

Achieving Sustainability in Railway Projects: Major Stakeholder Concerns

Hongping Yuan, School of Economics and Management, Southwest Jiaotong University, P. R. China.

ABSTRACT ■

Achieving sustainability is becoming increasingly critical for measuring the overall success of infrastructure projects. Given the complexity of such projects, the successful management of sustainability-related targets requires joint efforts from the major stakeholders involved, including project clients, contractors, suppliers, and the general public. Nevertheless, these stakeholders often have different, and sometimes even conflicting, concerns regarding the achievement of project sustainability. Confrontations and disputes can arise unless these concerns are carefully analyzed and addressed. However, we know little specifically about how major stakeholders perceive infrastructure sustainability and how their concerns differ in the three dimensions of project sustainability: economic, environmental, and social sustainability. This study investigated the major concerns of stakeholders in achieving sustainability in a typical infrastructure project (i.e., railway projects). A triangulated methodology was adopted, including a literature review, a questionnaire survey, and interviews to obtain data from project stakeholders. Based on the results, there was a significant divergence of views among stakeholder groups, and conflicts arose when there was a mismatch between stakeholders' perceptions. A list of major concerns from each individual stakeholder group was ranked and discussed. Some measures for promoting the consensus on achieving project sustainability among different stakeholder groups were also provided. The study not only provides insights into understanding differences in the concerns of major stakeholder groups in achieving railway project sustainability, it also helps develop quantitative approaches for measuring the degree of consensus and conflict among major stakeholder groups so as to minimize their concern differences.

KEYWORDS: stakeholder management; conflict; consensus; sustainability; railway projects

Project Management Journal, Vol. 48, No. 5, 00–00
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Published online at www.pmi.org/PMJ

INTRODUCTION ■

It has been widely recognized that construction activities consume a large amount of natural resources and simultaneously cause diverse adverse impacts on the environment and society. For instance, on the one hand, the construction industry consumes more than 30% of the energy in Organization for Economic Cooperation and Development (OECD) countries, whereas, on the other hand, it produces 16% of freshwater withdrawals in the United States and about 33% of global greenhouse gas emissions worldwide (Pearce, Ahn, & HammiGlobal, 2012). These great environmental impacts force the industry to convert from traditional construction practices toward sustainable construction, which collectively embraces the principles of economic sustainability, environmental sustainability, and social sustainability, with the ultimate aim of achieving a balance between the social, economic, and environmental aspects of construction and maximizing the benefits associated (Edum-Fotwe & Price, 2009; Sourani & Sohail, 2011).

Among the construction works, infrastructure projects—which cover a variety of construction works including bridges, tunnels, highways, railways, airports, water supply facilities, and power plants—have played an increasingly important role in both developed and developing economies. Compared to regular construction works, infrastructure projects require much greater amounts of difficult planning, financial investments, management efforts, and resources of varying natures (Matar, Osman, Georgy, Abou-Zeida, & El-Said, 2015), and their planning and execution are often riskier than those with other projects. Infrastructure projects also bring more influences—either positive or negative—to society (Flyvbjerg, 2007).

Because delivering infrastructure projects successfully is crucial in determining the success of manufacturing and agricultural activities, improving the delivery of health and other services, expanding the reach of education, and supporting social and cultural advances (The World Bank, 2015), the high complexity of infrastructure project implementation has been well perceived by prior studies. Understanding the complexity of infrastructure projects is important because it is associated with difficulties in decision making and project success (Remington, Zolin, & Turner, 2009). Baccarini (1996) summarized two dimensions of project complexity: technological complexity and organizational complexity, proposing that project complexity should be interpreted in terms of differentiation (for technological complexity) and interdependencies (for organizational complexity). Since then, the concept of project complexity has evolved quickly and subsequent studies have added diverse dimensions. For example, Maylor (2010) considered resource complexity to be a third dimension for capturing project complexity. Based on an extensive review of the literature, Bosch-Rekvelde, Jongkind, Mooi, Bakker, and Verbraeck (2011) stated that infrastructure complexity generally consists of technical complexity, organizational complexity, and

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environmental complexity. Vidal and Marle (2008) argued that project complexity can be characterized through four clusters of factors: project size factors, factors of project variety, the interdependencies and interrelations within the project system, and project complexity context—dependence. In a recent study, He, Luo, Hu, and Chan (2015) proposed a framework that integrates six dimensions of complexity for infrastructure projects: technological, organizational, goal, environmental, cultural, and information complexities.

In any infrastructure project, many different and sometimes discrepant interests have to be considered. The representatives of these interests are referred to as project stakeholders (Olander & Landin, 2005). Research interest in project stakeholders has grown considerably since Freeman (1984) published his seminal work *Strategic Management: A Stakeholder Approach*. Nowadays, stakeholder management has been identified as a considerable and inherent component that contributes to project complexity—organizational, environmental, and cultural (Aaltonen & Kujala, 2010; Flyvbjerg, 2007, 2014). Bosch-Rekvelde et al. (2011) believed that the multi-objectivity and multiplicity of stakeholders add to project complexity. Both the number of stakeholders and stakeholders' disaffection were identified as major determinants affecting the organizational complexity of infrastructure projects (Vidal & Marle, 2008). This statement is echoed by Brockmann and Girmscheid (2008), who proposed the idea of social complexity to define the complexity caused by the number and diversity of project stakeholders.

