Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

Managing Social Risks at the Housing Demolition Stage of Urban Redevelopment Projects: A Stakeholder-oriented Study Using Social Network Analysis

TaoYu[ab], Geoffrey QipingShen[b], QianShi[a], XiaodongLai[c], Clyde ZhengdaoLi[b], KexiXu[b]

[a] Department of Construction Management and Real Estate, School of Economics and Management, Tongji University, Tongji Building A1707, Zhangwu Road 1, Shanghai 200092, China

[b] Department of Building and Real Estate, The Hong Kong Polytechnic University, Z-Block, Hung Hom, Kowloon, Hong Kong

[c] School of Tourism and Urban Management, Jiangxi University of Finance and Economics, No. 169 of Shuangguan East Road, Economic and Technological Development Zone, Nanchang 330013, China

Abstract: In China, the social risks associated with housing demolition increasingly present a challenge to the success of urban redevelopment projects. In practice, these risks are interacting and are associated with various stakeholders. Previous studies have largely focused on what the risks are and how they affect redevelopment projects without giving sufficient consideration to key stakeholders and their linkages with risks. Therefore, we sought to use social network analysis to investigate social risks related to housing demolition, based on a stakeholder perspective. Stakeholder-associated risks and their interrelations were identified and subsequently quantified based on a literature analysis and interviews with key stakeholders. Using a network analysis we identified critical risks and their corresponding stakeholders. Social security schemes, efficient financial management, multi-dimensional impact assessments, policy analyses and adherence to laws, as well as public participation were proposed to mitigate social risks during housing demolition. The

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

effectiveness of these solutions was quantified based on a network simulation. This study contributes to the body of knowledge on social risk management via linking social risks with corresponding stakeholders. Furthermore, the model developed in this study can be used to analyze the complex interactions among different social risks based on a system and network perspective.

Keywords: housing demolition; social risk; social network analysis; stakeholder perspective; urban redevelopment project

In China, the social risks associated with housing demolition increasingly present a challenge to the success of urban redevelopment projects. In practice, these risks are interacting and are associated with various stakeholders. Previous studies have largely focused on what the risks are and how they affect redevelopment projects without giving sufficient consideration to key stakeholders and their linkages with risks. Therefore, we sought to use social network analysis to investigate social risks related to housing demolition, based on a stakeholder perspective. Stakeholder-associated risks and their interrelations were identified and subsequently quantified based on a literature analysis and interviews with key stakeholders. Using a network analysis we identified critical risks and their corresponding stakeholders. Social security schemes, efficient financial management, multi-dimensional impact assessments, policy analyses and adherence to laws, as well as public participation were proposed to mitigate social risks during housing demolition. The effectiveness of these solutions was quantified based on a network simulation. This study contributes to the body of knowledge on social risk management via linking social risks with corresponding

stakeholders. Furthermore, the model developed in this study can be used to analyze the complex interactions among different social risks based on a system and network perspective.

1. Introduction

In recent decades, China has experienced an unprecedented urban redevelopment process with multiple strategic targets including economic growth, urban modernization, gentrification, and updating of substandard housing (Ye, 2011; Alpopi and Manole, 2013; Zhang et al., 2014; Peng et al., 2015). In many large Chinese cities, urban redevelopment has become a primary way for local governments to address urban issues such as land shortage and environmental pollution (Xue et al., 2015). Numerous urban redevelopment projects (URPS) such as the URPS of the Dongcheng District in Beijing (Shin, 2009), the “Urban Renewal 365” programs in Shanghai (Shih, 2010), and the redevelopment of urban villages in Guangzhou (Chung and Zhou, 2011) have been carried out in response to this tendency. Laws and policies have been released to facilitate this prevalent redevelopment process. For example, the Hong Kong government established the Urban Redevelopment Authority (URA) in 1974 to manage URPS and issued a series of policies such as the “Urban Renewal Strategy” to support urban redevelopment activities. In 2012, the city government of Shenzhen promulgated the “Detailed Rules for the Implementation of Urban Redevelopment in

Shenzhen" to provide basic guidance for practitioners to develop URPS in Shenzhen. In 2015, the city government of Shanghai released the "Rules for the Implementation of Urban Renewal in Shanghai" to regulate and promote URPS in this international city.

Housing demolition is an important byproduct of URPS because urban redevelopment typically involves the redevelopment of built-up areas and the reuse of urban space (Talen, 2014; He, 2014). To meet the land demand from URPS, 460 million square meters of buildings were demolished annually during the 12th Five Year Plan (China Academic of Building Research, 2014). As a result, more than 20% of urban residents have already experienced housing demolition and relocation because of URPS in Chinese cities (Beijing Cailiang Law Firm, 2015). Various stakeholders have been affected by housing demolition and the inter-relationships of these stakeholders are very complex. Due to sharp conflicts of interests among different stakeholders, housing demolition has resulted in many social risks that increasingly challenge the success of URPS. For example, legal disputes over relocation compensation can easily incur cost overruns and the delay of the delivery time of URPS. Unreasonable relocation schemes frequently cause dissatisfaction among different project stakeholders and even lead to unexpected results (Shi et al., 2015). Misunderstandings among governments, developers and relocated residents can even give rise to mass incidents that significantly hinder the implementation of URPS (Beijing Cailiang Law Firm, 2015). Within a worst situation, the pressures from public opinions against housing demolition may force governments and developers to terminate ongoing URPS (Chu, 2008). In summary,

social risks related to housing demolition are extremely important for the success of URPS. The central government of China even stipulates that every redevelopment project must conduct a social risk evaluation before carrying out any housing demolition activities (The State Council of the People's Republic of China, 2011).

In the Chinese context, social risks are typically associated with mass incidents, violent resistance, social conflicts, and unrests that stem from the conflicts of interests among different stakeholders (Liu et al., 2016). Numerous studies have investigated social risks during the housing demolition stage of URPS. These studies largely focus on risk identification and evaluation (e.g., Chen et al., 2012; Chen and Yu, 2011; Jiang, 2014). However, very few of them examine the social risks based on a thorough stakeholder analysis despite these risks being subject to various stakeholders with different goals and interests in URPS. Although scholars such as Shi et al. (2015) have emphasized the importance of stakeholder analysis and investigated the key interest of stakeholders in their studies, they have not fully examined the linkages between social risks and stakeholders during the risk evaluation process. Since the conflicts among different stakeholders have become the primary source of social risks in housing demolition (Yang and Shen, 2012), sufficient attention should be paid to the linkages between stakeholders and social risks. The central government of China suggests that local governments and property developers should carefully collect the opinions of key stakeholders during URPS (Li et al., 2014). Scholars such as Li et al. (2016) and Yang et al. (2016) argued that in terms of analyzing

stakeholder-associated risks, the inter-relationships of risks should be considered on a network basis. However, previous studies do not sufficiently analyze the interactions among different social risks during the housing demolition stage of URPS. These knowledge gaps can lead to ineffective risk management (Li et al., 2016). Therefore, we used social network analysis (SNA) to investigate social risks and their inter-relationships during the housing demolition stage of URPS, from the perspective of stakeholders. This study contributes to the existing body of knowledge via bridging social risk management with stakeholder management. In addition, the complex interactions among different social risks, which present a challenge to risk management, were analyzed based on a network viewpoint.

2. Research background and literature review

2.1. Critical Stakeholders in Housing Demolition

Housing demolition is an important process in URPS because it can facilitate the reuse of built-up lands, redevelopment of urban areas and the updating of substandard housing (Talen, 2014; He, 2014; Wang et al., 2014). Various stakeholders with different interests are directly or indirectly affected by this process. Due to the sharp conflicts of interests among different stakeholders, housing demolition has become a primary source of social conflicts and unrests (Shih, 2010). Therefore, the central government issued the *Regulations on the Expropriation and Compensation of Houses on State Owned Land* (*RECHSOL*) to regulate

housing demolition and reduce the adverse impacts of URPS on social stability (The State Council of the People's Republic of China, 2011). This policy clearly stipulates the rights and responsibilities of governments, relocated residents and property developers. In addition to these three stakeholder groups, demolition crews, nearby residents and the general public are also potential stakeholders during the housing demolition stage of URPS.

Local governments are responsible for managing and supervising the entire process of housing demolition. Before initiating URPS, governments must judge whether these projects are in the public interest. If URPS can benefit the general public, then housing demolition will be conducted to make room for these projects. Governments should develop a preliminary relocation and compensation scheme, and subsequently negotiate with relocated residents to determine an improved scheme. Relocated residents must move to other places but they can receive compensations for their economic losses according to the improved scheme (Hu et al., 2015). Governments can employ demolition crews (typically from professional demolition or construction companies) to complete the relocation and demolition work. It is worth noting that existing laws start to constrain the power of demolition companies in URPS due to the previous violent incidents between demolition crews and relocated residents. However, to increase the efficiency of relocation and demolition, it is very difficult to mitigate the impacts of demolition companies in a short period, especially when local governments suffer from a lack of demolition professionals. After the demolition, the land for URPS is delivered to developers for reconstruction. Developers can significantly affect the

decision-making of governments because property investments have become the primary source of financial support for urban redevelopment (Ye, 2011; Li et al., 2014). Housing demolition can influence the daily life, health, and safety of nearby residents (Chu, 2008). Therefore, they are an important stakeholder group in this study. Because URPS must conform to the interests of the general public, public opinions can also significantly affect the decision-making of URPS.

