–private partnerships: A mixed experience. *International Journal of Project Management*, 32 (7): 1210–1222
- Holland J H (1995). *Hidden Order: How Adaptation Builds Complexity*. New York: Basic Books
- Liu X L, Yuan S, Song E X (2005). Strategic consideration on the development of engineering construction technology. *China Civil Engineering Journal*, (12): 1–7 (in Chinese)
- Luo L Z, Shen G Q, Xu G Y, Liu Y L, Wang Y J (2019). Stakeholder-associated supply chain risks and their interactions in a prefabricated building project in Hong Kong. *Journal of Management Engineering*, 35(2): 05018015
- Luoma-Aho V, Vos M (2010). Towards a more dynamic stakeholder model: Acknowledging multiple issue arenas. *Corporate Communications*, 15(3): 315–331
- Mok K Y, Shen G Q, Yang J (2015). Stakeholder management studies in mega construction projects: A review and future directions. *International Journal of Project Management*, 33(2): 446–457
- Mok K Y, Shen G Q, Yang R J (2017a). A network theory-based analysis of stakeholder issues and their interrelationships in large construction projects: A case study. *International Journal of Construction Management*, 17(3): 210–227
- Mok K Y, Shen G Q, Yang R J, Li C Z (2017b). Investigating key challenges in major public engineering projects by a network-theory based analysis of stakeholder concerns: A case study. *International Journal of Project Management*, 35(1): 78–94
- Olander S, Landin A (2005). Evaluation of stakeholder influence in the implementation of construction projects. *International Journal of Project Management*, 23(4): 321–328
- Rowley T J (1997). Moving beyond dyadic ties: A network theory of stakeholder influences. *Academy of Management Review*, 22(4): 887–910
- Shen G Q, Brandon P, Baldwin A (2009). *Collaborative Construction Information Management*. London: Taylor & Francis Group
- Xue J, Shen G Q, Li Y, Wang J, Yu J, Yang Y (2020a). Dynamic analysis on public concerns in Hong Kong–Zhuhai–Macao Bridge: A topic modeling approach. In: *ASCE Construction Research Congress: Project Management and Controls, Materials, and Contracts*. Tempe, AZ, 160–170

- Xue J, Shen G Q, Li Y, Wang J, Zafar I (2020b). Dynamic stakeholder-associated topic modeling on public concerns in mega infrastructure projects: Case of Hong Kong–Zhuhai–Macao Bridge. *Journal of Management Engineering*, 36(6): 04020078
- Xue J, Shen G Q, Yang R J, Wu H, Li X, Lin X, Xue F (2020c). Mapping the knowledge domain of stakeholder perspective studies in construction projects: A bibliometric approach. *International Journal of Project Management*, 38(6): 313–326
- Xue J, Shen G Q, Yang R J, Zafar I, Ekanayake E (2020d). Dynamic network analysis of stakeholder conflicts in megaprojects: Sixteen-year case of Hong Kong–Zhuhai–Macao Bridge. *Journal of Construction Engineering and Management*, 146(9): 04020103
- Yang J, Shen G Q, Ho M (2009). An overview of previous studies in stakeholder management and its implications for the construction industry. *Journal of Facilities Management*, 7(2): 159–175
- Yu T, Shen G Q, Shi Q, Lai X, Li C Z, Xu K (2017). Managing social risks at the housing demolition stage of urban redevelopment projects: A stakeholder-oriented study using social network analysis. *International Journal of Project Management*, 35(6): 925–941