Despite the vital importance of project stakeholders in project management, studies investigating the effective management of project stakeholders are poorly detailed in the existing literature. Numerous project failures occur as a result of insufficiently and improperly dealing with major project stakeholders' concerns and failing to satisfy their

expectations (Bourne & Walker, 2005). In line with Eskerod and Huemann (2013), stakeholder issues have been treated only superficially in project management standards. LeRoy (2005) ascertained that a root cause for the failure of complex projects can be the inability of the project managers, team members, clients, sponsors, and associated stakeholders to discern the level of complexity they face. Similarly, Atkin and Skitmore (2008) proposed that project failures are primarily attributed to the fact that certain stakeholder groups have the power (such as resources and capacity) to stop projects.

Therefore, developing approaches for effective stakeholder management in infrastructure projects is a pressing need. Given the high complexity of infrastructure projects, which is intensified by the varying and often conflicting concerns of project stakeholders (Atkin & Skitmore, 2008), it is challenging but essential to examine how each of the major stakeholder groups perceives project sustainability. Based on an investigation of a typical infrastructure project (i.e., a railway), the study intends to reach a consensus on project stakeholder concerns in achieving railway project sustainability.

Literature Review

Stakeholders in Infrastructure Projects

The term *stakeholder* originated with the Stanford Research Institute in the 1960s. It refers to any groups or individuals who support the organization and are crucial for its survival and development (Freeman, 1984). Although rooted in strategic management, the concept has received widespread attention worldwide and developed quickly after its origination. Because Freeman (1984, p. 46) defines the stakeholder as "any group or individual who can affect, or is affected by, the achievement of the firm's objectives," the concept has been brought and applied into many disciplines, including construction project management. In line with the Project Management Institute

(PMI, 2013, p. 31), a project stakeholder refers to "an individual, or group, who may affect, be affected by, or perceive itself to be affected by a decision, activity, or outcome of a project." This definition can also be properly extended to the implementation of infrastructure projects (Nguyen, Skitmore, & Wang, 2009).

In recent years, project stakeholder management has been perceived as an important criterion in project evaluation and implementation and, accordingly, the well-known "iron triangle" (i.e., cost, quality, and time) for measuring project success has been largely widened to encompass project stakeholder satisfaction as well (Toor & Ogunlana, 2010). A rational consideration for this extension is that project success means different things to different stakeholders. For instance, a project perceived as successful from the contractor's perspective can be viewed as a failure by the client or other stakeholders. Consequently, the perceptions of different stakeholders can be influential in measuring project success, taking all objective criteria into consideration. The perception of project success varies widely across various stakeholders, and these differences in stakeholders' views on project success can eventually have an impact on project implementation (Beringer, Jonas, & Kock, 2013; Li, Ng, & Skitmore, 2012).

Stakeholder identification has been commonly regarded as the first step in achieving effective stakeholder management in infrastructure projects (Nguyen et al., 2009). Previous studies document various approaches for grouping and categorizing project stakeholders. Project Management Institute (2013) suggested a way to identify project stakeholders from three categories. The first category of stakeholders includes those within the project, in other words, the project team. The second category encompasses those outside the project, but within the organization, including the sponsor, functional managers, and organizational groups. The last category includes

stakeholders outside the organization, such as joint partners, suppliers, end users, and government agencies. In infrastructure projects, stakeholders are generally divided into internal and external stakeholders, with internal stakeholders being those directly involved in a project's implementation processes (e.g., clients, contractors, engineers, suppliers, employees) and external stakeholders those affected by the project's implementation processes and outcomes (e.g., government agencies and the general public) (Atkin & Skitmore, 2008; Winch, 2004; Zeng, Ma, Lin, Zeng, & Tam, 2015). Ma'nowong and Ogunlana (2010) stressed that all stakeholders' interests need to be equally considered to achieve infrastructure project success.

As typical infrastructure, railway projects bring influences to society and the environment, either positively or negatively, in a number of ways, and those influences can be related to both internal and external stakeholders. In a Swedish railway project, Olander and Landin (2008) defined major stakeholder groups that included the project owner, employees and suppliers, authorities and politicians, and the general public. They further highlighted that the general public should be regarded as a key stakeholder because public acceptance was deemed necessary in order to achieve a successful outcome in such a large infrastructure project. Although the general public often has no formal power to affect the project decision-making process, it does have an informal power that, when exercised, can press more powerful stakeholders into changing their perceptions of the project. The important role of government agencies and the general public in developing sustainable railway projects was also confirmed by Rangarajan, Long, Tobias, and Keister (2013). Following Davis (2014), four groups of project stakeholders are included in our study: government agencies, environmental protection organizations, internal stakeholders such as clients and contractors, and the general public.

Government agencies and environmental protection organizations can influence railway project implementation processes, especially on issues of environmental and social influences; internal stakeholders can influence railway projects through project decisions and execution activities; and the general public can influence railway projects, particularly in the conceptualization stage and can be those most influenced by project outcomes (Li et al., 2012).

