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Evaluating Social Sustainability of Urban Housing Demolition in Shanghai, China

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Abstract: In China, urban housing demolition increasingly challenges the maintenance of social sustainability. Social sustainability is a multi-dimensional concept that contains complex implications. Therefore, an assessment system that considers a range of key social indicators could substantially simplify this concept and improve decision-making pertaining to sustainability practices. However, no such system exists in studies on housing demolition. To bridge this gap, this study sought to develop an assessment system for measuring the social sustainability of urban housing demolition. Firstly, an interview-based pilot study was conducted with scholars and practitioners to develop an optional list of indicators that reflect social sustainability. Subsequently, these indicators were validated via focus group meetings with key stakeholders in housing demolition programs. In addition, a two-wave questionnaire was designed to collect data to quantitatively analyze these sustainability indicators. Based on the questionnaire data, the indicators were ranked according to their relative importance and classified into five categories. Finally, the score of social sustainability of Shanghai was calculated to examine the impact of current housing demolition practices. The results showed that health and safety, social equality, and adherence to the law were the most critical dimensions that determined the social sustainability of urban housing demolition in Shanghai. The authors also found that to achieve greater social sustainability, existing housing demolition practices should be modified to reduce the negative impacts on the daily lives of residents that lived near demolition sites.

Keywords: focus group; pilot study; social sustainability; two-wave questionnaire survey; urban housing demolition

1. Introduction

Recent decades have witnessed an unprecedented urban-redevelopment process largely driven by local governments and property developers to promote economic growth in China. As a result,

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an enormous number of urban housing demolition (UHD) projects have been carried out and will continue to occur in the future. From 2011-2013, 345 – 460 million square meters of buildings were demolished every year ([China Academic of Building Research, 2014](#)). The majority of these buildings were residential ones. According to recent analysis¹, 1.32 – 1.60 billion square meters of housing are predicted to be demolished between 2015 and 2020. In UHD programs, millions of people have to leave their homes and move to new places. The *2014 Annual Report of Urban Housing Demolition in China* ([Beijing Cailiang Law Firm, 2015](#)) noted that more than 20% of urban residents had already experienced housing demolition in recent decades. This UHD process will persist a long time into the future because the *13th Five Year Plan* (the most important economic policy in China) emphasizes that China will actively promote urbanization that focuses on developing new towns, optimizing the existing layout of urban space and updating the infrastructure-housing system of cities.

To some degree, these UHD programs undoubtedly make a contribution to the economic growth of Chinese cities and provide better living conditions for urban residents ([Tang, 2007](#)). Meanwhile, housing demolition has also become a primary source of social conflicts in contemporary China ([He and Wu, 2005; He, 2014](#)). Based on official statistics, [Southern Weekend \(2003\)](#) reported that 26 people lost their lives due to violent conflicts over housing demolition in the first half of 2002. As a result of ineffective policies, the property rights of many displaced residents have not been well protected. Under extreme conditions, displaced households resort to violent resistance against UHD programs, a fact that has threatened the social sustainability of China ([Beijing Cailiang Law Firm, 2015](#)). This situation is compounded by the sharp increase in mass incidents related to UHD. In 2010, approximately 180,000 mass incidents occurred in China; more than half of these incidents were caused by housing demolition ([Jacobs, 2011](#)). In the last five years, courts at various levels in China have received approximately 800,000 cases of administrative disputes; more than 40% of them were due to housing demolition ([Beijing Cailiang Law Firm, 2016](#)). Considerable evidence shows that it is time to pay more attention to the social sustainability of UHD in China.

Numerous studies have been conducted to improve the social sustainability of UHD programs. For example, [Hu et al. \(2015\)](#) carried out residential surveys to investigate uneven compensation in Nanjing from two perspectives: compensation approaches and purchasing discounts on compensated affordable housing. This study provides valuable insights into improving existing relocation policies to reduce unfairness in UHD. [Farfel et al. \(2005\)](#) evaluated the adverse impacts of housing demolition on public health in East Baltimore. Effective measures must be taken to safeguard the well-being of surrounding residents and demolition crews. [Shih \(2010\)](#) examined

¹ The source of this analysis is <http://money.163.com/15/0825/10/B1S0FQUK00253B0H.html>. Chinese governments do not disclose statistical data related to UHD in their official reports. Therefore, most data presented in [Sections 1 and 2](#) are based on the evaluations of scholars or industrial professionals. Some current data about social issues of UHD may not be available (e.g., the death toll within the last five years).

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the legal system related to UHD in Shanghai. This scholar argued that existing laws should be modified to reduce violent incidents and social conflicts pertaining to UHD. In Atlanta, [Keene and Ruel \(2013\)](#) evaluated the impacts of UHD on the lifestyle of older adults. Some interviewees during this survey argued that their sense of belonging was significantly reduced after the relocation. In America, [Talen \(2014\)](#) analyzed the government-backed UHD during the mid-20 century. Via testing the impacts of UHD on racial containment, this author found that the improvement on racial issues was not very significant. [Goetz \(2000\)](#) investigated the UHD programs in the high-poverty neighborhoods of Minneapolis-Saint Paul. This study found that UHD could lead to political battles because the poor and minority groups did not want to lose their communities from the slum clearance.

These studies have contributed to settling social sustainability issues in UHD programs. However, very few studies have set up a systematic assessment system to evaluate the social sustainability of UHD programs in a Chinese context. Social sustainability is a typical multi-dimensional concept with complex implications ([Enyedi, 2002](#); [Omann and Spangenberg, 2002](#)). Therefore, an assessment system that takes various social factors into consideration is very useful for practitioners to judge the overall level of social sustainability ([Omann and Spangenberg, 2002](#); [Liu et al., 2013](#)). In addition, such an assessment system can provide a key-point checklist for practitioners to balance the interests of various stakeholders and reduce social conflicts in practice. More importantly, such a system can be used to rank the relative importance of different indicators on social sustainability. As a result, the most critical indicators can be paid attentions to and be improved accordingly. However, it is surprising that previous studies have not provided such a tool for measuring the social sustainability of UHD.

To bridge this gap, this study sought to develop an assessment system to evaluate the social sustainability of UHD programs in Shanghai based on a stakeholder perspective. Research pertaining to Shanghai can help to address the same issues in other large Chinese cities because Shanghai is an advanced and typical city in China that has experienced large-scale housing demolition in recent decades. Although an exemplar case cannot yield general theories that are applicable to all the potential conditions, it can provide valuable insights and empirical support for research issues that have not been well analyzed ([Yin, 2008](#)). With the development of grounded theory, the study of exemplar cases can be used as an explorative tool to build theories in different economic activities ([Eisenhardt and Graebner, 2007](#)). Therefore, it is also expected that this study contributes to the current body of knowledge pertaining to sustainability assessment of UHD.

2. Literature Review and Background Information

2.1. Assessment Tools for Evaluating Social Sustainability

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The World Commission on Environment and Development defined sustainable development as "...the development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs (WCED, 1987)." Although the implication of sustainable development varies according to the interests, culture and needs of different areas, a mainstream way of picturing sustainable development is to think of it as a stool with three legs representing environment, economy and society (Scottish Environment Protection Agency, 2003). As a result, economic, environmental and social sustainability become three basic dimensions for measuring sustainable development. Compared with the other dimensions, social sustainability has most often been ignored when developing future scenarios (Omann and Spangenberg, 2002) because social sustainability cannot be easily calibrated.

To address this issue, many scholars have attempted to employ evaluation tools such as social impact assessment (SIA) and social life cycle assessment (SLCA) to measure the social sustainability of various economic activities (e.g., Becker, 2001; Dong and Ng, 2015). Social impact assessment refers to "assessing (as in measuring or summarizing) a broad range of impacts (or effects, or consequences) that are likely to be experienced by an equally broad range of social groups as a result of some course of action (Freudenburg, 1986)." The primary steps of SIA typically include (Becker, 2001): design of scenarios, strategy development, impact assessment, ranking of strategies, reduction of negative impacts, reporting, stimulation of implement, and auditing an ex-post assessment. As an extension of environmental life cycle assessment (ELCA), SLCA is also widely applied by many scholars to evaluate social sustainability. Compared with ELCA, SLCA also covers four phases, namely, (1) definition of goal and scope, (2) inventory analysis, (3) impact assessment and (4) interpretation (Benoît and Mazijn, 2009). It is likely that SIA and SLCA are the most widely applied tools in the assessment of social sustainability. Some international organizations or governments have even developed official standards for conducting SIA and SLCA (e.g., ISO14040/44).

Besides SIA and SLCA, there are also many other methods that can be used to evaluate social sustainability. For example, Aspinall et al. (2011) employed quality of life assessment to evaluate the social sustainability of tourism development. This author designed 24 questions on community, family, social life, personal health and wealth for measuring social sustainability. Liu et al. (2013) used Human Development Index to measure the social sustainability of a coastal area in Liaoning Province. This index contained three variables, i.e., GNP per capita, life expectancy at birth and education level. In a study by Dempsey et al. (2011), social equity and the sustainability of community were used to measure the level of social sustainability. In terms of social equity, Dempsey et al. (2011) argued that exclusionary or discriminatory rules hindering individuals from participating in social activities or achieving social resources should be mitigated by political means. In terms of the sustainability of community, five factors including social network, participation in collective groups, community stability, sense of place, and safety and

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security were used to calibrate this dimension (Dempsey et al., 2011). In addition, scholars also employed social capital to reflect the status of social sustainability (e.g., Simpson, 2005). Social capital typically included but was not limited to “trust and reciprocity, strong sense of community, shared vision, and outcomes from participation in local and external networks (Simpson, 2005).” Besides these general indicators such as life of quality and Human Development Index, scholars also established specific indicator systems to evaluate social sustainability. For instance, Rajak and Vinodh, (2015) developed an assessment system containing 60 indicators to calibrate the social sustainability of an Indian automotive component manufacturing organization. Landorf (2011) proposed a framework and an indicator system for assessing the social sustainability of historic urban environments in Australia.

Generally speaking, applications of these social sustainability assessment tools typically require integrating empirical data (e.g., gained via interviews or questionnaires) with social sustainability theories (e.g., stakeholder theory). For example, based on a questionnaire survey, Dong and Ng (2015) evaluated the social impacts of construction activities in Hong Kong from a stakeholder perspective. Based on interviews with experts and key stakeholders, Hosseinijou et al. (2014) assessed the social impacts of building material selection. By conducting interviews with experts, Carrera and Mack (2010) developed social sustainability indicators for energy technologies based on a stakeholder perspective. In this study, the authors collected data from interviews, focus group meetings and questionnaire surveys. In terms of a theoretical foundation, the authors also employed a stakeholder perspective, which emphasized that the social sustainability indicators should reflect the key interests of stakeholders and the potential impacts of UHD programs on these stakeholders. Since the core of social sustainability refers to maintaining and improving the well-being of people (Chiu, 2003), stakeholder satisfaction has become a widely applied principle to measure social sustainability. The information input of stakeholders can help to identify social sustainability issues because the evaluation of social sustainability is typically related to the value judgment of people (Veldhuizen, 2015). In practice, considering the opinions from various stakeholders and enhancing stakeholder engagement is also an effective approach for improving social sustainability (Magee et al., 2013). As a result, stakeholder perspective was used in this study. Although previous studies have highlighted the importance of stakeholder principle in social sustainability assessment, this principle has not been applied to evaluate the social sustainability of UHD. Therefore, this study contributed to extending the application of stakeholder principle to the research field of UHD. More important, general social sustainability indicators such as Human Development Index cannot effectively response to the specific characteristics of UHD and the social contexts of China. This study also contributed to proposing a specific indicator system for the UHD programs in China.