Stakeholder management can be used to deal with the complex stakeholder circumstance of URPS. This method can be employed to balance the interests of the key stakeholders, mitigate stakeholder conflicts and manage stakeholder behaviors. Typically, stakeholder management involves four steps: stakeholder identification, stakeholder analysis, strategy development and performance control (Mok et al, 2015; Aaltonen et al, 2015). The first step is to identify critical stakeholders and their inter-relationships in order to describe the stakeholder circumstance of URPS. Then, these identified stakeholders can be classified into different categories based on their attributes (e.g., power, legitimacy and urgency; Mitchell et al., et al) and opinions (e.g., negative or positive attitudes towards a project; Aaltonen et al, 2015). The relative importance of different stakeholder groups can be ranked based on stakeholder classification and quantitative evaluations. Strategies such as stakeholder engagement can be subsequently developed to balance the interests of the stakeholders with different importance and reduce stakeholder conflicts. Finally, the effectiveness and the efficiency of stakeholder management should be assessed for further improvements (Mok et

al, 2015). Stakeholder management can be used to deal with stakeholder-associated issues as an important supplement to other project management technologies.

2.2. Social Risk Related to Housing Demolition

Project Management Institute defines "project risk" as uncertain events or conditions that may emerge during a project and can have uncertain impacts on the achievement of project objectives (Project Management Institute, 2013). In terms of social risk, researchers typically focus on activities or conditions that may exert negative effects on the social outcomes of a project (Shi et al., 2015). Therefore, compared with other types of project risk, social risk extends the focus of project management from traditional project objectives (e.g., time, cost, quality) to social performance. Scholars such as Kytle and Ruggie (2005) argued that social risks should be dealt with based on the perspective of corporate social responsibility in order to alleviate the environmental and social impacts of business activities. Under different social environments, the focus of social risk management may differ significantly. In China, social risk is typically related to the unexpected outcomes of state interventions (e.g., policies), mass incidents, social conflicts, and the destructive impacts of large-scale emergency incidents on social stability or social order (Liu et al., 2016). In this context, social risk management has a strong linkage with stakeholder management in most construction projects (Shi et al., 2015) because the majority of these risks are incurred by stakeholder-associated conflicts.

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

In terms of housing demolition, the sharp conflicts of interests among different stakeholders result in many social risks that frequently limit the success of URPS. To reduce social conflicts and ensure the feasibility of URPS, RECHSOL stipulates that URPS must carry out comprehensive evaluations on social risk before carrying out any demolition activity (The State Council of the People's Republic of China, 2011). Numerous studies have been conducted to investigate how to manage social risks during the housing demolition stage of URPS. Based on a case study, Shi et al. (2015) evaluated the social risks of infrastructure projects and identified unfair compensation and violent incidents as primary risk factors during housing demolition. This study implies that stakeholder management can help practitioners enhance social risk management in the context of China. In addition to the risks highlighted by Shi et al. (2015), Liu et al. (2016) argued that uncertainties in relocation policies were another source of social risk. Therefore, local governments can play an important role in social risk mitigation. Chen et al. (2012) conducted an empirical study to examine the critical social risks related to housing demolition in Guangzhou. These authors maintained that information exchange and stakeholder participation could effectively mitigate social risks. Based on qualitative analyses, Teng (2013) investigated the key social risks in housing demolition from the viewpoint of vulnerable groups. This researcher argued that existing policies and laws should be modified to enhance social security and properly protect the interests of relocated residents. Grounded in social combustion theory, Yang and Shen (2012) identified key risk factors and developed a risk assessment system containing 36

indicators to evaluate the impact of housing demolition on social stability. In terms of application, Ni (2015) used a fuzzy evaluation to identify critical social risks and then quantified the effects of these risks on the performance of the Binjiang project.

In terms of research methods, previous studies typically measure the importance of social risks based on the likelihood of occurrence and the degree of impact of different risks (e.g., Shi et al., 2015). Fuzzy evaluation is another method widely used to rank social risks in housing demolition (e.g., Ni, 2015). This method largely depends on the knowledge and subjective evaluation of project experts or managers. In addition, social combustion theory has also been applied in social risk management since it was introduced by Niu, Wenyuan (Yang and Shen, 2012). This theory argues that the social disorder and unrest incurred by social risks have similar characteristics with combustion phenomena. From this perspective, social risks and factors that may incur social risks are classified into three categories similar to the three key elements in combustion process, i.e., burning material, combustion point and supporter of combustion. As a result, practitioners can mitigate social risks in a similar way that people put out a fire.

Despite a large body of literature, previous studies have largely focused on social risk identification and evaluation without sufficient consideration given to the linkages between risks and stakeholders. Although researchers such as Shi et al. (2015) have recognized the importance of stakeholder management in social risk management, they did not quantify the

impacts of stakeholders in their risk evaluation. The primary purpose of social risk evaluation is to mitigate stakeholder-associated issues such as social unfairness between different social groups (The State Council of the People's Republic of China, 2011). Stakeholder analysis can help practitioners deal with social risks in the context of China (Teng, 2013; Shi et al., 2015) because the majority of these social risks such as mass incidents are caused by conflicts of interests among different stakeholders. According to Ward and Chapman (2008), stakeholders have become the main source of uncertainty in complex engineering projects where stakeholder entities, their interests and interactions at different project phases are the major stakeholder-associated uncertainties. As mentioned in Section 2.1, URPS typically involve various stakeholder groups with complex interests and interactions. Accordingly, linking risk management with stakeholder analysis can effectively reduce uncertainties in URPS. Therefore, identifying critical social risks and quantifying their impact based on a perspective of stakeholders is a critical concern for addressing social risks during the housing demolition stage of URPS. This study aims to bridge the research gaps mentioned above.

2.3. Social Network Analysis: An Effective Approach to Settle Stakeholder-associated Issues

SNA has become an effective tool for researchers and practitioners to model organization structure and analyze interactions among different individuals or groups since Moreno introduced this concept in 1934 (Moreno, 1960). The theoretical foundation of SNA is based

on graph theory, sociological and anthropological theories (Tichy et al, 1979). SNA assumes that network members can interact with each other and their behaviors are largely affected by the relationship pattern embodied in the network structure (Wasserman and Galaskiewicz, 1994). From this perspective, Mitchell defined SNA as "a specific set of linkages among a defined set of persons, with the additional property that the characteristics of these linkages as a whole may be used to interpret the social behavior of the person's involved (Mitchell, 1969)."

SNA has been widely used as an effective approach to settle stakeholder-associated issues in the field of construction project management as well as other research areas (Mok et al., 2015). According to Rowley (1997), SNA can be employed to describe stakeholder environment by mapping the structural characteristics of a stakeholder network and the inter-relationships among different stakeholders. Compared with other research methods, SNA can visualize the complex and abstract inter-relationships among multiple stakeholders using socio-grams (Chinowsky et al., 2008). In addition, the impacts of stakeholder behaviors and interactions can be quantified based on a network and system perspective (Mok et al., 2015). As a result, SNA can help researchers identify critical stakeholders and practical issues in their studies. Given the advantages mentioned above, SNA has been applied to settle stakeholder-associated issues in different types of construction projects such as school projects, infrastructure projects and mega projects (Mok et al., 2015). For example, Li et al (2016) set up a SNA model to deal with stakeholder-associated schedule issues in

prefabrication construction projects. Based on network analyses, these authors argued that a BIM-based information system can be applied to improve schedule performance. Mok et al. (2017) used SNA to investigate key challenges in major public engineering projects. They found that the key concerns of stakeholders could be effectively identified and removed by using SNA. Ruan et al. (2012) adopted SNA to analyze the knowledge integration process in the collaborative and competitive working systems of four construction projects. These authors highlighted the advantages of collaboration and knowledge sharing from a network perspective. In this study, we also employed SNA to investigate social risks because this method can link risks with corresponding stakeholders and quantify the interactions among different network nodes.

3. Methods

Previous studies on social risk management typically follow a classical framework containing risk identification, evaluation, analysis and response (e.g., Shi et al., 2015; Liu et al., 2016). This framework can effectively identify risks and quantify their impacts on project performance. However, in terms of stakeholder-associated risks, this classical framework cannot effectively consider stakeholders during the risk evaluation and analysis processes (Yang et al., 2016). According to Section 2.3, SNA is an effective approach to analyze and settle stakeholder-associated issues. SNA can link risks with corresponding stakeholders and analyze the interactions among different risks. Researchers such as Yang et al. (2016) and Li

et al. (2016) suggested integrating the traditional risk-management framework with SNA to handle stakeholder-associated risks because SNA can analyze risks based on a stakeholder and network basis. Therefore, we developed our research framework according to the suggestions of these scholars (Fig. 1). Although SNA has already been used to conduct risk analyses such as in green building (Yang and Zou, 2014; Yang et al., 2016) and prefabrication projects (Li et al., 2016), it appears that this method has not been adopted in the area of social risk management. Therefore, this study extends the application of SNA to social risk analysis.