Stakeholder Concerns About Railway Project Sustainability

Along with the evolution of criteria for measuring project success and performance, stakeholder-related issues have been receiving increasing attention because each stakeholder has a different kind of stake in the project under development, and all of the stakeholders' perceptions and concerns are influential when a project decision has to be made (Bryde & Brown, 2005). According to recent studies, there is a tendency for each group of stakeholders to attempt to impact the implementation of railway projects, depending merely on their own benefits and concerns, even though the success of such projects requires joint cooperation and endeavors from all stakeholders, both theoretically and practically (Berger & Lews, 2011; Olander & Landin, 2005).

Currently, in railway projects there is a lack of consensus among major stakeholders about achieving project sustainability. As discussed previously, the indicators for measuring railway project sustainability can be related to the three dimensions of economic, environmental, and social sustainability. Objectively, a successful project should explore and reach a harmonious balance among these three dimensions. However, it is of great difficulty, and sometimes even impossible, to realize this in real projects when stakeholder perceptions and concerns are taken into account. The reasons for this lie mainly in two aspects. The first aspect is that the perceptions and concerns of different

stakeholders in achieving railway project sustainability can be inconsistent or even conflicting (Li et al., 2012), and the second is that the perceptions and concerns of different stakeholders may not be sufficiently addressed and their expectations not met with satisfaction (Bourne & Walker, 2005). In order to deal with the perceptions and concerns of major stakeholders in railway projects, previous studies have proposed a diversity of indicators for measurement, which are provided in the next section.

Research Methodology

As Parnphumeesup and Kerr (2011) proposed, the combination of qualitative and quantitative methods is useful for drawing out the major preferences of a complex group of stakeholders; thus this approach has been applied in the present study. First, a preliminary questionnaire was designed based on the stakeholder concerns that were qualitatively identified and elicited from existing literature. A similar strategy of characterizing the concerns with a five-point Likert scale, as adopted by Li et al. (2012), was used for variable measurement, with 1 meaning the factor under evaluation was of least importance to railway project sustainability, and 5 indicating that the factor under evaluation was of most importance to railway project sustainability.

Given that some of the factors identified were primarily based on research outcomes beyond China, they were then supplemented by soliciting viewpoints from selected project stakeholders involved in the Chinese railway project to better demonstrate actual practices. In this regard, a pilot study was carried out to test the suitability and applicability of the questionnaire. In this exercise, 16 stakeholders representing the four stakeholder groups were invited to participate and are consulted about whether the items of the questionnaire were appropriate for acquiring the information intended. To ensure that each of the participants was sufficiently knowledgeable about railway project sustainability, the invited participants from

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Stakeholder Group	Code	Organization	Position
Government agencies	G1	Provincial Construction Department	Associate Director
	G2	Provincial Development and Reform Commission	Assistant Director
	G3	Provincial Land and Resources Department	Associate Director
	G4	Municipal Construction Bureau	Associate Director
Environmental protection organizations	E1	NGO	General Staff
	E2	NGO	Associate Director
	E3	NGO	General Staff
	E4	NGO	Fellow Member
Internal stakeholders	I1	Private Construction Company	Deputy Director
	I2	State-Owned Railway company	Director (Cost Control Unit)
	I3	State-Owned Railway Group	Project Manager
	I4	Communications Construction Company	Project Manager
The general public	P1	General Public	N/A
	P2	General Public	N/A
	P3	General Public	N/A
	P4	General Public	N/A

Table 1: Detailed profiles of the participants interviewed.

government agencies, environmental protection organizations, and internal stakeholders have all had hands-on experience in engaging in railway projects, whereas participants from the general public were residents who live in the nearby area where railway projects were carried out and have been affected by railway construction activities. The detailed profiles of the surveyed stakeholders are shown in Table 1.

After the pilot study, modifications were made accordingly. First, a short introduction was added, detailing the purpose of the questionnaire. Second, because some interviewees recommended considering that specific stakeholder group(s) may perceive some of the concerns irrelevant to their interests, an N/A (not applicable) item was also provided as an alternative selection in the questionnaire. And third, some of the factors were highlighted by some

interviewees when referring to the particular practice of implementing railway projects in China, including project financing risks, bureaucracy, rehabilitation cost of the ecosystem, environmental risk management, health and safety in construction, and conflicts between local people and migrant workers. Based on the outcomes of the literature review and the pilot study, the factors for the survey were finalized (Table 2).

Next, given that data for further analysis should be obtained from people who have adequate knowledge and practical experience in engaging in sustainability-related issues in railway projects, purposive sampling strategies were adopted. The method is deemed capable of allowing researchers to look for individuals who have particular expertise that is most likely to advance the understanding of issues under inquiry (Miles & Huberman, 1994). A total of

788 questionnaires were distributed through email and face-to-face site surveys. The survey was conducted between September 2015 and January 2016, with a follow-up reminder for questionnaires sent by email. In the survey, respondents were asked to judge to what extent the 28 sustainability-related factors were perceived as important when the stakeholders participated in railway projects. Finally, 226 valid questionnaires were returned by the respondents, reflecting a response rate of 28.7%, which was consistent with “the norm of 20% to 30% with most questionnaire surveys conducted in the construction industry.” (Akintoye, 2000)

The detailed profiles of the respondents are tabulated in Table 3, according to which, 50 (22.1%) respondents are from government agencies, 48 (21.2%) are from environmental protection organizations, 62 (27.4%) are from internal stakeholders, and 66 (29.2%) are from the general public. According to their responses to the particular question: “Have you had knowledge/experience in either engaging in railway projects or understanding railway project sustainability?” in Section 1 of the questionnaire, we believe that the vast majority of the respondents (214 respondents, or 94.7%) possess a good understanding of railway project sustainability and thus are well qualified for providing answers in the survey.