2.2. Housing Demolition in Shanghai

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Shanghai is one of the most advanced cities in China that has experienced large-scale urban-redevelopment programs. In the early 1980s, Shanghai was planned to be the economic center of China. Therefore, the redevelopment of shanty towns was high on the agenda of urban development. Prior to 1991, the city government carried out a package of redevelopment policies. Twenty-three plots of land were designated for urban redevelopment (Yang and Chang, 2007). China then experienced an economic transition from a command economy into a market system (Tang, 2007). In Shanghai, new policies for urban redevelopment began to come into force in 1991 (Shih, 2010). One of the central goals of these policies was the “urban renewal project 365,” which aimed to redevelop substandard buildings (Yang and Chang, 2007). Since 2000, the redevelopment of city villages has become a primary task of local governments because these city villages have negatively affected the city image and economic growth of Shanghai. Given limited land space, UHD has become an important approach to release land resources for urban redevelopment. Between 1991 and 1995, approximately 300,000 households experienced UHD programs (Shanghai City Government, 1996). The majority of them were relocated to new neighborhoods. Between 1996 and 2006, the number of displaced households reached 897,332 (Shanghai Statistics Bureau, 2007). From 2000 to 2010, 60.14 million square meters of housing in Shanghai were demolished, which led to a displacement of more than 646,000 households (Shanghai Statistical Bureau, 2011). During the initial phase of urban redevelopment, UHD programs in Shanghai were mainly driven by the local government with the aim of achieving urban modernization. After 2000, UHD has been mainly driven by the property market due to economic reforms (Tang, 2007). Current UHD policies stipulate that property developers should not directly participate in UHD programs because business interests may damage public interests. However, property market still significantly affects the decision-making of governments because property investments have become the primary source of financial support for urban redevelopment (Ye, 2011). In Shanghai, the current implementation of UHD programs must obey the rules in the “*Property Law*,” “*Detailed Regulations on the Expropriation and Compensation of Houses on State Owned Land in Shanghai (DRECHSOLS)*,” “*Land Administration Law of the PRC (LALP)*” and “*Regulations on the Expropriation and Compensation of Houses on State Owned Land (REXHSOL)*.”

To some degree, these UHD programs have made a significant contribution to the urban development of Shanghai and improved the living conditions of local residents. However, several social sustainability issues are also emerging during this process. Thus far, many studies have been conducted to investigate social issues related to UHD. For example, Wu and He (2005) analyzed the unequal allocation of economic interests in the UHD practices of Shanghai. It seems that the unreasonable pursuit of economic growth may damage the key interests of displaced households and other vulnerable groups. From the perspective of law, Shih (2010) argued that housing demolition had become a source of violent incidents and social conflicts in Shanghai. The ineffective law system has resulted in sharp conflicts among governments, property developers and displaced households (Shih, 2010). Based on game theory, Hu et al. (2009) analyzed the

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behaviors of displaced households, property developers and governments in terms of forced demolition and relocation. There are two primary limitations in these studies. Firstly, studies based on game theory mainly focused on theoretical analyses and were difficult to be applied in real UHD cases because the basic assumptions of game theory could differ from the real world. Secondly, very few of these studies have proposed a systematic assessment system to measure the social sustainability of UHD practices. Consequently, the definition of the social sustainability of UHD is still unclear. To bridge these research gaps, this study aimed to develop a comprehensive assessment system that could be easily applied in UHD programs.

3. Methods and Data Collection

3.1. Pilot Study

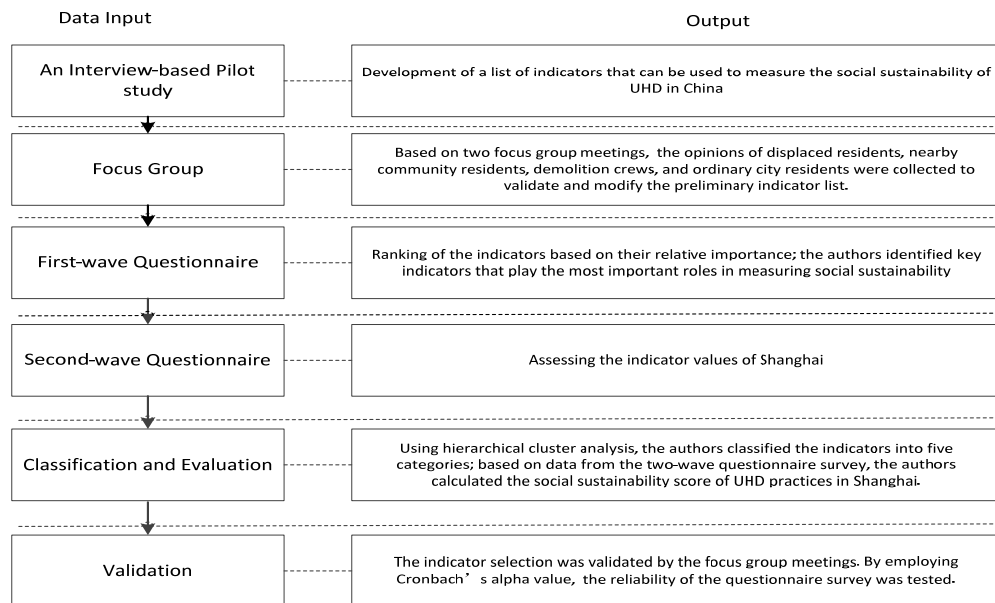


Fig.1 Design of the research

A hybrid research method was employed in this study (see Fig. 1). First, a pilot study based on semi-structured interviews was carried out to develop an optional list of indicators for measuring the social sustainability of UHD in Shanghai (see Fig. 2; following Wang et al., 2010); this work was motivated by the explorative nature of this research. Since the selection of social sustainability indicators is typically founded on practical understandings (Littig and Griessler, 2005), interviews with practitioners were an effective approach for this research. A snowball sampling technique was employed due to the lack of a systematic database of UHD projects in China. The interviewees were targeted based on their knowledge and experience of UHD in

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Shanghai. All of the interviewees possessed more than 5 years of working or research experience in the fields related to UHD. Initial contact was made via telephone and followed up with an e-mail that included a brief description of the research purpose and the interview content. As a result, 45 experts were initially contacted, and 8 of them claimed that they were not qualified to participate due to their insufficient knowledge of UHD or experience with UHD. In addition, 16 of the 45 experts demonstrated limited interest and refused to participate in this research. Therefore, the list of interviewees was cut down to 21. Among the 21 interviewees, 11 were industrial professionals (7 property developers and 4 planners), 5 were government officials (2 from planning departments; 3 from housing and construction departments) and 5 were scholars (from 2 famous universities). These interviewees had worked in Shanghai for more than 3 years. All of them were asked to prepare for their interview by reviewing the UHD projects they had participated in. The key types of interview questions were presented in the supplementary materials (S1.1). These questions focused on stakeholder identification, the key interests of the stakeholders and the factors that could reflect the wellbeing of the stakeholders.

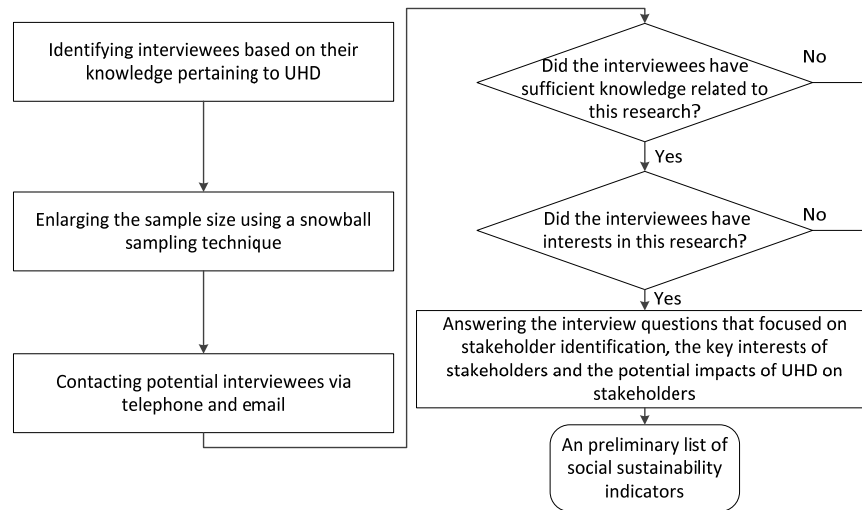


Fig.2 Key steps of the pilot study

3.2. The Rationale of Indicator Selection: A Stakeholder Perspective

As noted in the literature review, many studies have developed social sustainability indicators based on a stakeholder perspective (e.g., [Carrera and Mack, 2010](#); [Dong and Ng, 2015](#); [Veldhuizen et al., 2015](#)). By drawing upon these studies, this study also developed an indicator system from a stakeholder perspective. The pilot study was conducted to identify the primary stakeholders in the Chinese UHD programs, the key interests of these stakeholders and the potential impacts of UHD on these stakeholders. Based on existing literature ([Tang, 2007](#); [Yang and Chang, 2007](#); [Hu et al., 2005](#); [Chen and Tian, 2011](#); [Ho, 2013](#); [He, 2014](#); [Hu et al., 2015](#)), three key types of stakeholders were identified: Local governments, property companies and

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displaced households. Local governments can receive land-transferring fees from UHD; property developers can obtain business profits by demolishing old buildings and replacing them with high-priced ones; displaced households have to move to other places, but they can receive compensation for their relocation. During the interviews, some interviewees argued that UHD programs could also affect the interests of demolition crews, residents living in nearby communities and the general public. For example, demolition crews could receive more job opportunities from large-scale UHD. However, the health of nearby residents and the wider public may be adversely affected due to the construction dust created by UHD programs. In summary, the authors identified six types of stakeholders that were involved in UHD programs: Local governments (S1), property developers (S2), displaced households (S3), demolition crews (S4), residents living in nearby communities (S5) and the general public (S6). The indicator selection was based on the key interests of these stakeholders and the potential impacts of UHD programs on these stakeholders. After the pilot study, a list of 22 indicators for measuring the social sustainability of UHD was compiled (see [Table 1](#)).

3.3. Focus Group

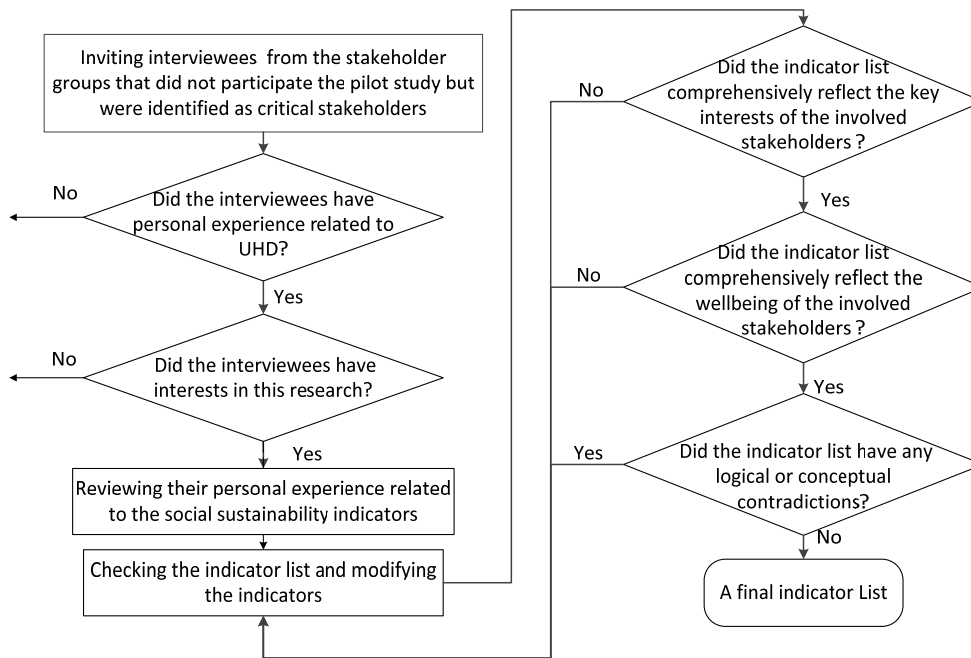


Fig.3 Key steps of the focus group

To validate the indicator list, two focus group meetings were conducted to investigate the opinions of the stakeholders that were identified but not involved in the pilot study. According to [Morgan \(1997\)](#), focus groups can be used as an effective complement to other methods for

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triangulation and validity checking. Moreover, compared with questionnaires and interviews, focus groups can enable researchers to acquire a large amount of information within a relatively short period of time (Gibbs, 1997). Finally, through interactive discussions and knowledge sharing, focus groups can integrate different opinions of various stakeholders and accordingly generate a consistent and holistic viewpoint. Therefore, this research method was applicable to the present study. In all, 8 demolition crews, 8 displaced residents, 6 residents from nearby communities and 6 ordinary city residents (the general public) were involved in the two focus group meetings. The demolition crews were selected from two local building demolition companies. All of the crews had at least three years of working experience. The displaced residents were selected from two resettlement communities that were developed in the last two years. All of them had experienced at least one UHD program within the last five years. The community residents were selected from two neighborhoods close to UHD projects in the Yangpu District. The ordinary city residents involved in this study were randomly selected from the urban area of Shanghai. The protocol of the focus group meetings (see Fig. 3) was consistent with the suggestions of Morgan (1997). Firstly, the indicator list was sent to each participant in the focus group. Stakeholders were interviewed to show their personal experience associated with these indicators. Subsequently, these participants were encouraged to conduct open discussion about social sustainability issues of UHD in order to check the robustness of the indicator list. Modifications were made until these interviewees reached an agreement on the indicator list. The key types of questions in the focus group were presented in the supplementary materials (S1.2).