Please place Fig.1. here

3.1. Data collection

Interviews were conducted to collect data because they can provide large amounts of information and face-to-face interactions between researchers and interviewees. Ambiguities can be mitigated via open discussion, and the reliability of data can be improved via information sharing among different participants (Brinkmann, 2014). The selection of interviewees followed a stakeholder-based sampling principle because this study examined social risks based on a stakeholder perspective (Li et al., 2016). In Section 2.1, relocated residents (S1), governments (S2), project developers (S3), demolition crews (S4), nearby residents (S5) and the general public (S6) were identified as key stakeholder groups in

housing demolition. All of the six stakeholder groups were investigated to avoid biased judgments. To ensure that the data is representative, all interviewees were selected from large cities where large-scale urban redevelopment programs were conducted in the last five years. Shanghai, Shenzhen and Beijing were identified as the most suitable cities because they have developed specific strategies and policies for implementing URPS. All of the interviewees from S2, S3 and S4 had more than five years of working experience related to URPS, and the majority had senior positions in their organizations. Interviewees from S1 and S5 were residents who experienced URPS after 2012 because the previous policy pertaining to housing demolition was replaced by a new regulation issued in 2011 (The State Council of the People's Republic of China, 2011). The identification of interviewees from S1 to S5 started by reviewing exemplar URPS that were launched after 2011. The majority of these URPS were pilot projects in the redevelopment plans of local governments. The key participants or stakeholders in these projects were initially identified as potential interviewees. The S6 interviewees were randomly selected in the urban areas of the three cities. A snowball sampling technique was used to encourage more potential interviewees to participate in our study. We initially contacted potential interviewees via telephone or email. Those who did not have sufficient knowledge on social risks in housing demolition were excluded from the study. Initially, we contacted 80 potential interviewees from these three cities; 25 of them did not have any interests in our research and rejected our invitation, and 19 potential participants claimed that they were not qualified to answer the interview questions. As a result, 36 participants were identified as qualified interviewees (each

stakeholder group had 6 members), and all of them contributed to this research.

3.2. Research Processes

The main processes of this research are shown in Fig.1. First, we identified social risks related to housing demolition using literature analysis and semi-structured interviews with key stakeholders. Before conducting the interviews, the background information and research content were sent to these interviewees via email so that they could review their previous experience related to housing demolition and make preparations for these questions. The interview questions (the key types of questions are summarized in the **Appendix**) largely focused on social risks and corresponding stakeholders related to housing demolition. For example, what are the major risks that may cause social conflicts during the housing demolition stage of URPS?

In the second step, we quantified the interactions among the identified social risks based on the empirical knowledge of key stakeholders. For this purpose, face-to-face interviews were conducted to examine the opinions of the interviewees from the six identified stakeholder groups. To minimize ambiguities, we provided verbal explanations for participants when they did not clearly understand an interview question. In SNA, nodes denote social risks identified in the first step. Links refer to the effects of social risks on other risks. For example, if there is a link from S_aR_b to S_cR_d, it indicates that S_aR_b can affect S_cR_d. The interviews required the

corresponding stakeholders to evaluate the directions and effects of potential links. For example, if S_aR_b can affect S_cR_d, then stakeholder groups S_a and S_c will be interviewed to assess the linkage between S_aR_b and S_cR_d. Accordingly, there were three types of questions in this evaluation: 1) Can risk S_aR_b affect S_cR_d during the housing demolition stage of URPS (the direction of the link)?; 2) What is the likelihood of this potential effect (the likelihood of the link)?; and 3) If S_aR_b impacts S_cR_d, to what degree can S_aR_b influence S_cR_d (the degree of influence)? A five-point scale was used to measure the results of the second and third types of questions, similar to studies conducted by Li et al. (2016) and Yang et al. (2016). Here, "1" denotes the lowest level and "5" refers to the highest level. The overall effect of a link (X) can be calculated by multiplying the likelihood of this link with the degree of influence.

In some cases, the related stakeholders could not reach an agreement on the final result of an evaluation on a link ($0 \leq X \leq 25$). In such a situation, we calculated the degree of variation ($V=\frac{X_{max}-X_{min}}{25}$, X_{max}=the maximal value of the evaluation, X_{min}=the minimal value of an evaluation) to judge whether a re-evaluation should be conducted to determine the weight of a link. In practice, V can be used as a simple parameter to measure the degree of variation in statistical samples (Jia et al., 2012). If the degree of variation was acceptable ($V \leq 0.2$), we used the median of the evaluation results to reflect the weight of this link (Jia et al., 2012). If the degree of variation is not acceptable ($V > 0.2$), we organized online meetings with the related stakeholders via Wechat (a kind of online communication software developed by Tencent Company). Then, a re-evaluation was carried out until generating an acceptable result. After two rounds of Wechat-based communication, an acceptable risk network was achieved from the investigation.

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

In the third step, we imported the data collected from the first and second steps into NetMiner 4 for risk network visualization and analysis. Six metrics suggested by previous studies (Li et al., 2016; Yang et al., 2016; Yang and Zou, 2014) were used to reflect the key characteristics of the risk network and to identify critical risks, links and corresponding stakeholders. These metrics included the following: network density, network cohesion, nodal degree, betweenness centrality, status centrality, and brokerage. They are widely used in studies pertaining to SNA and can effectively describe the key features of the network, nodes and links.

Finally, based on network analysis, we proposed potential strategies for social risk mitigation. This step involved understanding the in-depth implications of critical risks and links in the network. By integrating the findings of the literature analysis, interviews and SNA study, we discussed the major risks identified here and exhibited the rationale of the risk management strategies. We evaluated the effectiveness of these strategies based on a network simulation.

4. Results

4.1. Identification of Social Risks

Based on the literature analysis and semi-structured interviews, 38 social risks were identified (Table 1). To integrate social risks with corresponding stakeholders, we coded the

nodes of the risk network into S_aR_b for data processing; S_a refers to stakeholder (S1 to S6), and R_b denotes social risk (R1 to R38). As a result, 53 nodes are generated with 328 links among these risk nodes. The links in the risk network represents the influence between two different social risks. We calculated the weights of these links based on evaluations of key stakeholders in the second step of this research. The weight of a link is achieved by multiplying the likelihood of this link with the degree of influence. This calculation method is consistent with Li et al. (2016), Yang et al. (2016) and Yang and Zou (2014). We further classified the identified 38 risks into 9 risk categories based on the different characteristics of these social risks. The classification is largely based on the interviews and the literature (Ni, 2015; Yang and Shen, 2012; Jiang, 2014; Chen and Yu, 2011). The 9 risk categories contain the following: social unfairness (C1), financial risk (C2), adverse impacts on stakeholders' quality of life (C3), insufficient safety/health/environment management (C4), illegal activities and legal disputes (C5), unreasonable decision-making (C6), a lack of information (C7), insufficient preservation of urban characteristics (C8), and uncertainties in exterior circumstance (C9).

Please place Table 1 here

4.2. Network level analyses

The risk network was composed of 53 social risk nodes connected by 328 links. This is

visualized in Fig. 2 in which the colors and shapes of the nodes represent stakeholder groups and risk categories, respectively. An arrow from node S_aR_b to S_cR_d indicates that S_aR_b can impact S_cR_d. The thickness of this arrow denotes the level of influence. Social risks with more links are located at a more central position in the network, whereas nodes with fewer connections are placed closer to the border of the figure. Fig.2 provides a visual image of the risk structure for the researchers. All risks are connected to the risk network implying that even a small variation in one risk might affect the other risks in the network; therefore, the risk management processes are extremely complex. A large area of yellow nodes occupies the central location of the network map indicating that governments play the most important role in mitigating social risks related to housing demolition. Their interactions account for the majority of existing links. To address the potential conflicts between relocated residents and project developers, a new policy pertaining to URPS (i.e., *RECHSOL*) stipulates that developers should not directly participate in demolishing housing. Therefore, governments have become direct participants and are responsible for housing demolition. This may be the main reason why government-associated risks are located in the central areas of the network.

We calculated the network density and cohesion to examine quantitatively the configuration of the risk network. Network density reflects the overall connectivity of a network (Wasserman and Faust, 1994), and cohesion captures the network complexity by considering the reachability of different nodes (Parise, 2007). Scholars have used these two metrics to

measure the overall degree of difficulty in risk management (Li et al., 2016; Yang et al., 2016; Yang and Zou, 2014). A higher density or cohesion typically indicates that practitioners have to deal with more challenges in risk management. The network density is 0.119, and the mean distance between two nodes is 2.714 walks showing that the network is dense, and the nodes are proximate to each other. The network cohesion is 0.609, higher than the density value. This implies that the structure of the risk network is more complex from the perspective of node approachability.

Please place Fig.2. here

4.3. Node and link level analyses

To identify critical risks during the housing demolition stage of URPS, we explored the direct and propagating effects of individual nodes, and their roles in the network from multiple metrics suggested by previous studies (Yang and Zou, 2014 ;Li et al., 2016; Yang et al., 2016). First, the status centrality map of the risk network is shown in Fig.3. Here, all of the risks are included, and the overall impact of each risk can be seen. Typically, risks in the central area of the map play more important roles in the network (Li et al., 2016). Many yellow nodes are in the center of this map implying the important role of governments. In addition, two green nodes are placed in the central area indicating that project developers can still affect the risk network, although the new policy has reduced their degree of involvement in housing

demolition. Because property development has become a primary source of financial support for URPS, developers can indirectly influence the decision-making of other stakeholders by changing their investment strategies in URPS.