The data collected were analyzed through statistical analysis methods, including ranking analysis based on mean values, independent sample t-tests, ANOVA, and Levene’s tests. In particular, the results of ranking analysis formed the base for prioritizing each of the factors according to stakeholder perceptions, and the latter three were adopted to identify the significant differences of stakeholder concerns among the four stakeholder groups (if any), in which $P < 0.05$ was adopted as the cutting-off value (Li et al., 2012). All the analyses were conducted using Statistical Package for the Social Sciences (SPSS) software.

Dimensions of sustainability		Factors	Yao et al. (2011)	Yuan (2013)	Fernández-Sánchez Rodríguez-López (2010)	Kyili, Fokaides, and Jimenez (2016)	Ugwu et al. (2006)	Kumar and Katoch (2014)	Alsulami and Mohamed (2011)	Semi-Structured Interviews
Economic	Ec1: Impact to local economy	✓			✓		✓		✓	
	Ec2: Project financing risk	✓							✓	★
	Ec3: Project investment plan	✓								
	Ec4: Life cycle cost	✓	✓		✓			✓		
	Ec5: Life cycle profit	✓	✓					✓		
	Ec6: Payback period	✓								
	Ec7: Bureaucracy				✓					★
	Ec8: Rehabilitation cost of ecosystem							✓		★
Environmental	En1: Air pollution	✓	✓		✓	✓	✓	✓	✓	
	En2: Noise emission	✓	✓		✓	✓	✓	✓	✓	
	En3: Water pollution	✓	✓		✓	✓	✓	✓	✓	
	En4: Waste	✓	✓		✓	✓	✓	✓	✓	
	En5: Land pollution	✓	✓		✓	✓	✓	✓		
	En6: Habitat loss and damage	✓			✓	✓	✓	✓		
	En7: Soil loss and erosion	✓			✓	✓	✓	✓		
	En8: Proper utilization of resources		✓						✓	
	En9: Environmental risk management				✓	✓	✓			★
	En10: Visual impact	✓			✓	✓	✓	✓	✓	
Societal	S1: Impacts on living standards	✓			✓			✓	✓	
	S2: Protection of cultural heritage	✓			✓		✓	✓	✓	
	S3: Health and safety in construction	✓		✓	✓	✓	✓	✓	✓	★
	S4: Long-term health and safety	✓			✓		✓	✓	✓	
	S5: Job opportunities	✓			✓		✓	✓	✓	
	S6: Public participation and satisfaction			✓	✓	✓	✓	✓	✓	
	S7: Corporate social responsibility			✓	✓	✓		✓		
	S8: Stakeholders' awareness								✓	
	S9: Conflicts between local people and migrant workers							✓		★

Symbols: ✓ indicates the factor is identified from the literature; ★ means the factor is highlighted by the project practitioner interviewed.

Table 2: A tentative list of criteria for assessing infrastructure sustainability.

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Stakeholder Groups	Number of Questionnaires			Percentage in Overall Respondents (%)
	Sent Out	Valid Responses	Responding Rate (%)	
Government agencies	189	50	26.5	22.1
Environmental protection organizations	182	48	26.4	21.2
Internal stakeholders	210	62	29.5	27.4
The general public	207	66	31.9	29.2
Total	788	226	28.7	99.9

Table 3: Detailed profiles of respondents in the questionnaire survey.

Finally, the participants in the pilot study were invited again to a focus group in which the survey outcomes were presented and discussions about disparities in stakeholder concerns facilitated. The focus group was useful in gaining an in-depth understanding about the differences of perceptions among the four stakeholder groups and consequently enabled a clearer and more accurate interpretation on the analytic results.

Research Results and Analyses

Ranking of Concerns Based on Stakeholder Perceptions

The importance of stakeholder concerns is first ranked based on the mean score of each criterion as perceived by the stakeholder groups. The detailed results are tabulated in Table 4. To facilitate a comparison between various stakeholder concerns, the rule for categorizing the importance level of those stakeholder concerns is as follows: (1) not important (with a mean score of less than 1.5); (2) fairly important (with a mean score of greater than 1.5 but not more than 2.5); (3) important (with a mean score of greater than 2.5 but not more than 3.5); (4) very important (with a mean score of greater than 3.5 but not more than 4.5); and (5) extremely important (with a mean score of greater than 4.5).