3.4. Indicator Evaluation, Internal Relations among Different Indicators and Validation

Although the list of indicators was compiled from the pilot study and validated by the focus group meetings, the relative level of importance and the actual values of each indicator of Shanghai were still unknown. A two-wave questionnaire survey (the questionnaires could be found in the supplementary materials, i.e., S1.3) was designed to acquire the unknown information. In this survey, the evaluations of the importance level and the assessments of the indicator value were conducted separately with a time gap of 4 months (02/2015 through 06/2015) to avoid interactions between these two assessments (Podsakoff et al., 2003). In the first-wave questionnaire, the relative importance of each indicator was marked by respondents on a 5-point Likert scale where 5 denoted extremely important, 4 denoted important, 3 denoted less important, 2 denoted unimportant and 1 denoted negligible. In all, 400 questionnaires were distributed via e-mail to: 1) project managers or engineers from 3 construction companies and 3 property companies, 2) designers and planners from 3 design institutes and 2 planning institutes, 3) officials from 3 local government departments (planning, housing and construction, and land management departments) and 4) scholars from 5 local universities. All of these respondents are working in Shanghai. The primary consideration for selecting the target samples was that most of

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these individuals had working experience and professional knowledge regarding UHD in Shanghai. According to [Yang and Shen \(2014\)](#), the depth and the width of stakeholder involvement can significantly influence the final results of decision-making. The key interests of all of the stakeholders should be taken into consideration and reflected in the survey ([Yang and Shen, 2014](#)). However, it was unreasonable to determine the importance and the values of indicators based on the judgments of stakeholders with limited professional knowledge because these stakeholders (i.e., S3, S4, S5, S6) cannot analyze UHD programs from a systematic and holistic perspective. For example, the majority of demolition workers typically did not have any opportunities to deal with social conflicts in UHD programs because their primary work was to complete building demolition activities. Consequently, these demolition crews did not have sufficient knowledge about social conflicts in UHD (e.g., unfair relocation compensation). In the focus group meetings, many ordinary residents even acknowledged that their knowledge about UHD was mainly acquired from public media or the Internet. Such kinds of stakeholders were not qualified to evaluate the social sustainability of UHD from a comprehensive perspective. Consequently, the authors did not involve these stakeholders (namely, S3, S4, S5, S6) in the evaluation process. However, their key interests were presented in the questionnaire and validated in the focus group meetings. The authors received 156 questionnaires from 95 industrial professions, 31 scholars and 30 government officials (i.e., a response rate of 39%). Based on the mean value of importance, the indicators were ranked to demonstrate their relative importance (the calculation and ranking steps follow the suggestions of [Lu and Yuan \(2010\)](#) and [Wang et al. \(2010\)](#)).

In the second-wave questionnaire, the indicator values of Shanghai were evaluated on the basis of another 5-point Likert scale in which 5 implied extremely outstanding, 4 implied outstanding, 3 implied ordinary level, 2 implied low level and 1 implied very poor. In the survey, 156 questionnaires were redistributed to the respondents of the first-wave survey according to the protocol of [Podsakoff et al. \(2003\)](#). In all, 72 questionnaires from 38 professionals, 14 government officers and 20 scholars were collected (i.e., a response rate of 46.15%). Based on the data of the second-wave survey, the authors conducted hierarchical cluster analysis to classify the indicators into 5 categories to examine the internal relations among these indicators. In previous studies, scholars have typically employed factor analysis for classifying indicators, because this method can generate systematic and strong conclusions. However, factor analysis has strict constraints on data structure. In this study, the data failed to meet the requirements of Bartlett's test of sphericity ([Bartlett, 1954](#)) and Kaiser-Meyer-Olkin ([Kaiser, 1970](#)), which implied that factor analysis was not applicable to this research. According to [Jolliffe \(2002\)](#), cluster analysis can be used to reduce "dimensionality before undertaking another multivariate technique." This method can be adapted to group cases and variables ([Revelle, 1979; Norusis, 2005](#)). Compared with factor analysis, cluster analysis does not have very strict constraints on data structure. Therefore, this method was applicable to this study. Since indicators in the same category typically have similar characteristics, this analysis can also help to explain the implications of different indicators

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in an efficient way. Finally, by integrating the data collected from the first- and second-wave questionnaires, the authors evaluated the social sustainability of UHD practices in Shanghai.

The validation of indicator selection was based on the focus group meetings. In addition, Cronbach's alpha value was used to examine the reliability of the questionnaire survey. During the entire research, the authors also conducted other statistical analyses based on the questionnaire data (see Supplementary Materials, S2). The main focus of this study was to develop an assessment system. The identification of indicator and the calculation of indicator weight were the most important work. Therefore, the statistical analyses that did not have a very strong relation with these two parts were summarized in the Supplementary Materials to provide more information for readers.

4. Results and Analysis

4.1. Findings of the Pilot Study and the Focus Group

The researchers identified 22 indicators from the pilot study. These indicators were validated through the focus group meetings. The results are summarized in Table 1. The majority of the 22 indicators were fuzzy indicators instead of quantitative indicators because social sustainability was a complex concept with multiple abstract implications (Omann and Spangenberg, 2002). Some important dimensions of social sustainability (e.g., the city's image) were difficult to be calculated based on quantitative data (e.g., statistical data). Therefore, previous evaluations on social sustainability typically depended on the fuzzy judgments of experts with professional knowledge (e.g., Rajak and Vinodh, 2015; Singh et al., 2007). Although some fuzzy indicators could be further calibrated via quantitative data (e.g., X3 could be reflected by sub-indicators such as the density of pollution emission and the number of safety accidents; X15 could be measured by the number of violent incidents), the majority of these quantitative data could not be easily acquired in the context of China due to the lack of database and the political sensitivity of UHD. Therefore, the application of a quantitative indicator system could be extremely difficult in practice. As a result, a fuzzy indicator system was more feasible in this study. In the third column of Table 1, the implications of these fuzzy indicators are displayed. In the last column, the explanations are presented to show how these indicators reflect the wellbeing and interests of stakeholders in UHD.

Table 1 List of indicators to measure the social sustainability of UHD in China (FM refers to the focus group meetings; PL refers to the pilot study)

NO.	Indicators	Description of Each Indicator	The Key Linkages between Each Indicator and Corresponding Stakeholder(s)
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Yu T., Shen G.Q.P., Shi Q., Zheng H., Wang G., Xu K.X. (2017). Evaluating Social Sustainability of Urban Housing Demolition in Shanghai, China. *Journal of Cleaner Production*. 153(2017), 26-40. DOI: 10.1016/j.jclepro.2017.03.005, June. (SCI, 5-Year impact factor: 5.315. **Ranked 5/29 in Green & Sustainable Science & Technology; 5/50 in Environmental Engineering; 16/225 in Environmental Sciences by JCR in 2015).**

X1	Community transportation	To what degree the adverse impacts on community transportation can be controlled.	UHD can influence the transportation system of the nearby communities. For example, some residents living in Zhangwu Road stated that the transportation of demolition waste frequently caused traffic congestion in their communities (FM). These issues can significantly affect the daily life of the nearby residents. For instance, the commute time of these residents can be significantly prolonged (FM). Therefore, governments and demolition crews should take effective means to reduce such impacts on transportation (e.g., setting temporary bus lines for nearby residents).
X2	Community security	To what degree the adverse impacts on community security can be reduced.	Valuable demolition waste products such as steel may attract thieves and incur crimes (PL). In addition, the flow of strangers (e.g., demolition crews) into the community can reduce the sense of security of nearby residents (FM). Consequently, governments and demolition crews should exert efforts toward improving community security during housing demolition (e.g., employing additional security staff during UHD).
X3	Healthy/safe living conditions for nearby residents	To what degree the healthy/safe living conditions of nearby communities can be maintained.	UHD can cause adverse impacts on the health and safety of nearby residents (PL). For example, toxic demolition dusts such as lead can cause lung cancer (PL). Environmental pollutions such as air pollution and noise can incur health issues such as insomnia. In addition, safety issues such as falling objects also challenge the wellbeing of nearby residents. Thus, governments and demolition crews should take effective measures to reduce these adverse impacts. For example, dust control technologies can be applied during UHD. Laws have been released to protect the safety and health of nearby resident.
X4	Availability of public open place	To what degree the adverse impacts on the availability of public open place can be controlled.	Public open space can be occupied during UHD programs. For example, in a demolition project on Siping Road, public spaces were used for storing demolition waste and equipment (FM). Since open place provides activity space for nearby residents to talk and share ideas with one other, UHD can adversely influence the social activities of these residents (PL). Governments and demolition crews should take this indicator into consideration when developing UHD plans.
X5	Availability of public facilities	To what degree the adverse impacts on the availability of public facilities (e.g., sport facilities; recreational facilities) can be reduced.	UHD can affect the nearby residents' use of public facilities (PL). For example, in a UHD project on Zhangwu Road, the outdoor sport facilities were closed for safety reasons (FM). Public facilities can improve the residents' quality of life (FM). Therefore, governments and demolition crews should work to ensure that such facilities remain open during UHD. At least, these adverse impacts should be controlled to an acceptable level.
X6	Fair remuneration	To what degree the payment for demolition crews and other employees in a UHD program can be reasonable and fair.	Governments and developers should pay a fair salary to demolition crews and other employees in a UHD program. Unfairness can easily incur social dissatisfactions. However, some demolition workers maintained that their wages were docked in some projects because they were temporary workers

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			without formal contracts with their employer (FM). Governments can develop labor laws to protect the benefits of these crews.
X7	Child labor	The percentage of child labor in UHD programs.	The employment of children should be avoided during UHD programs (PL) because it can incur social discontent from the general public and damage the reputation of governments. Some experts in the pilot study argued that the employment of children should be strictly prohibited by labor laws.
X8	Forced labor	To what degree the work load of demolition crews are reasonable.	Work overload should be avoided during UHD programs because it can damage the health and wellbeing of workers. However, some demolition workers argued that sometimes their workloads were sharply increased to complete the demolition work on schedule (FM). Governments should design a reasonable plan for UHD activities.
X9	Health and safety of employees	To what degree the health and safety of employees can be protected.	The health and safety of demolition crews as well as other employees should be guaranteed during demolition programs (PL). "Zero casualty" is an important indicator to evaluate the performance of government officials in UHD programs. Therefore, governments and demolition crews should pay sufficient attention to the SHE management in UHD.
X10	Working hours	To what degree the working hours of demolition crews and other employees are reasonable.	The working hours of demolition crews and other employees should be reasonable (PL). For example, during the hot summer days of Shanghai, workers should have more resting time during the daytime (FM). If not, their health and sense of happiness can be significantly damaged (FM). Governments should develop a reasonable working schedule for these workers.
X11	Equal job opportunities	To what degree individuals with different social backgrounds can obtain equal job opportunities in UHD.	In a demolition project, equal job opportunities should be given to people with different backgrounds and genders (PL). For example, employers should not distinguish between local and nonlocal demolition crews (FM). In addition, unemployment of displaced households induced by UHD activities should be compensated for in relocation schemes (PL). A higher employment rate can contribute to the performance of local governments. Governments can develop social security schemes to maintain the employment rate in UHD areas.
X12	Personal dignity of demolition crews	To what degree the personal dignity of demolition crews can be protected in UHD programs.	Government officials as well as the other stakeholders (e.g., displaced households) should not violate the personal dignity of demolition crews during UHD programs (FM). Personal dignity is very important for the happiness and self-identity of an individual (PL).
X13	Illegal demolition	To what degree the relocation and demolition activities can conform to existing laws and policies.	Illegal demolition activities should be avoided during UHD programs. For example, demolition work should not be carried out without securing administrative approval (PL). Governments and demolition crews should carry out their UHD programs according to the existing laws such as the Property Law.