Please place Fig.3. here

In addition to the status centrality map, we calculated three other indicators including ego network size, out-degree and degree difference for the node-level analyses (see Table 2). These indicators reflect the characteristics and effects of risk nodes from different perspectives. If a risk can have a large ego network size, then there will be many risks with close relations to this risk. The out-degree reflects the sphere of direct influence, and a risk with a higher out-degree can directly affect more neighbors in the network. The degree difference equals the gap between the out-degree and in-degree (Wasserman and Faust, 1994). A risk having a large degree difference can exert stronger impacts on its neighbors than accept influences (Li et al., 2016). In terms of these three metrics, risks with high metric values typically play more important roles in the risk network. The top 15 risks ranked by these three metrics are shown in Table 2.

Please place Table 2 here

In this study, brokerage is considered a valuable network metric that exhibits the different

functions and abilities of risk nodes in connecting subgroups. The top 15 risks in the brokerage analysis are shown in Table 3. These risk nodes are important in the risk network because they play an important role in bridging various stakeholder groups (Li et al., 2016).

Please place Table 3 here

Finally, the betweenness centrality of different nodes and links were analyzed to show the degree to which a risk or an interaction can control the influences passing through it, i.e., the ability to control influence. The top 15 nodes and links ranked by the betweenness-centrality are displayed in Table 4. Removing these risks or interactions from URPS can significantly mitigate the complexity of the risk network.

Please place Table 4 here

5. Critical risks and risk-mitigation strategies

5.1. Critical challenges and social risks during the housing demolition stage of URPS

We identified the critical risks and interactions according to the results of the network analyses in Section 4, with consideration given to the degree of nodes, ego size, status centrality, brokerage, and betweenness centrality. Because the rankings of critical risks based

on different SNA metrics can slightly differ, previous studies tend to select 3 to 5 top factors from each ranking list as critical risks (e.g., Li et al., 2016; Yang et al., 2016). The logic is that these factors play the most important roles in different dimensions of the risk network. Removal of these nodes and links can reduce the overall complexity of the risk network (Yang and Zou, 2014; Yang et al., 2016; Li et al., 2016). We followed this principle in our research. In addition, risks that can emerge in more than three ranking lists were also identified as critical risks because they have multiple functions to support the risk network and play multiple roles in stakeholder-associated issues. As a result, the 15 social risks and 15 interactions that we found to be critical are summarized in Table 5. To deeply understand the implications of these social risks, we then classified them into six challenges with brief explanations to show the rationale of this classification. Social risks in the same challenge have similar characteristics and can be similarly addressed.

Please place Table 5 here

5.2. Solutions to risk mitigation

Please place Fig.4. here

Given these analyses, we propose five strategies for mitigating the critical risks during the housing demolition stage of URPS (see Fig.4). Because governments and developers are the

driving stakeholder groups in Chinese URPS, these strategies are designed largely based on the perspective of governments and developers. We followed a risk management principle that risks should be handled by qualified stakeholders who have sufficient abilities and are suitable to control risks. These risk mitigation strategies include: social security schemes, public participation, efficient financial management, multi-dimensional impact assessments, as well as policy analyses and adherence to laws.

Social security schemes (SL1)

To deal with the first challenge identified in Table 5, developers and governments should carefully consider social security issues when developing master plans and project development schemes for URPS. The basic living conditions of vulnerable stakeholder groups including relocated residents and nearby households must be well maintained. Social security schemes for URPS can be designed and carried into operation to facilitate the protection of vulnerable groups. According to Table 5, health problems, homelessness, unemployment issues, and potential impacts on social support network should be considered in these social security schemes. Effective measures should be identified in these schemes to deal with social security issues. For example, to reduce the homelessness of relocated residents, governments and developers can plan to provide resettlement housing for low-income residents. To address unemployment issues, governments and developers may organize reemployment-training programs to help vulnerable groups achieve new jobs

after moving to other places. In current URPS, large cities such as Shenzhen and Guangzhou have already adopted such measures to mitigate social risks.

Public participation (SL2)

Public participation can eliminate the misunderstandings among various stakeholders and improve stakeholder satisfaction (Li et al, 2013). By engaging key stakeholders in decision-making processes, this strategy can mitigate the impulsive actions of key stakeholders because stakeholders can better express their opinions pertaining to the URPS and influence the final decisions. In addition, by collecting feedback from key stakeholders, governments and developers can acquire more useful information for better decision-making. For example, the expectations on relocation compensation can be acquired to modify the preliminary compensation schemes. To facilitate this strategy, multiple participation approaches such as focus group, interview, questionnaire (Li et al., 2014), and internet-based participation platform (Lin et al., 2015) can be used to engage stakeholders in the decision-making processes of URPS. Meanwhile, the degree of engagement should be well distinguished because urban redevelopment is a complex process and many stakeholders do not have sufficient knowledge to make holistic decisions. All of the key stakeholders should have opportunities to express their opinions on the URPS. Their key interests should be considered by project managers and government officials. However, the final decisions should be made based on the professional knowledge of experts.

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

Efficient financial management (SL3)

According to Table 5, the challenges to financial management mainly stem from project financing and cost control. In terms of project financing, governments can encourage private sectors to invest in URPS and reduce the fiscal burden. The public-private-partnership mode has been widely adopted to spread financing pressures among different stakeholders in previous practices (Yang and Chang, 2007). In addition to the public-private-partnership, other financing modes such as build-operate-transfer can be adopted to attract large companies with sufficient funds to participate in urban redevelopment. We also suggest that governments and developers can cooperate and share project profits with relocated residents and nearby communities in order to mitigate financing risks caused by relocation compensation. In summary, effective financing modes must be selected and executed. In terms of cost control, governments and developers should pay sufficient attention to compensation schemes because relocation compensation accounts for the largest part of project costs at the demolition stage. Governments and developers should carefully study the compensation standard suggested by *RECHSOL.* They can employ professional appraisers to assess the total cost for compensation and then develop a reasonable project budget based on this assessment. In addition, the relocation compensation of URPS is significantly affected by negotiations with relocated residents (Wu, 2004; Hu et al., 2015). Governments and developers should also investigate the expectations and opinions of relocated residents.

Based on the feedback from relocated residents, the project budget must be modified to reduce potential cost risks.

Multi-dimensional impact assessments (SL4)

During the feasibility study and planning period, multi-dimensional impact assessments (such as social, environment, economic and health impact assessments) can be conducted to mitigate social risks caused by unreasonable decisions. Housing demolition is a complex process of URPS and involves a wide range of stakeholders with diversified interests. This process can significantly affect the society, economy and environment of a city as well as the lifestyles of involved stakeholders. Therefore, the impact of every potential project alternative must be evaluated from multiple dimensions to predict and control the adverse effects of housing demolition. By comparing the impacts of different alternatives, decision-makers can select a suitable option with a relatively low level of adverse effects. The primary steps of multi-dimensional impact assessments typically include (e.g., Becker, 2001): identification of key objectives (e.g., stakeholder satisfaction), design of scenarios, project alternative development, impact assessment, ranking of alternatives, reduction of negative impacts, reporting, stimulation of implement, and alternative selection.

Policy analyses and adherence to laws (SL5)

To reduce Challenges 5 and 6, developers and governments should conduct policy analyses before initiating URPS. According to *RECHSOL* and *Property Law*, URPS plans that conform to the basic requirements of public interests can apply to conduct housing demolition for land access. However, the definition of public interests is not sufficiently clear to provide a strict boundary for URPS (Shih, 2010). In addition, *RECHSOL* stipulates that housing demolition should not be carried out for business benefits. However, under many conditions, the pursuit of business benefits can contribute to economic development, and economic growth can benefit the general public by eliminating property and improving the quality of life of local residents. Therefore, URPS with the aim to achieve business benefits may also conform to public interests. Contradictions in policies can easily incur "illegal actions". Therefore, governments and developers should carefully study the existing policies before initiating URPS. They can employ professional legal advisors to deal with legal disputes and identify potential issues. After policy analyses, governments and developers must check their master plan to ensure that the URPS meet the requirements of the existing policies. Illegal demolition can frequently result in violent resistance from relocated residents (Beijing Cailiang Law Firm, 2015), and adherence to laws can help governments and developers avoid violent conflicts and mass incidents. The relocation compensation schemes of URPS should be developed based on the standard suggested by *RECHSOL*. Fair compensation for relocated residents can enhance their satisfaction and reduce impulsive actions.