All the criteria are regarded by the respondents from government agencies to be at least important in achieving railway project sustainability. Among

them, three are considered extremely important, including Ec6 (4.80), Ec5 (4.76), and Ec2 (4.62); 18 are considered very important; and the other six are perceived as important. Obviously, the economic dimension of sustainability is highlighted by the respondents from government agencies. In particular, they are concerned not only about the potential profit to be gained from undertaking railway projects, but also about the time frame for gaining the profit. In addition, when implementing railway projects, the environmental dimension receives relatively less attention compared with the other two dimensions. The interviewed participants explained that over the past few years, environmental and social criteria have received increasing emphasis from Chinese government agencies at different levels, because those agencies are challenged to inspect any adverse environmental and social impacts of considerable influence in implementing railway projects. The participants also admitted that at present, economic criteria generally remain their first priority when developing railway projects. This is especially common in projects financed under the framework of PPP (public-private partnership), according to which the economic advantage of projects has been considered a component that cannot be ignored when negotiating with the private party.

For the respondents from environmental protection organizations, all of the criteria are considered at least important in achieving railway project sustainability

because the lowest mean score is 2.73, which is greater than 2.5. When the three dimensions of criteria are compared, it is clear that these respondents generally perceive the environmental dimension of the criteria to be of the utmost importance, because the top three criteria are all related to environmental sustainability, including En1 (4.88), En2 (4.83), and En9 (4.79). Although environmental criteria are highly ranked by the respondents from environmental protection organizations, these respondents complained that, in practical cases, the situation can be very different. Four of the interviewed participants admitted that in the majority of cases, the development of major railway projects is merely evaluated and implemented from an economic point of view. They suggested that the current performance evaluation mode of governmental agencies in China should be changed from emphasizing regional economic contribution to national gross domestic product (GDP) alone, to effectively balancing the coordinated development of the three dimensions of economy, environment, and society. Otherwise, the continual development pattern of railway projects would cause more and more resource consumption and environmental-social threats.

The respondents from internal project stakeholders assign high scores to all the criteria (>3.20), whereas some of the economic criteria—including Ec6 (4.79), Ec7 (4.76), Ec2 (4.76), and Ec5 (4.66)—are regarded as the most important concerns. The interviewed internal stakeholders argued that because of China's unique political, social, and cultural background, the government normally plays a leading and mostly dominant role in the governing system of railway project decision making. As a result, the most significant and tempting incentive for private parties to be involved in railway project implementation is the expectation of either gaining economic benefits from projects or establishing a mutual relationship with the local government in the long run, through which it would be much easier

Dimension	Stakeholder Concerns About Infrastructure Sustainability	Environmental						The General Public	
		Government Agencies		Protection Organizations		Internal Stakeholders		Mean Value	Ranking
		Mean Value	Ranking	Mean Value	Ranking	Mean value	Ranking		
Economic	Ec1: Impact to local economy	4.50	4	3.52	21	3.77	18	4.30	18
	Ec2: Project financing risk	4.62	3	3.19	25	4.76	2	3.53	27
	Ec3: Project investment plan	3.54	21	2.73	27	4.27	10	3.55	26
	Ec4: Life cycle cost	4.16	11	3.19	24	4.31	8	3.67	9
	Ec5: Life cycle profit	4.76	2	3.42	22	4.66	4	3.89	25
	Ec6: Payback period	4.80	1	3.00	26	4.79	1	4.03	21
	Ec7: Bureaucracy	2.72	27	3.25	23	4.76	2	4.44	14
	Ec8: Rehabilitation cost of ecosystem	3.56	19	4.69	5	4.31	8	4.42	15
Environmental	En1: Air pollution	3.56	19	4.88	1	3.95	15	4.73	6
	En2: Noise emission	3.58	18	4.83	2	3.58	22	4.73	6
	En3: Water pollution	3.20	25	4.60	8	3.35	25	4.55	12
	En4: Waste	3.34	22	4.71	4	4.13	11	4.74	5
	En5: Land pollution	3.18	26	4.56	10	3.68	21	4.27	19
	En6: Habitat loss and damage	3.30	24	4.52	12	3.50	23	3.95	22
	En7: Soil loss and erosion	3.32	23	4.44	15	3.26	27	3.91	23
	En8: Proper utilization of resources	3.82	17	4.23	17	4.05	13	4.32	16
	En9: Environmental risk management	4.06	14	4.79	3	3.27	26	4.62	10
	En10: Visual impact	4.28	9	4.42	16	3.44	24	4.32	16
Societal	S1: Impacts on living standards	4.30	8	4.50	13	3.81	17	4.76	4
	S2: Protection of cultural heritage	4.12	12	4.67	7	4.10	12	4.58	11
	S3: Health and safety in construction	4.08	13	4.21	18	4.52	5	4.17	20
	S4: Long-term health and safety	4.02	15	4.54	11	3.90	16	4.70	8
	S5: Job opportunities	4.48	5	3.83	20	4.03	14	4.83	1
	S6: Public participation and satisfaction	3.90	16	4.58	9	3.73	20	4.83	1
	S7: Corporate social responsibility	4.42	7	4.69	5	3.77	18	4.79	3
	S8: Stakeholders' awareness	4.28	9	4.48	14	4.45	6	4.48	13
	S9: Conflicts between local people and migrant workers	4.44	6	3.96	19	4.35	7	3.91	23

Table 4: Ranking of respondents' perceptions of concerns about infrastructure sustainability.