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X14	Illegal waste disposal	To what degree illegal waste disposal can be reduced.	Cities such as Shanghai and Shenzhen have developed laws (or regulations) regarding construction waste disposal in order to improve the efficiency of natural resource conservation. Demolition crews should not dispose their demolition waste in an illegal way (PL). For example, demolition waste should not be transported to a waste disposal plant without an operating license (PL). In addition, governments are responsible for supervising the waste disposal during UHD.
X15	Violent incidents	To what degree violent incidents can be controlled during UHD.	Violent incidents among demolition crews, displaced households and governments should be avoided during UHD programs because these incidents can easily incur social dissatisfactions and threaten the social stability of China (PL). The reputation of local governments can be adversely affected as well.
X16	Stakeholder engagement and acceptance of the UHD plan	The degree of stakeholder engagement and acceptance.	Each stakeholder group (especially vulnerable groups) should have effective approaches to express their opinions to the decision makers of UHD (PL). Stakeholder engagement can effectively mitigate social conflicts and social resistance (PL). Based on stakeholder engagement, the UHD plan developed by governments should be accepted by most key stakeholders (PL).
X17	Fair compensation for displaced households	To what degree the compensation standards for different households can be consistent.	In UHD programs, local governments should develop a reasonable compensation standard for displaced residents based on the market value of the property and the potential losses caused by the relocation (PL). Fair compensation should be paid to displaced residents according to this standard (PL). However, some displaced residents complained that, to reduce development costs, in many cases governments/developers sent unfair compensations to them without any option for negotiation (FM).
X18	Personal dignity of displaced households	To what degree the personal dignity of displaced households can be maintained.	The personal dignity of displaced households should be protected in UHD programs because it can influence the happiness and self-identity of these displaced residents (PL). Governments and demolition crews should pay sufficient attention to this point when they carry out their UHD activities.
X19	Fair treatment for low-income and minority groups	To what degree low-income and minority groups can achieve the same benefits as stakeholders from higher social classes.	The interests of low-income or minority groups should be fairly treated and protected without discrimination (PL). Governments should develop a social security scheme to meet the basic needs of these vulnerable groups (FM).
X20	Preserving social networks	To what degree the social ties in the demolished areas can be maintained.	The social relationships of displaced households should be well preserved because social relationships play an important role in maintaining the wellbeing of these residents (PL). For example, a displaced resident argued that his father felt frustrated after relocating because this old man was unable to spend time with his old friends in his new community (FM). Therefore, the planning departments of local governments should take such kinds of social issues into consideration when developing a master plan.

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X21	Preservation of the city's image	To what degree the city's image can be preserved during UHD.	Since UHD programs can change the image of a city, the adverse impacts of this process should be controlled by governments and demolition crews to an acceptable degree (PL). The image of a city can reflect the shared attitudes and values prevailing in the local society (PL). A positive image can enhance the sense of attachment to this city (PL).
X22	Cultural heritage preservation	To what degree culture heritages can be preserved during UHD.	Cultural heritages near the demolition site should be carefully protected by governments and demolition crews (PL). Cultural heritages record the historical activities and the cultural identity of the former generations (PL). They should be preserved for the general public.

4.2. Relative Importance of Each Indicator

To identify critical indicators, the authors developed a ranking list of the indicators (Table 2) by comparing their mean values of importance in the first-wave survey. An indicator was considered to be more important than another if it was associated with a higher mean value. If two or more indicators had the same mean value level, the indicator with a smaller standard deviation was adopted as a more important indicator. This ranking method has been adopted in many studies as a simple and effective approach to identify critical indicators in a questionnaire survey (e.g., Lu and Yuan, 2010; Wang et al., 2010). From Table 2, one can infer that: 1) the mean values of all the indicators were larger than 3 (less important), which indicated that none of them were unimportant or negligible factors; 2) there were nine indicators with mean values greater than 4 (important level) that should be regarded as critical indicators for the social sustainability of UHD in Shanghai, namely: violent incidents, illegal demolition, health and safety of employees, healthy/safe living conditions, fair compensation for displaced households, fair treatment for low-income and minority groups, fair remuneration, preservation of the city's image, and the personal dignity of displaced households.

Table 2 The primary results of the first- wave questionnaire survey

NO.	Mean	Standard deviation	Rank	NO.	Mean	Standard deviation	Rank
x15	4.740	0.65	1	x11	3.896	0.75	12
x13	4.612	0.77	2	x12	3.773	0.71	13
x9	4.579	0.74	3	x22	3.759	1.01	14
x3	4.490	0.65	4	x1	3.635	0.97	15
x17	4.436	0.90	5	x8	3.526	0.73	16
x19	4.229	0.84	6	x10	3.490	1.51	17
x6	4.197	0.63	7	x5	3.343	1.04	18
x21	4.106	0.94	8	x14	3.275	0.75	19
x18	4.040	0.82	9	x7	3.221	1.32	20

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x2	3.988	0.61	10	x4	3.202	1.01	21
x16	3.897	0.88	11	x20	3.019	1.44	22

4.3. Indicator Values of Shanghai and Hierarchical Cluster Analysis

In the second- wave questionnaire, the authors evaluated the indicator values of Shanghai by adopting a 5-point Likert scale. The mean value and standard deviation of each indicator are presented in [Table 3](#). Based on the data in [Table 3](#), one can see that: 1) the mean values of all of the indicators exceeded 2, which implied that even the poorest part of Shanghai had already exceeded a low level of social sustainability; 2) there were three indicators with mean values less than 3 (ordinary level): healthy/safe living conditions, working hours and preserving social networks. These indicators were the poorest ones that required further improvements; 3) there were nine indicators (40.91% of all the indicators) with mean values greater than 4, which can be regarded as the excellent parts of Shanghai's previous work.

Table3 The primary results of the second-wave questionnaire survey

NO.	Mean	Standard deviation	NO.	Mean	Standard deviation
x1	3.667	1.13	x12	3.300	1.15
x2	4.430	0.79	x13	4.531	1.16
x3	3.641	0.72	x14	3.978	1.03
x4	2.875	1.42	x15	4.853	1.07
x5	3.378	1.32	x16	3.011	1.35
x6	4.325	0.73	x17	4.414	0.81
x7	4.314	1.36	x18	3.778	1.26
x8	4.203	1.23	x19	3.778	1.33
x9	3.364	1.22	x20	2.203	0.88
x10	2.781	1.09	x21	4.497	0.94
x11	3.517	1.08	x22	4.300	1.06

To investigate the internal relations among the indicators, the authors subsequently carried out hierarchical cluster analysis to divide the indicators into five categories. The data collected from the second- wave survey were input into SPSS16.0. The results are shown in [Fig.4](#). There were several different schemes for indicator classification (e.g., Line1, 2 and 3). Previous studies have defined several principles to judge whether one scheme is better than others. Firstly, the final classification should be determined on the basis of the characteristics of the research objectives ([Revelle, 1979](#); [Rapkin and Luke, 1993](#)). Secondly, the division should also make "theoretical sense while offering a parsimonious and manageable representation of reality([Saint-Arnaud and Bernard, 2003](#))."

To satisfy these two requirements, the implications of the classification are

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explained in [Section 5.2](#). The authors also present related literature and UHD practices to support these findings. Finally, each category should avoid containing too many or too few indicators.

According to the principles noted above, line 2 was selected as the baseline for classification. As a result, the first category included X6, 8, 9, 11, 12; the second category included X2, 3, 21, 22; the third category included X13, 14, 15, 17, 18, 19; the fourth category included X1, 4, 5. However, there were still four indicators (X7, 10, 16, 20) that could not be assigned to any categories in the cluster analysis. The authors grouped these indicators into one category as an autonomous part because they shared a common characteristic: each of them had very weak relations with the other indicators in the assessment system. If line 3 was selected, the first cluster would have contained 9 indicators (40.91% of all the indicators), which covered too many components of the assessment system. If line 4 was adopted as the final scheme for indicator classification, indicators X2, 3, 21, 22 would have been divided into two categories. Each category would have just two factors, which was too few elements for the assessment system. As a result, line 2 was considered to be the most suitable choice in this case.

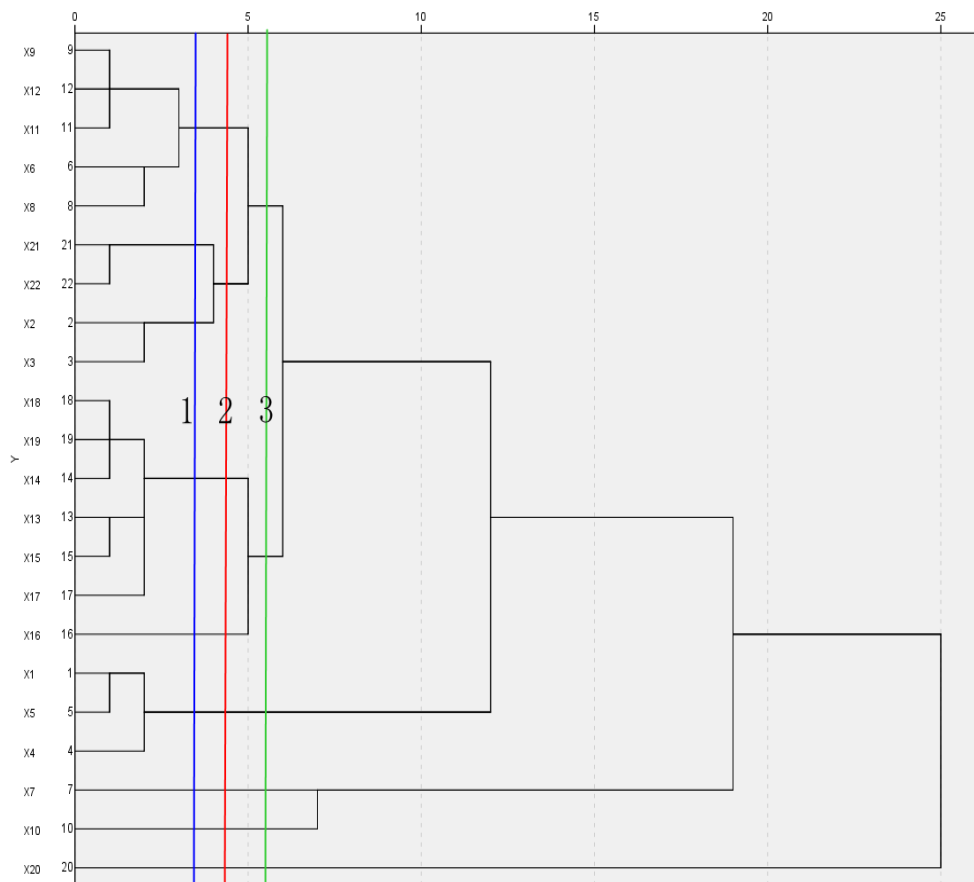


Fig. 4 Dendrogram of the indicators

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4.4. Social Sustainability of UHD in Shanghai

By integrating the results of the first- and second- wave questionnaires, the authors calculated the social sustainability score of UHD in Shanghai based on the following processes:

$$(1) \quad M_i = \sum_k M_{ik}$$

$$(2) \quad W_i = \frac{M_i}{\sum_{j=1}^5 M_j}$$

$$(3) \quad W_{ik} = \frac{M_{ik}}{M_i}$$

$$(4) \quad NV_{ik} = \frac{V_{ik}}{5}$$

$$(5) \quad NV_i = \sum_k NV_{ik} \cdot W_{ik}$$

$$(6) \quad NV = \sum_{i=1}^5 NV_i \cdot W_i$$

M_{ik} was the mean importance value (in the first- wave survey) of the k th indicator in the i th category ($i=1,2,3,4$ or 5); V_{ik} was the mean indicator value (in the second- wave survey) of the k th indicator in the i th category ($i=1,2,3,4$ or 5). Equation (2) was used to calculate the weight of each category (W_i). Equation (3) was used to calculate the weight of each indicator in its category (W_{ik}). Equation (4) was used to normalize the indicator values in order to ensure that they fell over a range of 0- 1. Equation (5) was used to calculate the social sustainability score of each category (NV_i). Equation (6) was used to calculate the overall score of social sustainability (NV).