5.3. The effectiveness of risk-mitigation solutions

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

Please place Fig.5. here

To evaluate the effectiveness of the five risk management strategies, we simulated and quantified the risk network after implementing the aforementioned solutions (see Fig. 5). The simulation was carried out according to the study conducted by Li et al. (2016). A primary assumption (PA) here is that all of the proposed strategies can be effectively conducted, and corresponding nodes and links can be completely removed from the network. In Table 5, the critical risks (nodes and links) identified in Section 4 are classified into 6 challenges according to their characteristics and risk categories. In Fig.4, one can see that these challenges can be alleviated if corresponding strategies are taken. In the simulation, when a strategy was carried out, the risks related to this strategy (according to Fig. 4 and Table 5) were removed from the risk network of Fig. 2 (according to PA). For instance, if SL1 is implemented, then the links and nodes in Challenge 1 will be removed from Fig. 2 because Fig. 4 implies that SL1 can be used to deal with Challenge 1. It indicates that if a reasonable social security scheme is developed and effectively carried out, then the risks caused by a lack of social security can be well controlled. After removing the nodes and links from the original network, the global network parameters in Section 4.2 can be recalculated to evaluate the effectiveness of risk-mitigation strategies. This simulation approach can be employed to measure the effectiveness of a strategy (e.g., SL1) or a strategy profile (e.g., SL1+SL2; SL1+SL2+SL3+SL4+SL5)

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

Please place Fig.6. here

Due to the limited space, this paper only focused on the overall effectiveness of the five strategies identified in Section 5.2. If all of these strategies are taken, then all of the nodes and links listed in Table 5 will be removed from Fig. 2. After reshaping the risk network (see Fig. 6), we recalculated the two network metrics used in Section 4.2, network density and cohesion, because they reflect the global characteristics of the risk structure. All of the five strategies are assumed to be effectively implemented. As a result, the improved risk network is shown in Fig.6. The complexity of the network is significantly reduced versus Fig.2. The network is less condensed after taking our risk mitigation strategies. In addition, a few isolated nodes emerge in the figure, indicating that more social risks can be handled individually without constraints from other risks. The network density and cohesion are reduced to 0.050 (-57.98%) and 0.279 (-54.19%), respectively. These simulation results imply that the proposed five solutions can largely mitigate social risks during the housing demolition stage of URPS.

6. Conclusions

Grounded in social network theory and classical risk management approach, this study employed SNA to investigate the underlying network of stakeholder-associated social risks during the housing demolition stage of URPS. A risk list containing 38 factors (see Table 1)

was compiled through a literature analysis and interviews with critical stakeholders. Based on network analyses, we identified critical risks and interactions that had significant impacts on other risks directly or indirectly (see Table 5). We found that local governments were the most important stakeholders that can determine the finial effect of social risks during housing demolition. A lack of social security, information challenges, challenges to financial management, difficulties in decision-making, uncertainties in policies and legal disputes, and impulsive actions of relocated residents were identified as the primary concerns of social risk management. Decision-makers must consider these challenges when initiating URPS. Social security schemes, efficient financial management, multi-dimensional impact assessments, policy analyses and adherence to laws, and public participation were proposed to mitigate these social risks. We tested and quantified the effectiveness of these solutions by recalculating the network densities and cohesions of the improved risk network. The results show that our strategies can effectively mitigate social risks related to housing demolition.

6.1. Theoretical and practical implications

In terms of theoretical implications, this study contributes to the body of knowledge on the social risk management of projects. Compared with other types of risks, social risks can be significantly affected by project stakeholders and alleviated via proper stakeholder coordination. In a few current studies, scholars such as Shi et al. (2015) and Liu et al. (2016) starts to investigate the interests of stakeholders based on qualitative analyses when

evaluating social risks. Compared with them, this study not only highlights the importance of stakeholder analysis in social risk management but also quantifies the linkages between risks and corresponding stakeholders. Therefore, the roles of different stakeholders can be examined based on quantitative analyses. In practice, social risks typically interact with each other in URPS. However, most studies such as Chen and Yu (2011) and Ni (2015) paid insufficient attentions to these interactions when ranking the relative importance of different social risks. This research gap can adversely affect the efficiency of risk management (Li et al., 2016). The SNA model developed in this study can be used to examine the complex inter-relationships among different risks when evaluating the impacts of these risks and mapping the most important risks. Accordingly, this finding can help enhance the efficiency of social risk models in previous literature. Resonating with researchers such as Li et al. (2016) and Yang et al. (2014), this study argues that SNA can be effectively applied to settle stakeholder-associated issues. The application of SNA has been extended to the area of social risk management. Finally, this study indicates that stakeholder management can be integrated with other project management tools (e.g., risk management) to deal with stakeholder-associated issues in a more effective way. Researchers can develop a bridge between stakeholder management and social risk management.

In terms of practical implications, this study can assist practitioners in managing and mitigating social risks at the housing demolition stage of URPS. Firstly, the 38 social risks identified in Table 1 can be referred as a checklist for practitioners to identify risks and

develop risk-response plans in URPS. This finding helps practitioners to better understand the potential social risks related to housing demolition. Secondly, the SNA model established in this study can be used to evaluate and identify critical risks based on a network and system viewpoint. The potential impacts of different social risks were quantified through network analysis. Therefore, more attentions can be effectively paid to these most important risks that significantly affect URPS. Thirdly, this study took stakeholder groups into consideration when analyzing social risks. This work can help practitioners identify and coordinate key stakeholders that have strong relations with social risks. Since the conflicts of interests among different stakeholders have become a primary source of social risks (Yang and Shen, 2012), this study can improve the efficiency of social risk management via enhancing stakeholder management. Finally, five risk mitigation strategies were proposed via interview and validated via simulation. These strategies can be applied to reduce the negative impacts of social risks in URPS. More important, practitioners can use the simulation approach to evaluate other potential risk-mitigation strategies in their projects.

6.2. Limitations and future research

The main limitations of this study include: 1) the identification of social risks and linkages was conducted based on the knowledge of 36 interviewees. Due to the complexity and uniqueness of URPS, this survey may not cover all of the potential conditions and social risks at the housing demolition stage of URPS. Practitioners may meet new challenges or network

structures that were not identified in this study. 2) The evaluation on the risk-mitigation strategies were carried out based on a theoretical assumption and simulation without empirical tests. 3) This study employed a small-sample survey. The sample size may affect the robustness of our findings. However, this limitation does not completely diminish the contribution of this study because the tendency of a network can be captured via in-depth interviews with representative stakeholders (e.g., Li et al., 2016). Due to the lack of a database, developing a network model based on big data is extremely difficult for researchers in the field of urban redevelopment.

Further research opportunities of this study should focus on the following four aspects: 1) Empirical studies should be conducted to test the generalization and effectiveness of the five solutions proposed by this study because the performance of these solutions was evaluated based on theoretical assumptions and simulations; 2) The time span of this study can be extended to the life cycle of URPS including decision-making, housing demolition, construction, operation and re-demolition stages; 3) A framework that integrates other types of risks (economic risks) with this study should be developed to facilitate the overall risk management during the housing demolition stage of URPS because this study largely focuses on social risks; and 4) Large-sample analyses can be conducted to identify more potential risks and interactions in different cases if a database pertaining to URPS can be developed in the future.

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

Appendix: Key Types of Interview Questions

Goal 1: identification of social risks. We sent an email to each interviewee before this research step. The email briefly described the background and purposes of this study.

Interview questions:

1. What are the major risks that may cause social conflicts during the housing demolition stage of URPS?
2. In the latest urban redevelopment project that you experienced, can you list some social risks at the housing demolition stage?
3. Can you propose additional social risks that are not presented in the risk list (in the third question, the researchers showed each interviewee a risk list compiled based on existing literature, i.e., risks identified by literature in table 1; in the first and second questions, the researcher did not display this list)?
4. How can these additional risks affect the benefits of stakeholders and the performance of projects at the housing demolition stage?
5. In the latest redevelopment project that you experienced, how did these additional risks affect the benefits of stakeholders and the performance of this project?
6. Which risks (in Table 1) may be associated with you in urban redevelopment projects?
7. In the latest redevelopment project that you experienced, how did these risks affect you? How did you influence these risks?

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

Goal 2: identification of inter-relationships. We sent the social risks listed in Table 1 to each interviewee before this research step.

Interview questions:

8. Can risk S_aR_b significantly affect S_cR_d during the housing demolition stage of URPS?
9. If S_aR_b impacts S_cR_d, what is the likelihood of this potential effect (the likelihood of the link)?
10. If S_aR_b impacts S_cR_d, to what degree can S_aR_b influence S_cR_d (the degree of influence)?

Goal 3: identification of risk mitigation strategies. We sent the critical risks presented in Table 5 to each interviewee before this research step.

Interview questions:

11. Based on the perspective of stakeholder management, what can be done to mitigate challenge i (i=1,2,3,4,5,6)?
12. If you are a senior manager in an urban redevelopment project, how can you deal with challenge i (i=1,2,3,4,5,6)?
13. If you are a senior official in the local government, what measures can you take to deal with challenge i (i=1,2,3,4,5,6)?
14. In the latest urban redevelopment project that you experienced, what measures were

adopted to deal with challenge i (i=1,2,3,4,5,6)?

Reference

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.

Alpopi, C., Manole, C. (2013). "Integrated urban regeneration–solution for cities revitalize". Procedia Economics and Finance 6, 178-185.

Becker, H. A. (2001). "Social impact assessment". European Journal of Operational Research, 128(2), 311-321.

Beijing Cailiang Law Firm (2015), “2014: Annual Report of Urban Housing Demolition in China”. Online source [accessed 01/02/2015]: http://www.cai-liang.com/view.asp?/1893.html

Brinkmann, S. (2014). "Interview". Springer.