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Stakeholder Concerns	Equal Variances Assumed	Levene's Tests for Equality of Variances		T-test for Equality of Means				
		F	Sig.	t	df	Sig. (two-tailed)	Mean diff.	Std. error diff.
Ec1	N	6.506	0.012	7.234	84.2	0.000	0.98	.135
Ec2	N	6.584	0.012	10.049	83.5	0.000	1.43	.143
Ec3	Y	0.002	0.963	5.167	96.0	0.000	0.81	.157
Ec4	Y	2.957	0.089	5.338	91.5	0.000	0.97	.183
Ec5	N	37.257	0.000	8.521	63.1	0.000	1.34	.158
Ec6	N	26.310	0.000	10.914	59.6	0.000	1.80	.165
Ec7	N	4.067	0.047	-2.571	90.3	0.012	-0.53	.206
Ec8	N	11.397	0.001	-9.941	89.5	0.000	-1.13	.113
En1	N	77.316	0.000	-8.401	59.1	0.000	-1.32	.157
En2	N	29.297	0.000	-11.067	75.7	0.000	-1.25	.113
En3	N	4.385	0.039	-10.196	80.3	0.000	-1.40	.138
En4	N	8.439	0.005	-11.290	83.8	0.000	-1.37	.121
En5	N	4.630	0.034	-9.280	81.2	0.000	-1.38	.149
En6	Y	2.776	0.099	-9.304	96	0.000	-1.22	.131
En7	Y	2.059	0.155	-9.199	96	0.000	-1.12	.121
En8	Y	3.776	0.055	-2.564	96	0.012	-0.41	.160
En9	N	12.938	0.001	-5.921	75.6	0.000	-0.73	.124
S2	Y	0.533	0.467	-4.690	96	0.000	-0.55	.117
S4	Y	2.348	0.129	-3.775	96	0.000	-0.52	.138
S5	Y	2.361	0.128	5.011	96	0.000	0.65	.129
S6	N	14.444	0.000	-4.925	80.3	0.000	-0.68	.139
S7	N	13.017	0.000	-2.292	87.7	0.024	-0.27	.117
S9	N	8.187	0.005	3.603	95.2	0.001	0.48	.134

Table 5: Stakeholder concerns with significant differences between government agencies and environmental protection organizations.

for the private party to strive for project development in that region.

For the general public, all the criteria receive relatively high mean scores (>3.50) when compared with those given by the other three stakeholder groups, among which S5 (4.83), S6 (4.83), S7 (4.79), and S1 (4.76) are identified as the most important concerns. The participants from the general public claimed that although railway projects are beneficial to more convenient and comfortable living conditions, these conditions also suffered a lot from railway project implementation, especially with regard to pollution and safety issues. Three of the interviewed people

advised that the decision-making process of railway project development has to be improved to enable more public participation. They further explained that in accordance with the current regulatory system, although the environmental impact evaluation report must be released to the public, under current conditions, the general public is rarely involved in the entire evaluation process and its voice is rarely heard.

Differences in Perceptions Between Stakeholder Groups

To further demonstrate and clarify the differences in perceptions regarding railway project sustainability between

different stakeholder groups, independent sample t-tests were carried out to investigate any significant differences existing in the mean values of any pair of stakeholder groups. The results are shown in Tables 5 through 10 and explained in the following sections.

Government Agencies Versus Environmental Protection Organizations

In line with the results shown in Table 5, more than 85% of the criteria (23 out of 27) demonstrate significant differences in the mean value as perceived by government agencies and environmental protection organizations. The two stakeholder

Stakeholder Concerns	Equal Variances Assumed	Levene's Tests for Equality of Variances		T-test for Equality of Means				
		F	Sig.	t	df	Sig. (two-tailed)	Mean diff.	Std. error diff.
Ec1	Y	0.154	0.696	6.554	110	0.000	0.73	0.111
Ec3	N	13.190	0.000	-5.675	81.1	0.000	-0.73	0.129
Ec7	N	22.096	0.000	-14.645	66.9	0.000	-2.04	0.139
Ec8	Y	1.286	0.259	-5.631	110	0.000	-0.75	0.133
En1	N	18.584	0.000	-2.249	82.7	0.027	-0.39	0.174
En4	N	7.349	0.008	-6.377	91.0	0.000	-0.79	0.124
En5	Y	0.468	0.495	-3.259	110	0.001	-0.50	0.153
En9	Y	0.157	0.693	5.372	110	0.000	0.79	0.146
En10	Y	0.065	0.800	6.155	110	0.000	0.84	0.137
S1	Y	1.805	0.182	3.041	110	0.003	0.49	0.162
S3	Y	0.132	0.717	-3.948	110	0.000	-0.44	0.110
S5	Y	0.203	0.653	3.886	110	0.000	0.45	0.115
S7	Y	0.727	0.396	5.090	110	0.000	0.65	0.127

Table 6: Stakeholder concerns with significant differences between government agencies and internal stakeholders.

groups by and large reached a common understanding about the criteria of En10, S1, S3, and S8. The greatest difference in mean values lies in the criteria of Ec6 (with a mean difference of 1.80), Ec2 (with a mean difference of 1.43), and En3 (with a mean difference of 1.40).