Similar calculation methods have already been adopted in previous studies to evaluate social sustainability (e.g., [Dong and Ng, 2015](#)). Based on the calculation, the sustainability score of each category was rescaled into a comparable range of 0-1. The implications of the sustainability score were similar to those of the study conducted by [Dong and Ng \(2015\)](#). In the calculation of the scores of social sustainability, 1 implied extremely outstanding, 0.8 implied outstanding, 0.6 implied ordinary level, 0.4 implied low level and 0.2 implied very poor. The overall score of Shanghai was 0.782 ($0 \leq NV \leq 1$), which indicated that the social sustainability of UHD in Shanghai was quite close to being at an excellent level (0.8).

4.5. Validation and Reliability

The validation of indicator selection was based on the findings of the focus group meetings. By integrating the results of the pilot study and the focus group, the authors examined the opinions of all of the stakeholders identified in this research. The authors used the personal experience and statements of these stakeholders to explain the implications of each indicator in [Table 1](#). The authors measured the reliability of the questionnaire survey using Cronbach's alpha value. The

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result of this test was 0.705 (i.e., greater than 0.50) in the first-wave questionnaire survey, which meant that the data could be accepted with a significance level of 5% (Norusis, 2005). The Cronbach's alpha value of the second-wave survey was 0.794, which indicated that the results were quite reliable. Accordingly, the data achieved in this study represents a robust understanding of the respondents in terms of the relative importance of the indicators that measure the social sustainability of UHD in China.

5. Results and Discussion

5.1. Critical Indicators

According to the analyses of the first-wave questionnaire, one can see that the most critical indicators identified in this study mainly reflect three dimensions of social issues during UHD programs: 1) social equality and fair treatment (fair compensation for displaced households, fair treatment for low-income and minority groups, fair remuneration, personal dignity of relocated households), 2) adherence to the law (violent incidents, illegal demolition, preservation of the city's image), and 3) health and safety (health and safety of employees, healthy/safe living conditions). It is worth noting that a social sustainability indicator can display multiple attributes and be analyzed from different perspectives. For example, relocation compensation can be analyzed from the perspective of economic sustainability because it can influence the transaction costs of urban redevelopment projects. Meanwhile, relocation compensation is also an important social issue based on the viewpoint of social fairness. This study focused on the social attributes of these indicators. In the following paragraphs, the authors summarized the shared characteristics of these critical indicators based on their social implications.

5.1.1. Social Equality and Fair Treatment

Social equality and fair treatment are extremely important to improving social sustainability (Enyedi, 2002; Bramley et al., 2009). The interests of various stakeholders in UHD programs should be fairly treated and protected without discrimination. This conclusion resonates with the study of Biddulph (2009); this scholar highlighted that social justice and fairness during UHD should be maintained to ensure that Chinese society was stable and harmonious. To balance conflicting interests and maintain social fairness, the policy related to UHD in Shanghai (i.e., *DRECHSOLS*) stipulates that public interests must be given priority protection during UHD programs. However, after investigating the allocation of economic interests in previous UHD practices of Shanghai, Wu and He (2005) argued that the pursuit of economic growth could significantly damage the interests of displaced households and other vulnerable groups. To increase fiscal income, the local government of Shanghai tends to support property development even at the cost of the satisfaction of other stakeholders (Wu and He, 2005). According to the

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latest literature, Shanghai ranked the third on a list that compared various regions' fiscal dependences on land leasing and property development ([HuDong Wiki, 2014](#)). In addition, the definition of public interest was unclear in the previous legal system of Shanghai ([Tang, 2007](#)). Consequently, in the name of public interest, unfair or unequal treatments became legal and reasonable during previous UHD episodes in Shanghai. The unfairness and inequality of UHD programs are primarily reflected in uneven compensation ([Li and Song, 2009](#); [Ho, 2013](#); [Hu et al., 2015](#)) and unfair treatment between different stakeholders (e.g., employment discrimination between local and nonlocal demolition workers; disrespecting the personal dignity of relocated households due to their weak power position in UHD). These issues related to social fairness and equality have become a primary challenge to the social sustainability of UHD programs in Shanghai.

5.1.2. Adherence to the Law

In recent years, the central government of China has emphasized that it would govern the country by adopting the principle of "rule by law ([He, 2014](#))." The primary purpose of this mindset is to improve the harmony and stability of Chinese society. However, illegal acts sometimes occur during UHD programs. These acts are often accompanied by serious criticisms from various circles of Chinese society. Meanwhile, the property rights and other human rights of displaced households have been severely infringed upon ([Yang and Zhang, 2012](#)). Some people have even lost their lives during UHD programs. As one of the most advanced cities in China, Shanghai has paid sufficient attention to reducing illegal behaviors related to UHD programs. According to *DRECHSOLS*, violent incidents or illegal demolition must be strictly avoided during UHD because these incidents can damage the basic human rights of involved stakeholders and result in serious dissatisfaction among the public. Since the central government has planned to develop Shanghai as an international city and economic center ([Tang, 2007](#)), the senior officials in the central government have placed great emphasis on maintaining the reputation and city image of Shanghai. Therefore, critical comments from public media on violent incidents or illegal demolition can adversely affect the annual performance assessment of local officials. These negative comments can even result in the demotion of local government leaders ([a government official in the pilot study](#)). In addition, a package of laws and policies has been developed to control the adverse impacts of UHD on the city image of Shanghai (e.g., the *Master Plan of City of Shanghai*). Illegal operations (e.g., illegal demolition waste dumping) that may damage the city's image are strictly prohibited by the law system because Shanghai is an important gateway city that symbolizes the prosperity of China ([a project manager in the pilot study](#)). In summary, adherence to the law has become an important dimension to measure the social sustainability of UHD programs in Shanghai.

5.1.3. Health and Safety

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Health and safety have been frequently employed in previous studies as important dimensions of measuring social sustainability (e.g., [Dong and Ng, 2015](#)) because even small threats on health and safety can easily incur serious social disputes and unrest. For example, in the case of the Hung Hom Estate in Hong Kong, negative impacts on the health of surrounding residents were highlighted by a Non-government Organization, the Friends of the Earth, as an important reason for terminating the demolition projects ([Chu, 2008](#)). Existing research has shown that UHD is an important source of various toxic wastes that is significantly correlated with the incidence of serious diseases such as cancer ([Lange et al., 1989](#); [Farfel, et al., 2005](#); [Smilee et al., 2011](#)). Therefore, waste materials generated during UHD such as debris and dust must be well controlled at a safe level for the health of the public. The building demolition regulations of Shanghai (i.e., *DGJ08-70-2013*) stipulate that sustainable technologies should be adopted to reduce the adverse impacts of UHD on the surrounding environment and safeguard the health of the public. Meanwhile, safety hazards should be effectively dealt with during UHD programs to reduce casualties caused by accidents. In a study conducted by [Dong and Ng \(2015\)](#), safety was identified as the most important indicator to measure the social sustainability of construction projects. Therefore, demolition workers should receive sufficient safety trainings ([Cha and Choi, 2007](#)). A safety management system should be developed prior to the start of the demolition work. In Shanghai, regulations such as “*DGJ08-70-2013*” have identified the safety responsibilities of key stakeholders and clearly demonstrated safety requirements for site operations (e.g., the “red line” for site layout). Before carrying out any UHD activities, the building demolition regulation (*DGJ08-70-2013*) requires that every demolition project should pass a safety evaluation. In addition, safety risks must be identified and assessed in the master plan to eliminate potential accidents ([a project manager in the pilot study](#)). In summary, practitioners in Shanghai have paid sufficient attentions to the health and safety issues related to UHD.

5.2. Results of Hierarchical Cluster Analysis and Opportunities for Improvement for Shanghai

Based on the findings of the second- wave questionnaire, all of the indicators were classified into five categories (see [Section 4.3](#)). The social sustainability of Shanghai was evaluated. Based on [Fig. 5](#), one can see that the values of categories 2 and 3 exceeded 0.8. The value of category 1 was very close to 0.8. It indicated that these three aspects attained an excellent level in Shanghai. Meanwhile, the values of categories 4 and 5 failed to reach 0.8 but exceeded 0.6, which implied that these two aspects exceeded the ordinary level but still required further improvements.

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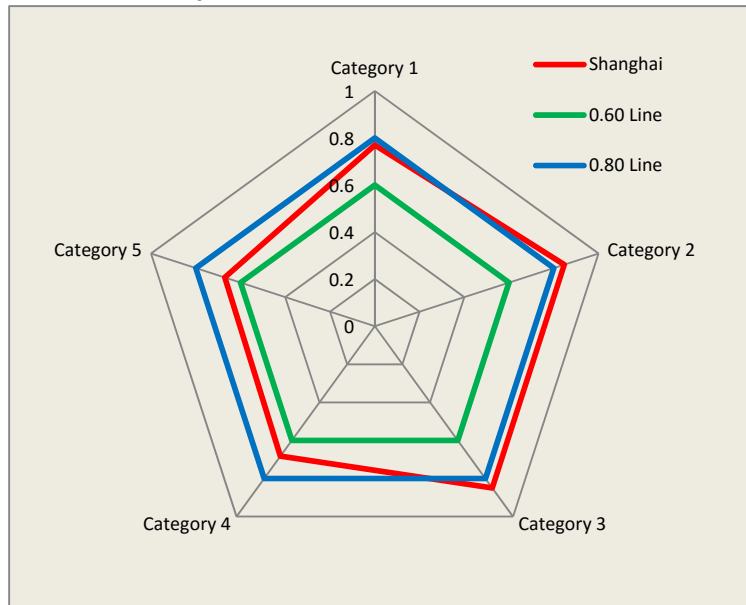


Fig. 5 Social sustainability score of each category in Shanghai

5.2.1. Category 1: Job Opportunities and Working Conditions

The indicators in category 1 largely reflected job opportunities and working conditions in UHD programs. Consistent with [Chan and Lee \(2008\)](#) who used the availability of job opportunities as a social sustainability indicator, this study also reveals that job opportunity is a key dimension to measure the social sustainability of UHD. [Omaman and Spangenberg \(2002\)](#) highlighted that social problems such as poverty, social exclusion, welfare dependence and psychological issues could be mitigated by increasing the employment rate. Consequently, UHD should not significantly influence the employment of displaced residents. Equitable job opportunities should be provided for demolition crews with different backgrounds. In some real cases, displaced households were relocated to suburban places that were quite far away from family members' workplaces. As a result, these individuals had to give up their jobs. In Shanghai, due to the high level of monetary compensation, displaced households typically have a package of flexible approaches to select a new home through the housing market. Therefore, the impacts on employment are well controlled compared with in other large cities in China. UHD regulations in Shanghai (i.e., *DRECHSOLS*) stipulate that unemployment issues caused by UHD must be taken into consideration during the decision-making period. Economic losses associated with UHD-induced unemployment must be compensated for at the relocation stage. In addition, due to the mature labor-law system, the basic rights of employees such as healthy/safe working conditions and a fair salary can be safeguarded in UHD programs in Shanghai. Therefore, the overall performance of Category 1 attained a favorable level in previous UHD activities in Shanghai.