Chen, C., Yu, W., 2011. "Social Risk and Management of City Demolition", Conference on Web Based Business Management (WBM2011), Wuhan University, Scientific Research Publishing, Engineering Information Institute

Chen, L., Tan, J., Wu, K., Li, M. (2012). "Social Risk Assessment of Demolition Projects——An Empirical Study of Guangzhou Municipality". Journal of Guangzhou University (Social Science Edition) 3, 014.

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

China Academic of Building Research (2014). “Researches on Building Demolition Management Policy”. 17-02-2014

Chinowsky, P., Diekmann, J., & Galotti, V. (2008). "Social network model of construction". Journal of construction engineering and management, 134(10), 804-812.

Chu, C. (2008). "The myths and politics of housing in Hong Kong: the controversy over the demolition of the Hunghom Estate". Habitat International 32, 375-383.

Chung, H., Zhou, S.-H. (2011). "Planning for plural groups? Villages-in-the-city redevelopment in Guangzhou City, China". International Planning Studies 16, 333-353.

Harvey, T.B., John (2001). "Housing renewal and mental health: a case study". Journal of Mental Health 10, 571-583.

He, X. (2014). "Maintaining Stability by Law: Protest‐Supported Housing Demolition Litigation and Social Change in China". Law & Social Inquiry 39, 849-873.

Hu, Y., Hooimeijer, P., Bolt, G., Sun, D. (2015). "Uneven compensation and relocation for displaced residents: The case of Nanjing". Habitat International 47, 83-92.

Jia, J.P., He, X.Q., Jin, Y.J. (2012.). Statistics. Beijing. China Remin University Press.

Jiang, J. (2014). "Social Risk of Policy Implementation in Local Governments: a Multi-Case Analysis on P District's Policies on Housing Relocation". Comparative Economic & Social Systems, 148-156.

Keene, D.E., Geronimus, A.T. (2011). "“Weathering” HOPE VI: the importance of evaluating the population health impact of public housing demolition and displacement". Journal of Urban Health 88, 417-435.

Kytle, B., Ruggie, J.G. (2005). "Corporate Social Responsibility as Risk Management. John F

Kennedy School of Government". Harvard University, Boston, MA.

Li, C.Z., Hong, J., Xue, F., Shen, G.Q., Xu, X., Mok, M.K. (2016). "Schedule risks in prefabrication housing production in Hong Kong: a social network analysis". Journal of Cleaner Production.

Li, L.H., Lin, J., Li, X., Wu, F. (2014). "Redevelopment of urban village in China–A step towards an effective urban policy? A case study of Liede village in Guangzhou". Habitat International 43, 299-308.

Li, T. H., Ng, S. T., Skitmore, M. (2013). "Evaluating stakeholder satisfaction during public participation in major infrastructure and construction projects: A fuzzy approach". Automation in construction, 29, 123-135.

Liu, Z.-z., Zhu, Z.-w., Wang, H.-j., Huang, J. (2016). "Handling social risks in government-driven mega project: An empirical case study from West China". International Journal of Project Management 34, 202-218.

Lin, Y., Zhang, X., Geertman, S. (2015). "Toward smart governance and social sustainability for Chinese migrant communities". Journal of Cleaner Production, 107, 389-399.

Mitchell, R. K., Agle, B. R., & Wood, D. J. (1997). "Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts". Academy of management review, 22(4), 853-886.

Mitchell, J. C. (1969). "The concept and use of social networks". Bobbs-Merrill.

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., & Li, C. Z. (2017). "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.

Moreno, J. L. (1960). "The sociometry reader", The Free Press, Glencoe,Ill.

Ni, L., 2015. "Research on Risk Management Binjiang Land Expropriation and Resettlement Project". University of South China, Nanjing.

Parise, S. (2007). "Knowledge management and human resource development: An application in social network analysis methods". Advances in Developing Human Resources 9, 359-383.

Peng, Y., Lai, Y., Li, X., Zhang, X. (2015). "An alternative model for measuring the sustainability of urban regeneration: the way forward". Journal of Cleaner Production 109, 76-83.

Project Management Institute (2013). "A Guide to the Project Management Body of Knowledge (PMBOK® Guide)". 4th ed. PMI, Newtown Square, PA.

Rabito, F., Iqbal, S., Shorter, C., Osman, P., Philips, P., Langlois, E., White, L. (2007). "The association between demolition activity and children's blood lead levels". Environmental research 103, 345-351.

Rowley, T. J. (1997). "Moving beyond dyadic ties: A network theory of stakeholder influences". Academy of management Review, 22(4), 887-910.

Ruan, X., Ochieng, E. G., Price, A. D., & Egbu, C. O. (2012). "Knowledge integration process in construction projects: a social network analysis approach to compare competitive and

collaborative working". Construction Management and Economics, 30(1), 5-19.

Schmidt–Soltau, K. (2003). "Conservation–related Resettlement in Central Africa: Environmental and Social Risks". Development and change 34, 525-551.

Shi, Q., Liu, Y., Zuo, J., Pan, N., Ma, G. (2015). "On the management of social risks of hydraulic infrastructure projects in China: A case study". International Journal of Project Management 33, 483-496.

Shih, M. (2010). "The Evolving Law of Disputed Relocation: Constructing Inner‐City Renewal Practices in Shanghai, 1990‐2005". International Journal of Urban and Regional Research 34, 350-364.

Shin, H.B. (2009). "Residential redevelopment and the entrepreneurial local state: The implications of Beijing's shifting emphasis on urban redevelopment policies". Urban Studies 46, 2815-2839.

Talen, E. (2014). "Housing demolition during urban renewal". City & Community 13, 233-253.

Teng, S. (2013). "The Risk and Governance of the Vulnerable Group in the City Demolition Advancement". Economy and Management 3, 002.

The State Council of the People's Republic of China (2011). "Regulations on the Expropriation and Compensation of Houses on State Owned Land". Online source [accessed 21/01/2011]: http://www.gov.cn/flfg/2011-01/21/content_1791480.htm

Tichy, N. M., Tushman, M. L., & Fombrun, C. (1979). "Social network analysis for organizations". Academy of management review, 4(4), 507-519.

Ward, S., & Chapman, C. (2008). "Stakeholders and uncertainty management in projects.

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

Construction Management and Economics". 26(6), 563-577.

Wang, H., Shen, Q., Tang, B.-s., Lu, C., Peng, Y., Tang, L. (2014). "A framework of decision-making factors and supporting information for facilitating sustainable site planning in urban renewal projects". Cities 40, 44-55.

Wasserman, S., Faust, K. (1994). "Social network analysis: Methods and applications". Cambridge university press. UK.

Wasserman, S., Galaskiewicz, J., 1994. Advances in Social Network Analysis: Research in the Social and Behavioral Sciences. Sage, CA.

Wu, F. (2004). "Residential relocation under market-oriented redevelopment: the process and outcomes in urban China". Geoforum 35, 453-470.

Xue, C., Zheng, X., Zhang, B., Yuan, Z. (2015). "Evolution of a multidimensional architectural landscape under urban regeneration: A case study of Jinan, China". Ecological Indicators 55, 12-22.

Yang, F., Shen, K. (2012). "A Study on the System Construction about Social Stability Risk Assessment of Housing Demolition". Journal of Nanchang University (Humanities and Social Sciences) 43, 51-56.

Yang, R.J., Zou, P.X. (2014). "Stakeholder-associated risks and their interactions in complex green building projects: A social network model". Building and environment 73, 208-222.

Yang, R.J., Zou, P.X., Wang, J. (2016). "Modelling stakeholder-associated risk networks in green building projects". International journal of project management 34, 66-81.

Yang, Y. R., Chang, C. H. (2007). "An urban regeneration regime in China: A case study of

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

urban redevelopment in Shanghai's Taipingqiao area." Urban Studies, 44(9), 1809-1826.

Ye, L. (2011). "Urban regeneration in China: Policy, development, and issues". Local Economy 26, 337-347.

Zhang, X., Hu, J., Skitmore, M., Leung, B.Y. (2014). "Inner-city urban redevelopment in China metropolises and the emergence of gentrification: Case of Yuexiu, Guangzhou". Journal of Urban Planning and Development 140, 05014004.

Zhang, P. C. (2014). "Research on the problems and solutions in the process of Urban Housing Demolition". Chongqing University, Chongqing.