Government Agencies Versus Internal Stakeholders

Compared with the former pair of groups, government agencies and internal stakeholders share more common viewpoints on railway project sustainability, with more than 50% criteria having no significant differences in mean values (Table 6). Among the criteria of significant mean difference, the top three are Ec7 (with a mean difference of -2.04), En10 (with a mean difference of 0.84), and En4 and En9 (both with a mean difference of 0.79, respectively), demonstrating that the disparities in railway project sustainability are mainly in the economic and environmental aspects.

Government Agencies Versus the General Public

When representatives from government agencies and the general public are

asked about their concerns over railway project sustainability, a very conflicting circumstance is revealed, with about 89% of the criteria (24 out of 27) having significant differences in mean values (Table 7). Among those 24 criteria, the greatest mean differences are in Ec7 (with a mean difference of -1.72), En4 (with a mean difference of -1.40), and En3 (with a mean difference of -1.35). Similar to the group of government agencies and internal stakeholders, the concerns of greatest contradiction here are primarily involving economic and environmental issues.

Environmental Protection Organizations Versus Internal Stakeholders

For environmental protection organizations and internal stakeholders, the survey results in Table 8 show disparities in 23 of the 27 criteria, and the top three of the most significant mean differences are Ec6 (with a mean difference of -1.79), Ec2 (with a mean difference of -1.57), and Ec3 (with a mean difference of -1.55), showing that environmental protection organizations and internal stakeholders perceive railway project

sustainability very differently, particularly in terms of economic performance.

Environmental Protection Organizations Versus the General Public

Only 14 criteria receive mean values of significant difference when considered by environmental protection organizations and the general public. Of these, Ec7 (with a mean difference of -1.19), Ec6 (with a mean difference of -1.03), and S5 (with a mean difference of -1.00) obtain the greatest values in mean difference. In line with the results shown in Table 9, the two stakeholder groups have apparent contradicting perceptions regarding the majority of economic sustainability criteria, and disagree with each other on only three environmental sustainability criteria and three social sustainability criteria.

Internal Stakeholders Versus the General Public

Generally, internal stakeholders and the general public reach a consensus on only two criteria, including Ec8 and S8 (Table 10). Among the other criteria of significant mean differences,

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Stakeholder Concerns	Equal Variances Assumed	Levene's Tests for Equality of Variances		T-test for Equality of Means				
		F	Sig.	t	df	Sig. (two-tailed)	Mean diff.	Std. error diff.
Ec1	N	9.827	0.002	2.057	95.8	.042	.20	.096
Ec2	N	8.557	0.004	8.407	113.0	.000	1.09	.130
Ec4	Y	0.531	0.468	3.280	114	.001	.49	.150
Ec5	N	14.321	0.000	7.703	106.1	.000	.87	.112
Ec6	Y	2.628	0.108	7.312	114	.000	.77	.105
Ec7	N	4.662	0.033	-11.589	81.4	0.000	-1.72	.148
Ec8	Y	0.717	0.399	-6.796	114	0.000	-0.86	.127
En1	N	60.397	0.000	-7.350	62.5	0.000	-1.17	.159
En2	N	17.007	0.000	-10.093	78.3	0.000	-1.15	.114
En3	N	4.934	0.028	-10.115	75.3	0.000	-1.35	.133
En4	N	14.104	0.000	-12.190	76.3	0.000	-1.40	.115
En5	N	15.589	0.000	-7.902	67.5	0.000	-1.09	.138
En6	N	4.020	0.047	-4.893	95.2	0.000	-0.65	.134
En7	Y	1.298	0.257	-3.944	114	0.000	-0.59	.149
En8	Y	2.105	0.150	-4.197	114	0.000	-0.50	.119
En9	N	4.782	0.031	-4.525	78.2	0.000	-0.56	.124
S1	N	19.889	0.000	-3.519	68.6	0.001	-0.46	.130
S2	Y	0.022	0.881	-4.135	114	0.000	-0.46	.110
S4	N	5.696	0.019	-5.148	83.2	0.000	-0.68	.132
S5	N	38.837	0.000	-4.155	87.2	0.000	-0.35	.085
S6	N	50.120	0.000	-7.329	63.9	0.000	-0.93	.127
S7	N	30.689	0.000	-3.412	76.2	0.001	-0.37	.108
S9	Y	2.828	0.095	3.569	114	0.001	0.53	.149

Table 7: Stakeholder concerns with significant differences between government agencies and the general public.

En9 (with a mean difference of -1.35), Ec2 (with a mean difference of 1.23), and En3 (with a mean difference of -1.19) obtain the greatest values. It is obvious that railway project sustainability is perceived very differently by these two stakeholder groups.

Differences in Perceptions Among All Stakeholder Groups

To further understand the consensus and conflict over railway project sustainability among all the stakeholder groups, a one-way ANOVA test was carried out to check for sample homogeneity. As shown in Table 11, it is clear that the

four stakeholder groups have very different viewpoints and/or concerns on railway project sustainability (26 out of 27 criteria). The top three conflicting concerns lie in economic and environmental sustainability, including En2 (with an F value of 86.320), Ec7 (with an F value of 85.005), and Ec6 (with an F value of 81.673).