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5.2.2. Category 2: Preservation of Community and City

Category 2 mainly illustrated the conservation of community functions and city characteristics during the UHD process. Some scholars argued that community was a critical dimension to measure the social sustainability of urban development (Bramley, 2009; Dempsey et al., 2011). Consequently, during the urban redevelopment process, UHD should not result in any significantly negative impacts on the basic functions of surrounding communities. Since safety, health and security are basic demands of human beings (Littig and Griessler, 2005), these indicators are most essential indicators to measure the sustainability of a community (Dempsey et al., 2011). According to the survey of this study, these basic functions of communities were well preserved during UHD programs in Shanghai. The central and local governments have paid sufficient attention to the public order and social security of Shanghai because Shanghai is one of the most advanced cities in China. "Compared with other first-tier cities in China, the crime rate of Shanghai is the lowest (a government official in PL)." Meanwhile, the city characteristics of Shanghai were also conserved properly during UHD programs. According to Fung (2004) and Chan and Lee (2008), heritage and city image should be preserved for future generations because these aspects are a testament to historical changes in time and reflect the historical activities of former generations. During redevelopment processes in previous decades, the preservation of heritage and city image of Shanghai was fully taken into consideration by the local government. For example, the traditional 'Shikumen' architectural form was conserved in Taipingqiao urban redevelopment projects. In addition, public scrutiny also had a significant impact on the protection of cultural heritages and the city's image. (e.g., the preservation of Xintianidi Shanghai)

5.2.3. Category 3: Operational Efficiency of Laws and Policies

Category 3 generally reflected the operational efficiency of laws and the relocation policies of UHD in Shanghai. After 2007, UHD programs in Shanghai have been carried out based on the rules of *Property Law* (new version from 2007) that emphasize the protection of citizens' lawful properties (Tang, 2007). Compared with the situation prior to 1991, urban-renewal projects in Shanghai are mainly driven by the property market instead of the local government due to economic reforms. Therefore, illegal demolition in the name of government authorization has been significantly mitigated. Nowadays, the power of housing authorities and property developers are strictly constrained by laws and policies because pressure from previous UHD disputes has changed the attitudes of courts and governments toward rapid urbanization (Shih, 2010). As a result, the prevalence of illegal acts has been sharply reduced in recent years in Shanghai. More importantly, due to the reform on compensation policy, displaced residents have more flexible options for relocation. They can choose among monetary compensation, in-kind

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compensation or combined compensation (monetary compensation plus a discount price for affordable housing) (Tang, 2007). Displaced residents can buy their new homes from the housing market or be resettled via a relocation policy. The basic interests of displaced households can be safeguarded. As a result, people seem to be more satisfied with the existing UHD laws and policies.

5.2.4. Category 4: Daily Lives of Nearby Residents

The indicators in category 4 were strongly related to the daily lives of nearby residents in demolished areas. Open spaces can provide buffer zones for entertainment activities and social gatherings (Chiu, 2003), which can help to foster and strengthen social relationships among community members. Public facilities such as schools and hospitals can satisfy the basic demands of nearby residents and facilitate their daily lives (Chan and Lee, 2008). Transportation systems can influence the commute times and transportation costs of nearby people. In Shanghai, the score of category 4 was relatively low compared with the aforementioned categories. In the pilot study, some interviewees argued that public spaces and facilities were frequently occupied or adversely affected during UHD projects due to the limited urban space of Shanghai. In the focus group meetings, a resident living near Zhangwu Road proposed an example to support this viewpoint. This resident complained that the sport facilities in his community were occupied during a UHD program. However, the existing laws and policies in Shanghai generally ignored such kinds of issues. Another resident in the focus group meetings stated that a road near his community had been blocked for approximately 20 days due to a UHD project. When this resident reported the issue to the police, he was told that this UHD project was lawful. Although the interests of these two residents were damaged in UHD programs, the existing laws and policies in Shanghai did not effectively protect their interests. Therefore, existing laws and policies must be modified to enhance the performance of the indicators in category 4. For example, if demolition companies that take effective measures to reduce impacts on the daily life of nearby residents can be provided with economic incentives, they will pay more attention to this work. The authors are hopeful that the local government of Shanghai regards category 4 as an opportunity for improving the social sustainability of UHD in the region. Although the indicators in this category were not identified as critical indicators in this study, these indicators reflected the poorest part of the social sustainability of UHD in Shanghai. Consequently, sufficient attention should be paid to the indicators in category 4.

5.2.5. Category 5: Autonomous Factors

The indicators in category 5 have weak relations with the other ones in the assessment system because they could not be classified into any other categories during the cluster analysis. In addition, each indicator in category 5 also has limited linkages with other elements in this category. However, this situation does not mean that these indicators cannot affect the social

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sustainability of UHD programs. For example, the preservation of social networks was identified as being a critical factor for social sustainability in many previous studies (e.g., [Wu and He, 2005](#); [Keene and Geronimus, 2011](#)) because social networks can enhance the sense of belonging and provide many social resources for community residents. In Shanghai, such factors seem to be ignored during the UHD process. Improving autonomous indicators typically requires targeted efforts and the input of resources because they have very weak linkages with the entire system. Consequently, during the early phase of urban renewal, if sufficient resources are not available to improve every sustainable indicator, indicators in category 5 cannot be effectively enhanced in the short term.

5.3. Degrees of Involvement and Research Methods for Investigating the Opinions of Different Stakeholders

In this study, the authors used various research methods to investigate the viewpoints of different stakeholders. The degrees of involvement of different stakeholders were well distinguished and based on different approaches because the urgency, power, proximity and knowledge background of these stakeholders were varied. This situation was consistent with that of the study by [Yang and Shen \(2014\)](#). As noted in [Section 3](#), the authors developed and validated the indicator system by integrating the opinions of all the key stakeholders of UHD programs. However, the value judgment was based on the professional knowledge of industrial practitioners and scholars. This imbalance cannot be avoided in practice. In many conditions, experts that possess professional knowledge in decision-making might not be the key stakeholders whose interests are significantly affected. For example, in a construction project, project managers typically possess better knowledge and abilities for decision-making than project owners. However, the most important stakeholders who would be significantly influenced by the project were project owners. In this study, the interests of all of the potential stakeholders were taken into consideration during the explorative stage. However, it is unreasonable to require the unqualified stakeholders to judge the overall conditions of UHD in Shanghai.

Table 4 Comparison between different research methods ([Babbie, 2015](#))

Features	Method	Interview	Focus Group	Questionnaire
Amount of information		Large	Large	Small
Sample Size		Small	Small	Large
Time span		Moderate	Short	Long
Applicable Scope		Explorative problem; pilot study; qualitative analysis	Explorative problem; modifying or improving preliminary findings; triangulation and validity checking; qualitative	Well-defined problem; quantitative analysis

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Robustness	analysis		
	Low	Moderate	High
Interactions between researchers and interviewees	High	High	Low

According to [Reed \(2008\)](#), effective methods should be selected for different stakeholders to engage them in the decision-making process. In this study, the authors used interviews, focus groups, and questionnaires to test the opinions of different stakeholders. These methods are compared in [Table 4](#). Qualitative and quantitative analyses were integrated in this study. In addition, the authors used the snowball sampling technique to enable more stakeholders and experts to engage in this study (consistent with [Yang and Shen, 2014](#)). In summary, this study displayed a hybrid research method and proposed a framework for analyzing stakeholder-associated issues.

6. Conclusion

Based on a hybrid method, this study identified 22 indicators for evaluating the social sustainability of UHD. The 22 indicators were divided into five categories via hierarchical cluster analysis, i.e., job opportunities and working conditions, preservation of community and city, operational efficiency of laws and policies, daily lives of nearby residents, and autonomous factors.

Previous studies associated with UHD in China have mainly focused on two aspects: unfair allocation of economic benefits (e.g., [Hu et al., 2015](#)) and legal issues related to human rights (e.g., [Shih, 2010](#)). [Hu et al. \(2015\)](#) investigated issues of biased compensation in UHD. These scholars argued that displaced residents with similar pre-displacement situations could receive different amounts of compensation. Scholars such as [Wu and He \(2005\)](#) have argued that the pursuit of economic growth may result in social unfairness and damage the interests of vulnerable groups. Social unfairness has become a primary challenge to the social sustainability of UHD. Consistent with this argument, social fairness and equitability have been identified as a critical dimension for measuring the social sustainability of UHD in this study. The benefits of displaced residents and demolition staff were highlighted in this dimension. In addition, resonating with scholars such as [Shih \(2010\)](#) who emphasized the importance of laws, this study identified adherence to the law as another critical dimension for evaluating the social sustainability of UHD. Social issues such as violent incidents and illegal demolition were reflected in this dimension. More important, this study highlighted the importance of safety and health in UHD programs. Compared with the majority of the existing literature that pays insufficient attention to this issue, this study revealed that safety and health were extremely important to

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the social sustainability of UHD programs in Shanghai.

In terms of stakeholder analysis, previous studies have typically focused on governments, property developers and displaced households (e.g., [Hu et al., 2009](#); [Shih, 2010](#)). This study investigated the opinions of all the potential stakeholders involved in UHD programs. The interests of demolition crews, nearby residents and the general public were taken into consideration as well. Some critical indicators identified in this study had strong relations with these three types of stakeholders (e.g., health and safety). Consequently, to enhance the social sustainability of UHD practices, the viewpoints of demolition crews, nearby residents and the general public should not be ignored during the decision-making stage. Compared with studies focusing on single-dimensional improvements (e.g., relocation compensation; [Ho, \(2013\)](#)), this study provided a comprehensive checklist of 22 social sustainability indicators in UHD programs. This checklist can help practitioners evaluate the overall level of social sustainability of UHD and diagnose the key social issues that require further improvements. In the context of Shanghai, the authors highlighted that the daily lives of nearby residents should not be significantly affected during UHD programs.

In the field of social sustainability assessment, previous studies have typically integrated empirical data with sustainability principles to evaluate the social sustainability of different economic activities (e.g., [Hosseinijou et al., 2014](#); [Dong and Ng, 2015](#)). The primary purpose of maintaining social sustainability is to improve the well-being and satisfaction of the people involved ([Chiu, 2003](#)). Based on this theoretical foundation, the interests and wellbeing of key stakeholders should be considered when assessing the social sustainability of an activity. Although scholars have investigated social sustainability issues in UHD programs (e.g., [Shih, 2010](#)), a comprehensive assessment system based on the opinions of key stakeholders is still missing in this field. This study extended the application of the stakeholder principle to the area of UHD. An assessment system containing 22 indicators was established from the perspective of stakeholder. Compared with theoretical models such as game theory, the findings of this study can be easily applied in real UHD practices because the development of this specific indicator system was based on the characteristics of the UHD programs in China. Since UHD is a critical process of urban redevelopment, this study also contributes to enhancing the social performance of urban redevelopment in China.

Further research opportunities are also emerging during the analyses of this study. The findings of this paper were mainly based on the context of Shanghai. Via an exemplar case, this study can provide empirical support and theoretical insights for addressing the research issue ([Yin, 2008](#)). However, modifications may be required in some other cases whose conditions differ from those of Shanghai. The findings of this study should be tested by large-sample data in future studies.

In addition, this study answered the research question “How does one assess the social

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sustainability of UHD programs?” However, it failed to answer the questions: “How does one improve the social sustainability of UHD?” and “What can be done to change the unsustainable behaviors of the key stakeholders using, for example, policy instruments or market mechanisms?” Future research work should focus on identifying effective approaches for enhancing the social sustainability of UHD programs. Analytical tools that can be used to optimize UHD schemes should be developed to improve current UHD practices.