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

Figure List

Fig.1. Research method

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

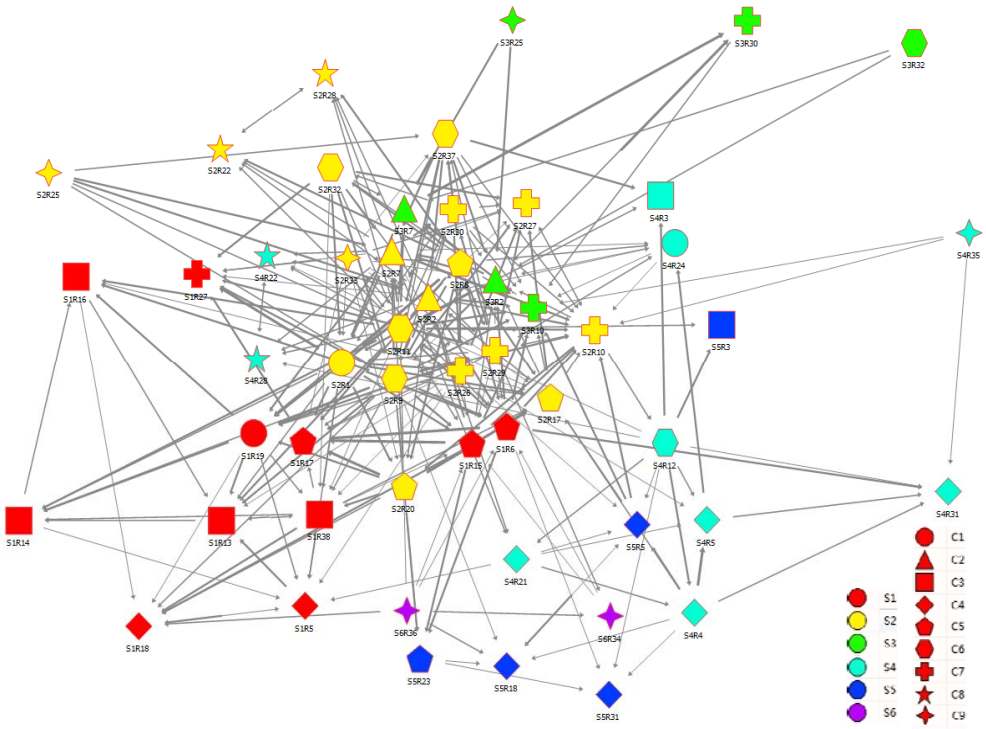

Fig.2. Stakeholder-associated social risk network

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

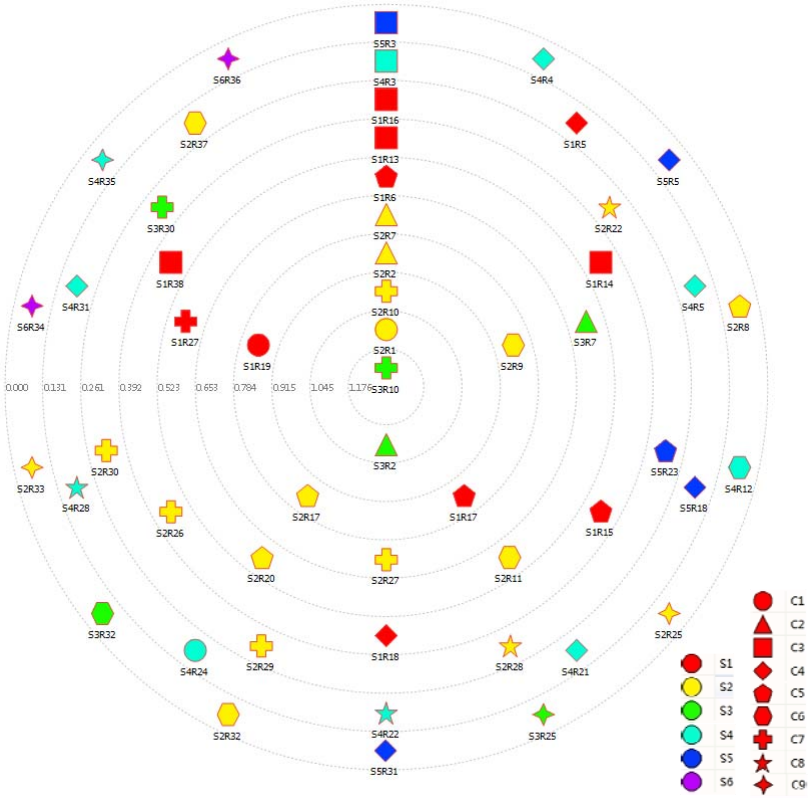

Fig.3. Risk locations in the status centrality map

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

Fig.4. Framework for understanding and mitigating social risks

Fig.5. Key steps of the evaluation on risk-mitigation solutions

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

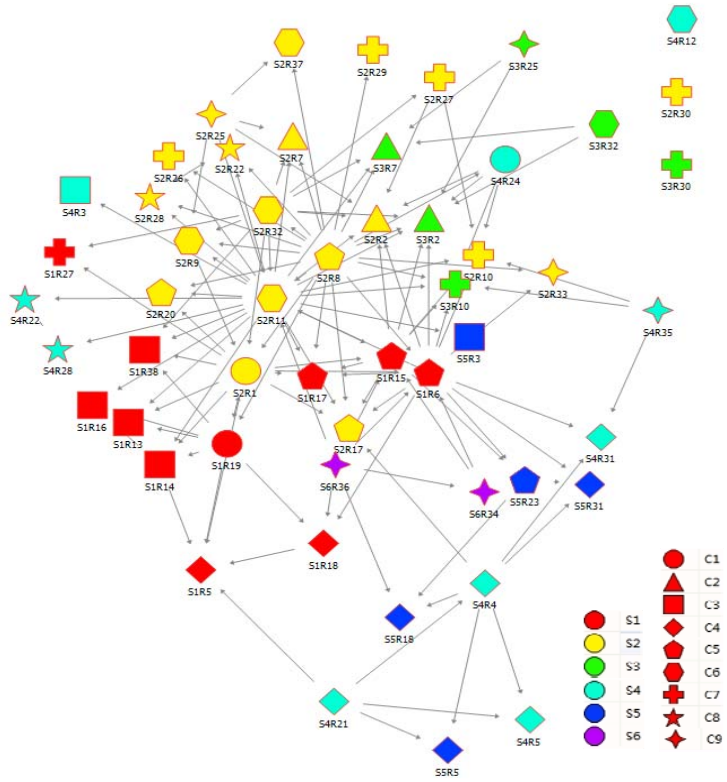

Fig.6. Risk network after mitigating critical risks and interactions

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

Table list

Table 1 Social risks and corresponding stakeholders

Risk ID	Stakeholder node	Risk node	Risk name	Source	Category
S1R1	S1	R1	Unfair compensation for housing demolition and relocation	Chen et al. (2012); Shi et al. (2015)	C1
S2R2	S2	R2	Cost overrun	Ni (2015)	C2
S3R2	S3				
S4R3	S4	R3	Traffic jams and congestion	Chen and Yu (2011)	C3
S5R3	S5				
S4R4	S4	R4	Environment pollution	Yang and Shen (2012); Ni (2015); Chu (2008)	C4
S1R5	S1	R5	Health risk	Schmidt–Soltau (2003);	C4
S4R5	S4			Rabito et al. (2007);	

S5R5	S5			Keene and Geronimus (2011)	
S1R6	S1	R6	Violent incidents because of forced demolition	Chen and Yu (2011)	C5
S2R7	S2	R7	Lack of funds	Yang and Shen (2012)	C2
S3R7	S3				
S2R8	S2	R8	Government corruption and adverse impacts on the creditability of governments	Chen and Yu (2011); Ni (2015)	C5
S2R9	S2	R9	Unreasonable relocation and compensation schemes	Chen et al. (2012); Jiang (2014); Yang and Shen (2012); Shi et al. (2015); Liu et al. (2016)	C6
S2R10	S2	R10	Schedule risk	Ni (2015)	C6
S3R10	S3				
S2R11	S2	R11	Changes in master plans because of unreasonable decision-making	Interview	C6
S4R12	S4	R12	Technical errors in demolition schemes	Interview	C6

S1R13	S1	R13	Unemployment problem	Teng (2013); Chen and Yu (2011); Schmidt–Soltau (2003)	C3
S1R14	S1	R14	Unavailability to public facilities (e.g., school, hospital, public space and so on)	Teng (2013); Chen et al. (2012); Jiang (2014); Schmidt–Soltau (2003)	C3
S1R15	S1	R15	Mass incidents	Teng (2013); Chen and Yu (2011)	C5
S1R16	S1	R16	Adverse impacts on social support networks (e.g., reducing social relationships)	Teng (2013); Chen and Yu (2011); Jiang (2014); Schmidt–Soltau (2003)	C3
S1R17	S1	R17	Legal disputes	He (2014); Ni (2015)	C5
S2R17	S2				
S1R18	S1	R18	Psychological problems	Keene and Geronimus (2011); Harvey (2001)	C4
S5R18	S5				
S1R19	S1	R19	Insufficient protection for vulnerable groups	Teng (2013); Yang and Shen (2012)	C1
S2R20	S2	R20	Illegal demolition	Yang and Shen (2012); Ni (2015)	C5

S4R21	S4	R21	Ineffective waste disposal	Interview	C4
S2R22	S2	R22	Insufficient preservation	Interview	C8
S4R22	S4		of urban image		
S5R23	S5	R23	Security risk (e.g., a rising	Yang and Shen (2012); Ni	C5
			crime rate)	(2015)	
S4R24	S4	R24	Labor strikes because of	Interview	C1
			unfair remuneration or		
			treatment		
S2R25	S2	R25	Uncertainties in housing	Ni (2015)	C9
S3R25	S3		price		
S2R26	S2	R26	A lack of information on	Yang and Shen (2012)	C7
			key stakeholders'		
			interests		
S1R27	S1	R27	Uncertainties in	Yang and Shen (2012); Ni	C7
S2R27	S2		relocation negotiation	(2015)	
			because of insufficient		
			information		
S2R28	S2	R28	Insufficient preservation	Interview	C8
S4R28	S4		of cultural heritage		
S2R29	S2	R29	Insufficient information	Teng (2013); Chen and Yu	C7
			exchange	(2011); Yang and Shen	

			among different stakeholders	(2012)	
S2R30	S2	R30	A lack of data for decision-making	Interview	C7
S3R30	S3				
S4R31	S4	R31	Safety risk	Ni (2015)	C4
S5R31	S5				
S2R32	S2	R32	Unreasonable evaluations on housing price	Ni (2015)	C6
S3R32	S3				
S2R33	S2	R33	Variations in policies or compensation standards	Jiang (2014); Yang and Shen (2012); Ni (2015);Liu et al. (2016)	C9
S6R34	S6	R34	Cultural conflicts	Yang and Shen (2012)	C9
S4R35	S4	R35	Uncertainties in weather and environment	Ni (2015)	C9
S6R36	S6	R36	Negative attitudes of local residents towards urban redevelopment	Yang and Shen (2012); Ni (2015);Chu (2008)	C9
S2R37	S2	R37	Unreasonable feasibility studies	Yang and Shen (2012)	C6
S1R38	S1	R38	Homelessness	Schmidt–Soltau (2003)	C3

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

Table 2 Ranking of critical risks based on status centrality, ego network and nodal degree analyses

Ranking	Risk ID	Out-Status Centrality	Risk ID	Ego size	Risk ID	Out-Degree	Risk ID	Degree Difference
1	S2R8	2.4	S2R9	31	S2R9	25	S2R8	21
2	S2R9	2.3	S2R11	31	S2R11	22	S2R29	15
3	S2R2	1.4	S2R2	28	S2R8	21	S2R9	11
4	S1R6	1.2	S2R7	25	S2R29	19	S2R11	11
5	S2R7	1.2	S1R1	22	S2R2	18	S4R12	9
6	S2R11	1.2	S3R2	21	S2R7	17	S2R33	9
7	S2R29	1.0	S1R6	21	S2R26	15	S2R7	8
8	S1R1	0.9	S2R8	21	S1R6	13	S2R26	8
9	S2R32	0.9	S2R29	21	S2R33	11	S2R30	8
10	S2R37	0.9	S2R26	20	S2R30	11	S2R32	8
11	S1R15	0.8	S2R17	18	S1R1	11	S6R36	6
12	S2R26	0.8	S2R10	17	S4R12	10	S2R25	5
13	S2R30	0.8	S3R10	17	S2R32	10	S4R4	4
14	S2R20	0.7	S1R15	17	S2R37	9	S1R6	4
15	S3R2	0.6	S2R20	16	S2R20	8	S2R37	4

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

Table 3 Ranking of critical risks based on brokerage analysis

Ranking	Risk ID	Coordinator	Gatekeeper	Representative	Itinerant	Liaison	Total
1	S2R9	49	16	131	1	24	221
2	S2R2	66	27	68	7	10	178
3	S2R11	40	15	84	4	17	160
4	S2R7	35	16	31	0	12	94
5	S1R1	8	6	50	4	18	86
6	S1R6	1	8	4	14	41	68
7	S3R2	7	26	12	10	9	64
8	S2R26	8	0	49	0	0	57
9	S2R10	16	22	11	2	5	56
10	S2R20	3	0	35	0	0	38
11	S1R15	1	3	5	6	22	37
12	S2R17	12	10	7	0	5	34
13	S1R19	0	33	0	1	0	34
14	S2R29	15	0	18	0	0	33
15	S1R38	6	15	2	1	0	24

Table 4 Ranking of critical risks and interactions based on betweenness centrality

Ranking	Interaction ID	Link Betweenness Centrality	Risk	Node Betweenness

Yu T., Shen G.Q.P., Shi Q., Xu K.X. (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, 36(6), 925-941, DOI: 10.1016/j.ijproman.2017.04.004, August.

			ID	Centrality
1	S1R13→S1R38	213.3	S2R2	0.1392
2	S5R5→S2R10	150.2	S2R10	0.1307
3	S1R38→S1R15	143.9	S2R9	0.1051
4	S2R10→S4R12	129.6	S3R2	0.0862
5	S2R17→S2R2	120.1	S1R38	0.0844
6	S1R5→S1R13	117.3	S2R17	0.0689
7	S1R38→S2R17	101.5	S1R15	0.0673
8	S5R18→S5R5	96.6	S1R13	0.0667
9	S2R10→S2R29	94.1	S1R6	0.0667
10	S3R2→S2R9	90.0	S5R5	0.0555
11	S1R15→S2R2	83.9	S2R11	0.0491
12	S2R10→S2R9	76.1	S2R7	0.0466
13	S3R2→S2R7	74.8	S1R1	0.0382
14	S1R16→S1R13	65.5	S2R29	0.0358
15	S2R2→S2R30	62.9	S4R12	0.0330

Table 5 Identification of critical risks and challenges based on integrating multiple network metrics

Critical risks/	Associated critical	Primary Challenges and description

interactions	**stakeholder**	
S5R5→S2R10	Nearby residents	1. A lack of social security. The sources of the links in this challenge are social risks in C3 and C4. These include health problems, homelessness, unemployment problems, and adverse impacts on social support network. These social risks can adversely affect the basic living conditions of key stakeholders and incur social unrests. URPS can significantly change the lifestyles and living conditions of relocated residents and nearby households. For example, relocated residents may move to new places far from their workplaces. Sometimes, they have to give up their previous jobs. Therefore, social security schemes that aim to maintain the basic quality of life of these two stakeholder groups must be well designed and carried into action.
S1R5→S1R13	Relocated residents	
S1R13→S1R38	Relocated residents	
S1R16→S1R13	Relocated residents	
S1R38→S1R15	Relocated residents	
S1R38→S2R17	Relocated residents	
S5R18→S5R5	Nearby residents	
S2R26	Governments	2. Information challenges. All of the social risks in this challenge belong to C7 (a lack of information). This challenge illustrates the difficulties in carrying out information sharing among different participants and collecting stakeholder-related information for decision-making, during the housing demolition stage of URPS. Although *RECHSOL* stipulates that governments should actively collect the opinions of key stakeholders (The
S2R29	Governments	
S2R30	Governments	

		State Council of the People's Republic of China, 2011), this policy does not propose any effective approaches to facilitate the information collection. Because housing demolition typically affect a wide range of stakeholders, it is difficult to acquire stakeholder-related information.
S2R2 S3R2 S2R7 S3R2→S2R7 S3R2→S2R9 S2R2→S2R30	Governments Developers Governments Governments Governments Governments	3. Challenges to financial management. The social risks (the critical risks and the sources of the links) in this challenge belong to C2 (financial risk). Housing demolition requires large amounts of funds to compensate for the economic losses of relocated residents (Ni, 2015). To protect the benefits of vulnerable groups, *RECHSOL* stipulates that governments must raise sufficient funds for relocation compensation before carrying out any demolition activities. Therefore, governments have to achieve a large amount of funds in a relatively short period. In addition, due to the uncertainties in housing price and compensation negotiation, URPS also suffer from cost overruns during the demolition stage (Ni, 2015). These potential risks present a challenge to the financial management of URPS.
S2R11 S2R9 S4R12	Governments Governments Demolition crews	4. Difficulties in decision-making. Most social risks in this challenge are caused by unreasonable decisions (C6) made by governments or demolition crews. Housing demolition is a

S2R37	Governments	complex process involving a wide range of stakeholders with various interests (Zhang, 2014). This process can influence the environment, society and economy of a city. Therefore, reasonable decisions must be made to take the multi-dimensional impacts of housing demolition into consideration. However, due to the complexity of housing demolition, it is very difficult for decision-makers to develop reasonable schemes (Zhang, 2014). More importantly, existing policies and laws fail to propose effective decision-making tools to improve decisions related to housing demolition.
S2R10→S2R29	Governments	
S2R10→S4R12	Governments	
S2R10→S2R9	Governments	
S2R17	Governments	5. Legal disputes and uncertainties in policies. Social risks in this challenge are typically induced by illegal actions (C5) or variations in policies (C9). Due to ineffective policies related to URPS, governments and relocated residents can be easily swept into legal disputes (He, 2014). For example, existing policies stipulate that housing demolition must conform to public interests. However, the scope of public interests is not clearly identified in *RECHSOL or Property Law.* Therefore, illegal demolition can be carried out in the name of public interests (Shih, 2010). In addition, uncertainties or variations in policies can also give rise to social risks. For example, the variations in
S2R20	Governments	
S2R33	Governments	
S2R17→S2R2	Governments	

		official compensation standards can incur serious conflicts between governments and relocated residents. Such social risks can adversely affect the performance of URPS and even terminate the implementation of URPS.
S1R6	Relocated residents	6. Impulsive behaviors of relocated residents. Due to sharp conflicts of interests among different stakeholders and ineffective policies, the property rights of relocated residents have not been well protected in many cases. Under extreme conditions, relocated households resort to violent resistance against housing demolition (C5), a fact that has threatened the social stability of China (Beijing Cailiang Law Firm, 2015). Such social risks can adversely affect the performance of URPS.
S1R15	Relocated residents	
S1R15→S2R2	Relocated residents	