Based on the findings of this study, further analyses such as regression analysis may be conducted to identify driving factors that can significantly influence the social sustainability of UHD. For example, a third-wave questionnaire may be carried out by the authors of this paper or other researchers in their future studies. The indicators identified in this study can be used as dependent variables to measure the performance of UHD programs. Driving factors such as information disclosure can be used as independent variables. Using regression analysis researchers can evaluate the degree to which a driving factor can affect the social sustainability of UHD.

In the end, the authors found that the existing literature failed to paid sufficient attention to health and safety issues related to UHD. Therefore, future research should be carried out to enhance the health and safety performance of UHD programs in China. In particular, legal measures, economic instruments, social sensitiveness assessment and other policy tools should be investigated to identify effective approaches for improving current practices.

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Yu T., Shen G.Q.P., Shi Q., Zheng H., Wang G., Xu K.X. (2017). Evaluating Social Sustainability of Urban Housing Demolition in Shanghai, China. *Journal of Cleaner Production*. 153(2017), 26-40. DOI: 10.1016/j.jclepro.2017.03.005, June. (SCI, 5-Year impact factor: 5.315. **Ranked 5/29 in Green & Sustainable Science & Technology; 5/50 in Environmental Engineering; 16/225 in Environmental Sciences by JCR in 2015**).

Supporting Information

Evaluating Social Sustainability of Urban Housing Demolition in Shanghai, China

S1. Additional information pertaining to the research processes

S1.1.Key questions in the pilot study

Stakeholder identification:

1. In UHD programs, who can significantly affect the implementation of UHD? (followed by question 2)
2. Can you propose an example to show how this kind of stakeholders exerts an impact on the implementation of UHD?
3. In UHD programs, who can be significantly affected by UHD? (followed by question 4)
4. Can you propose an example to show how UHD programs influence this kind of stakeholders?
5. In the context of China, who has a stake in UHD programs?

The development of the indicator list:

1. What are the key interests of Si (i=1,2,3,4,5,6) in UHD programs?
2. What factors can reflect the wellbeing of Si (i=1,2,3,4,5,6) in UHD programs?
3. What factors should be taken into consideration if decision-makers attempt to protect the key interests of Si (i=1,2,3,4,5,6) without sacrificing the key interests of other stakeholder groups in UHD programs?
4. What factors should be taken into consideration if decision-makers aim to improve the wellbeing of Si (i=1,2,3,4,5,6) without damaging the wellbeing of other stakeholder groups in UHD programs?
5. What measures can be taken to protect the key interests of Si (i=1,2,3,4,5,6) without

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sacrificing the key interests of other stakeholder groups in UHD programs?

6. What measures can be taken to improve the wellbeing of Si ($i=1,2,3,4,5,6$) without damaging the wellbeing of other stakeholder groups in UHD programs?
7. From the perspective of stakeholder, when practitioners aim to improve the social sustainability of UHD, the wellbeing or the key interests of these key stakeholders should be well maintained during UHD. Based on this viewpoint, what factors can significantly affect the social sustainability of UHD?
8. From the perspective of stakeholder, what indicators can be used to measure the social sustainability of UHD?

S1.2. Key questions in the focus group

The indicator list (Table 1) was sent to each member in the focus group before the open discussion. The main topics of the discussion are displayed in the following part.

1. Can this indicator list comprehensively reflect the key interests of you in UHD programs?
2. Based on your personal experience, can you propose examples to show how these indicators reflect the key interests of you in UHD programs?
3. Can this indicator list comprehensively reflect the wellbeing of you in UHD programs?
4. Based on your personal experience, can you propose examples to show how these indicators reflect the wellbeing of you in UHD programs?
5. In your opinion, can this indicator list comprehensively reflect the key interests of the other key stakeholders in UHD?
6. In your opinion, can this indicator list comprehensively reflect the wellbeing of the other key stakeholders in UHD?
7. In your opinion, are there any logical or conceptual contradictions in the indicator list?
8. Which indicator in the list should be modified or cancelled? How can we modify this indicator?
9. Should we add more indicators to improve this indicator list?

S1.3. Questionnaire

Q1: A survey for measuring the social sustainability of urban housing demolition (evaluating the relative importance of each indicator)

Part 1:

1. Professional expert in which you are representing:
A) Government B) Property developer C) Planner

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D) Designer E) Consultant F) Academic G) Contractor G) Other: _____

2. Years of working or research experience in the field related to urban housing demolition (please specify: _____)

< 3 years 3-5 years 5-10 years 11-15 years 16-20 years > 20 years

Part 2:

Background: Stakeholders are defined as individuals or organizations that can affect or be affected by urban housing demolition (UHD). The key stakeholders in UHD include: local governments, property developers, displaced households, demolition crews, residents living in nearby communities and the general public. From the perspective of stakeholder theory, if practitioners aim to improve the social sustainability of UHD, the wellbeing or key interests of these stakeholders should be well maintained during UHD. Based on this viewpoint, an indicator system containing 22 indicators was developed for measuring the social sustainability of UHD.

Please evaluate the relative importance of each indicator in the list.

Indicators	Description of Each Indicator	Explanation of Each Indicator	The Relative Importance of Indicators for Measuring the Social Sustainability of Urban Housing Demolition (UHD)				
			Negligible	Unimportant	Less Important	Important	Extremely Important
Community transportation	To what degree the adverse impacts on community transportation can be controlled.	UHD can influence the transportation system of the nearby communities. For example, the transportation of demolition waste may cause traffic congestion in their communities. This issue adversely affected the daily life of residents living in nearby communities. Therefore, negative impacts on community transportation should be controlled during UHD programs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Community security	To what degree the adverse impacts on community security can be	Valuable demolition waste products such steel may attract thieves and incur crimes. In addition, the flow of strangers (e.g.,	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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	reduced.	demolition crews) into the community can reduce the sense of security of the nearby residents. Consequently, efforts should be exerted toward improving community security during housing demolition.					
Healthy/safe living conditions for nearby residents	To what degree the healthy/safe conditions of nearby communities can be maintained.	UHD can cause adverse impacts on the health and safety of nearby residents. For example, toxic demolition waste such as lead can cause lung cancer. Thus, effective measures should be taken to reduce these adverse impacts.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Availability of public open place	To what degree the adverse impacts on the availability of public open place can be controlled.	Public open space can be occupied during UHD programs. For example, public spaces may be used for storing demolition waste and equipment. Since open place provides activity space for nearby residents to talk and share ideas with one other, UHD can adversely influence the social activities of these residents.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Availability of public facilities	To what degree the adverse impacts on the availability of public facilities (e.g., sport facilities; recreational facilities) can be reduced.	UHD can affect the nearby residents' use of public facilities. For example, outdoor sport facilities may be closed for safety reasons. Project managers should work to ensure that such facilities remain open.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Yu T., Shen G.Q.P., Shi Q., Zheng H., Wang G., Xu K.X. (2017). Evaluating Social Sustainability of Urban Housing Demolition in Shanghai, China. *Journal of Cleaner Production*. 153(2017), 26-40. DOI: 10.1016/j.jclepro.2017.03.005, June. (SCI, 5-Year impact factor: 5.315. **Ranked 5/29 in Green & Sustainable Science & Technology; 5/50 in Environmental Engineering; 16/225 in Environmental Sciences by JCR in 2015).**

Fair remuneration	To what degree the payment for demolition crews and other employees in a UHD program can be reasonable and fair.	The employers should pay a fair salary to the demolition crews and other employees in a UHD program. However, some demolition workers maintained that their wages were docked in some projects because they were temporary workers without formal contracts with their employer.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Child labor	The percentage of child labor in UHD programs.	The employment of children should be avoided during UHD programs because it can incur social discontent from the general public and damage the reputation of governments.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Forced labor	To what degree the work load of demolition crews are reasonable.	Work overload should be avoided during UHD programs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Health and safety of employees	To what degree the health and safety of employees can be protected.	The health and safety of demolition crews as well as other employees should be guaranteed during demolition programs. "Zero casualty" is an important indicator to evaluate the performance of government officials in UHD programs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Working hours	To what degree the working hours of demolition crews and other employees are reasonable.	The working hours of demolition crews and other employees should be reasonable. For example, during the hot summer days of Shanghai, workers should have more resting time during the daytime. If not,	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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		their health and sense of happiness can be significantly damaged.					
Equal job opportunities	To what degree individuals with different social backgrounds can obtain equal job opportunities in UHD.	In a demolition project, equal job opportunities should be given to people with different backgrounds and genders. For example, employers should not distinguish between local and nonlocal demolition crews. In addition, unemployment of displaced households induced by UHD activities should be compensated for in relocation schemes. A higher employment rate can contribute to enhancing the performance of local governments.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Personal dignity of demolition crews	To what degree the personal dignity of demolition crews can be protected in UHD programs.	The personal dignity of demolition crews should not be violated during UHD programs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Illegal demolition	To what degree the relocation and demolition activities can conform to existing laws and policies.	Illegal demolition activities should be avoided during UHD programs. For example, demolition work should not be carried out without securing administrative approval.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Illegal waste disposal	To what degree illegal waste disposal can be reduced.	The disposal of demolition waste should not be performed in an illegal way. For example, demolition waste should not be	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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		transported to a waste disposal plant without an operating license.					
Violent incidents	To what degree violent incidents can be controlled during UHD.	Violent incidents among demolition crews, displaced households and governments should be avoided during UHD programs .	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stakeholder engagement and acceptance of the UHD plan	The degree of stakeholder engagement and acceptance.	Each stakeholder (especially vulnerable groups) should have effective approaches to express their opinions to the decision makers of UHD .	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fair compensation for displaced households	To what degree the compensation standards for different households can be consistent.	In a UHD project, reasonable compensation should be paid to displaced residents. However, to reduce development costs, in many cases governments/developers may send unfair compensations to displaced residents without any option for negotiation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Personal dignity of displaced households	To what degree the personal dignity of displaced households can be maintained.	The personal dignity of displaced households should be protected in UHD programs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fair treatment for low-income and minority groups	To what degree low-income and minority groups can achieve the same benefits as stakeholders from higher	The interests of low-income or minority groups should be fairly treated and protected without discrimination.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Yu T., Shen G.Q.P., Shi Q., Zheng H., Wang G., Xu K.X. (2017). Evaluating Social Sustainability of Urban Housing Demolition in Shanghai, China. *Journal of Cleaner Production*. 153(2017), 26-40. DOI: 10.1016/j.jclepro.2017.03.005, June. (SCI, 5-Year impact factor: 5.315. **Ranked 5/29 in Green & Sustainable Science & Technology; 5/50 in Environmental Engineering; 16/225 in Environmental Sciences by JCR in 2015).**

	social classes.						
Preserving social networks	To what degree the social ties in the demolished areas can be maintained.	The social relationships of displaced households should be well preserved because social relationships play an important role in maintaining the wellbeing of these residents. For example, displaced residents (especially the old) may feel frustrated after relocating because they may be unable to spend time with their old friends in his new community.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Preservation of the city's image	To what degree the city's image can be preserved during UHD.	Since UHD programs can change the image of a city, the adverse impacts of this process should be controlled to an acceptable degree.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cultural heritage preservation	To what degree culture heritages can be preserved during UHD.	Cultural heritage near the demolition site should be carefully protected. However, to maximize business profit, governments/developers may demolish old buildings with cultural value to build high-priced buildings.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q2: A survey for measuring the social sustainability of urban housing demolition (UHD) in Shanghai

Part 1:

1. Professional expert in which you are representing:

A) Government B) Property developer C) Planner

D) Designer E) Consultant F) Academic G) Contractor G) Other: _____

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2. Years of working or research experience in the field related to urban housing demolition
(please specify: _____)

< 3 years 3-5 years 5-10 years 11-15 years 16-20 years > 20 years

Part 2:

Background: Stakeholders are defined as individuals or organizations that can affect or be affected by urban housing demolition (UHD). The key stakeholders in UHD include: local governments, property developers, displaced households, demolition crews, residents living in nearby communities and the general public. From the perspective of stakeholder, if practitioners aim to improve the social sustainability of UHD, the wellbeing or key interests of these stakeholders should be well maintained during UHD. Based on this viewpoint, an indicator system containing 22 indicators was developed for measuring the social sustainability of UHD. **Please evaluate the indicator values of Shanghai in the list.**

Indicators	Description of Each Indicator	Explanation of Each Indicator	The Social Sustainability of Urban Housing Demolition in Shanghai				
			Very poor	Low Level	Ordinary	Outstanding	Extremely outstanding
Community transportation	To what degree the adverse impacts on community transportation can be controlled.	UHD can influence the transportation system of the nearby communities. For example, the transportation of demolition waste may cause traffic congestion in their communities. This issue adversely affected the daily life of residents living in nearby communities. Therefore, negative impacts on community transportation should be controlled during UHD programs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Community security	To what degree the adverse impacts on community security can be reduced.	Valuable demolition waste products such steel may attract thieves and incur crimes. In addition, the flow of strangers (e.g., demolition crews) into the community can reduce the sense of security of the nearby	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Yu T., Shen G.Q.P., Shi Q., Zheng H., Wang G., Xu K.X. (2017). Evaluating Social Sustainability of Urban Housing Demolition in Shanghai, China. *Journal of Cleaner Production*. 153(2017), 26-40. DOI: 10.1016/j.jclepro.2017.03.005, June. (SCI, 5-Year impact factor: 5.315. **Ranked 5/29 in Green & Sustainable Science & Technology; 5/50 in Environmental Engineering; 16/225 in Environmental Sciences by JCR in 2015).**

		residents. Consequently, efforts should be exerted toward improving community security during housing demolition.					
Healthy/safe living conditions for nearby residents	To what degree the healthy/safe living conditions of nearby communities can be maintained.	UHD can cause adverse impacts on the health and safety of nearby residents. For example, toxic demolition waste such as lead can cause lung cancer. Thus, effective measures should be taken to reduce these adverse impacts.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Availability of public open place	To what degree the adverse impacts on the availability of public open place can be controlled.	Public open space can be occupied during UHD programs. For example, public spaces may be used for storing demolition waste and equipment. Since open place provides activity space for nearby residents to talk and share ideas with one other, UHD can adversely influence the social activities of these residents.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Availability of public facilities	To what degree the adverse impacts on the availability of public facilities (e.g., sport facilities; recreational facilities) can be reduced.	UHD can affect the nearby residents' use of public facilities. For example, outdoor sport facilities may be closed for safety reasons. Project managers should work to ensure that such facilities remain open.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fair remuneration	To what degree the payment for demolition crews and	The employers should pay a fair salary to the demolition crews and other employees in a UHD program. However,	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Yu T., Shen G.Q.P., Shi Q., Zheng H., Wang G., Xu K.X. (2017). Evaluating Social Sustainability of Urban Housing Demolition in Shanghai, China. *Journal of Cleaner Production*. 153(2017), 26-40. DOI: 10.1016/j.jclepro.2017.03.005, June. (SCI, 5-Year impact factor: 5.315. **Ranked 5/29 in Green & Sustainable Science & Technology; 5/50 in Environmental Engineering; 16/225 in Environmental Sciences by JCR in 2015**).

	other employees in a UHD program can be reasonable and fair.	some demolition workers maintained that their wages were docked in some projects because they were temporary workers without formal contracts with their employer.					
Child labor	The percentage of child labor in UHD programs.	The employment of children should be avoided during UHD programs because it can incur social discontent from the general public and damage the reputation of governments.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Forced labor	To what degree the work load of demolition crews are reasonable.	Work overload should be avoided during UHD programs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Health and safety of employees	To what degree the health and safety of employees can be protected.	The health and safety of demolition crews as well as other employees should be guaranteed during demolition programs. "Zero casualty" is an important indicator to evaluate the performance of government officials in UHD programs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Working hours	To what degree the working hours of demolition crews and other employees are reasonable.	The working hours of demolition crews and other employees should be reasonable. For example, during the hot summer days of Shanghai, workers should have more resting time during the daytime. If not, their health and sense of happiness can be significantly damaged.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Equal job opportunities	To what degree individuals with different social	In a demolition project, equal job opportunities should be given to people with different	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Yu T., Shen G.Q.P., Shi Q., Zheng H., Wang G., Xu K.X. (2017). Evaluating Social Sustainability of Urban Housing Demolition in Shanghai, China. *Journal of Cleaner Production*. 153(2017), 26-40. DOI: 10.1016/j.jclepro.2017.03.005, June. (SCI, 5-Year impact factor: 5.315. **Ranked 5/29 in Green & Sustainable Science & Technology; 5/50 in Environmental Engineering; 16/225 in Environmental Sciences by JCR in 2015).**

	backgrounds can obtain equal job opportunities in UHD.	backgrounds and genders. For example, employers should not distinguish between local and nonlocal demolition crews. In addition, unemployment of displaced households induced by UHD activities should be compensated for in relocation schemes. A higher employment rate can contribute to enhancing the performance of local governments.					
Personal dignity of demolition crews	To what degree the personal dignity of demolition crews can be protected in UHD programs.	The personal dignity of demolition crews should not be violated during UHD programs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Illegal demolition	To what degree the relocation and demolition activities can conform to existing laws and policies.	Illegal demolition activities should be avoided during UHD programs. For example, demolition work should not be carried out without securing administrative approval.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Illegal waste disposal	To what degree illegal waste disposal can be reduced.	The disposal of demolition waste should not be performed in an illegal way. For example, demolition waste should not be transported to a waste disposal plant without an operating license.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Violent incidents	To what degree violent incidents can be controlled	Violent incidents among demolition crews, displaced households and governments should be avoided during UHD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Yu T., Shen G.Q.P., Shi Q., Zheng H., Wang G., Xu K.X. (2017). Evaluating Social Sustainability of Urban Housing Demolition in Shanghai, China. *Journal of Cleaner Production*. 153(2017), 26-40. DOI: 10.1016/j.jclepro.2017.03.005, June. (SCI, 5-Year impact factor: 5.315. **Ranked 5/29 in Green & Sustainable Science & Technology; 5/50 in Environmental Engineering; 16/225 in Environmental Sciences by JCR in 2015).**

	during UHD.	programs .					
Stakeholder engagement and acceptance of the UHD plan	The degree of stakeholder engagement and acceptance.	Each stakeholder (especially vulnerable groups) should have effective approaches to express their opinions to the decision makers of UHD .	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fair compensation for displaced households	To what degree the compensation standards for different households can be consistent.	In a UHD project, reasonable compensation should be paid to displaced residents. However, to reduce development costs, in many cases governments/developers may send unfair compensations to displaced residents without any option for negotiation.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Personal dignity of displaced households	To what degree the personal dignity of displaced households can be maintained.	The personal dignity of displaced households should be protected in UHD programs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fair treatment for low-income and minority groups	To what degree low-income and minority groups can achieve the same benefits as stakeholders from higher social classes.	The interests of low-income or minority groups should be fairly treated and protected without discrimination.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Preserving social networks	To what degree the social ties in the demolished areas can be maintained.	The social relationships of displaced households should be well preserved because social relationships play an important role in maintaining the wellbeing of these residents. For example, displaced residents (especially the old) may feel frustrated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Yu T., Shen G.Q.P., Shi Q., Zheng H., Wang G., Xu K.X. (2017). Evaluating Social Sustainability of Urban Housing Demolition in Shanghai, China. *Journal of Cleaner Production*. 153(2017), 26-40. DOI: 10.1016/j.jclepro.2017.03.005, June. (SCI, 5-Year impact factor: 5.315. **Ranked 5/29 in Green & Sustainable Science & Technology; 5/50 in Environmental Engineering; 16/225 in Environmental Sciences by JCR in 2015**).

		after relocating because they may be unable to spend time with their old friends in his new community.					
Preservation of the city's image	To what degree the city's image can be preserved during UHD.	Since UHD programs can change the image of a city, the adverse impacts of this process should be controlled to an acceptable degree.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cultural heritage preservation	To what degree culture heritages can be preserved during UHD.	Cultural heritage near the demolition site should be carefully protected. However, to maximize business profit, governments/developers may demolish old buildings with cultural value to build high-priced buildings.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

S2. ANOVA-test

Since the survey's respondents had distinctly different backgrounds, it might be valuable to test the consistency of their understanding about the importance of different indicators. The authors employed ANOVA analysis, which is a widely adopted tool that can judge whether there is a significant difference between the responses from different groups of experts (Hair et al., 2006). There were two types of hypotheses in this test:

H0: the evaluations of industry professionals, government officials and industrial professionals on X_i ($i=1,2,3,\dots,22$) are consistent.

H1: the evaluations of industry professionals, government officials and industrial professionals on X_i ($i=1,2,3,\dots,22$) are inconsistent.

According to Hair et al. (2006), when the P-value of ANOVA analysis is less than or equal to 0.01, the difference between different groups is extremely significant; when P is between 0.01 and 0.05, there is a variation; when P is greater than 0.05, there is no difference. Based on the data in Table S1, we can see that the respondents with different backgrounds showed inconsistent opinions about the importance of health/safe living conditions and preserving social networks. In terms of health/safe living conditions, the mean value of the industrial professionals (reaching 4.375) was lower than the values of the other two groups, which implies that industrial practitioners in Shanghai may fail to pay sufficient attention to the living conditions of the

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residents around their work sites. In UHD projects, sustainable practices such as waste recycling or noise control may incur additional costs that reduce the short-term profits of these projects. Although sustainable practices can improve the living conditions of nearby residents and may increase the welfare of the society in a long term, practitioners may have limited incentives to take these practices because existing policies and business operations cannot enable them to achieve economic profits within project cycle (PL). Accordingly, industrial professionals may pay sufficient attentions to this indicator in practice. Meanwhile, the scholars from universities exhibited the greatest concern about health/safe living conditions (reaching 4.788), and government officials showed a neutral opinion among all of the respondents (reaching 4.549). In this study, most scholars have research experience in the fields of sustainable development. Therefore, they may have a better sustainable awareness and pay more attentions to community conditions in UHD, compared with government officials and industrial professionals. This may be the reason to explain why scholars had the highest score in this indicator.

In terms of preserving social networks, the mean value of the government officials amounted to 3.567, which was the highest level of the tree groups. Meanwhile, the scholars gave this indicator the lowest mean point (2.696), and the practitioners' mean value was 2.951. In the context of China, relationships in social network are very important for the promotion of government officials and the efficiency of business operations (Ling and Li, 2012). Therefore, these two groups of respondents paid more attentions to social network.

In the second-wave questionnaire, all of the indicators' P-values were greater than 0.05. Therefore, the evaluation of the respondents in terms of indicator values was consistent and robust. The results implied that respondents generally reached an agreement on the assessment of current social sustainability level of Shanghai.

Table S1 ANOVA test

NO.	P-Value in survey 1	P-Value in survey 2	NO.	P-Value in survey 1	P-Value in survey 2
x1	0.246	0.437	x12	0.309	0.439
x2	0.549	0.079	x13	0.414	0.605
x3	0.007	0.922	x14	0.639	0.930
x4	0.152	0.675	x15	0.121	0.870
x5	0.435	0.436	x16	0.765	0.622
x6	0.505	0.694	x17	0.591	0.344
x7	0.081	0.296	x18	0.978	0.967
x8	0.806	0.218	x19	0.593	0.462
x9	0.931	0.409	x20	0.047	0.769
x10	0.998	0.350	x21	0.164	0.100

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x11	0.935	0.682	x22	0.145	0.295
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It is worth noting that the final sustainability score of this study was calculated based on the overall evaluation of all the three groups of respondents. The reliability-test in Section 4.5 indicates that the differences among these three groups of respondents are acceptable in this study. Therefore, these differences could not significantly affect the final results of this study. Accordingly, the authors only presented the results of ANOVA-test in the Supplementary materials.

Reference

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