Based on the results exhibited in Tables 5 through 10, En2 receives a relatively high mean difference among groups of government agencies versus the general public, environmental protection organizations versus internal stakeholders, and internal stake-

holders versus the general public. In the interviews, both government agencies and internal stakeholders stated that the development of railway projects, especially mega-railway projects, would undergo a strict feasibility study and environmental impact assessment, and part of the documents would be released publicly. Therefore, they argued that noise emissions as a result of project development should meet the requirements of government regulations. Simultaneously, two stakeholders from government agencies added that it is understandable that surrounding residents should be expected to bear a

Stakeholder Concerns	Equal Variances Assumed	Levene's Tests for Equality of Variances		T-test for Equality of Means				
		F	Sig.	t	df	Sig. (two-tailed)	Mean diff.	Std. error diff.
Ec2	N	25.000	0.000	-12.086	67.1	0.000	-1.57	.130
Ec3	N	14.452	0.000	-12.028	78.6	0.000	-1.55	.128
Ec4	N	4.845	0.030	-6.587	84.6	0.000	-1.12	.170
Ec5	N	34.213	0.000	-7.903	63.3	0.000	-1.24	.157
Ec6	N	30.503	0.000	-10.966	57.7	0.000	-1.79	.163
Ec7	N	52.209	0.000	-8.831	57.8	0.000	-1.51	.171
Ec8	N	16.448	0.000	3.299	104.3	0.001	0.38	.116
En1	N	15.862	0.000	9.018	91.1	0.000	0.92	.102
En2	N	34.384	0.000	12.791	101.3	0.000	1.25	.098
En3	N	14.770	0.000	9.356	99.0	0.000	1.25	.134
En4	Y	.104	0.748	5.826	108	0.000	0.58	.099
En5	N	5.583	0.020	7.359	107.9	0.000	0.89	.120
En6	N	7.055	0.009	8.741	107.1	0.000	1.02	.117
En7	Y	1.059	0.306	9.646	108	0.000	1.18	.122
En9	N	19.453	0.000	13.249	96.9	0.000	1.52	.115
En10	N	6.215	0.014	8.466	106.9	0.000	0.98	.116
S1	Y	2.281	0.134	4.354	104.6	0.000	0.69	.159
S2	N	13.280	0.000	4.476	99.7	0.000	0.57	.127
S3	N	5.212	0.024	-2.398	76.8	0.019	-0.31	.128
S4	Y	0.090	0.765	5.368	108	0.000	0.64	.119
S6	N	20.833	0.000	6.308	98.3	0.000	0.86	.136
S7	N	4.376	0.039	8.455	107.2	0.000	0.91	.108
S9	N	10.607	0.002	-3.091	107.0	0.003	-0.40	-.651

Table 8: Stakeholder concerns with significant differences between environmental protection organizations and internal stakeholders.

certain level of noise caused by railway project implementation, because they will definitely benefit from those projects in the long term. Although they understood the above explanations, the interviewed stakeholders from both the general public and environmental protection organizations emphasized that government agencies should take a main role in ensuring that project environmental impact assessment reports be carefully prepared and the noise of project development be controlled at an acceptable level.

For Ec7 of bureaucracy, there are great conflicts between government

agencies and internal stakeholders, as well as between government agencies and the general public. In the interviews, both internal stakeholders and the general public mentioned that bureaucracy in the governing system can be of great importance in affecting the overall efficiency of railway project development. Meanwhile, some of them also admitted that this is not unique to the Chinese construction area, and that the situation of bureaucracy in construction has been changing and improving over the past few years. Some interviewed stakeholders from government agencies responded that although

bureaucracy exists in some processes of railway project development, such as land expropriation and compensation for resident resettlement, most of the government agencies behave ethically when performing the duty.

Ec6 also emerges as a criterion with great perception conflicts, particularly between groups of government agencies and environmental protection organizations, environmental protection organizations and internal stakeholders, and environmental protection organizations and the general public. Most of the stakeholders from environmental protection organizations complained that

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Stakeholder Concerns	Equal Variances Assumed	Levene's Tests for Equality of Variances		T-test for Equality of Means				
		F	Sig.	t	df	Sig. (two-tailed)	Mean diff.	Std. error diff.
Ec1	N	20.800	0.000	-6.252	71.3	0.000	-0.78	.125
Ec2	Y	.042	0.839	-2.197	112	0.030	-.34	.156
Ec3	Y	1.519	0.220	-6.094	112	0.000	-0.82	.134
Ec4	Y	2.079	0.152	-2.883	112	0.005	-0.48	.166
Ec5	N	6.576	0.012	-2.753	84.2	0.007	-0.48	.173
Ec6	N	13.404	0.000	-5.904	72.2	0.000	-1.03	.175
Ec7	N	24.085	0.000	-6.669	67.2	0.000	-1.19	.178
Ec8	N	16.264	0.000	2.397	111.2	0.018	0.26	.110
En5	N	10.033	0.002	3.025	89.5	0.003	0.29	.096
En6	Y	.916	0.340	5.069	112	0.000	0.57	.112
En7	N	5.088	0.026	4.081	106.9	0.000	0.53	.129
S1	N	23.471	0.000	-2.029	66.9	0.046	-0.26	.127
S5	N	23.318	0.000	-8.465	64.0	0.000	-1.00	.118
S6	N	30.715	0.000	-2.924	83.6	0.004	-0.25	.085

Table 9: Stakeholder concerns with significant differences between environmental protection organizations and the general public.

in past years, economic performance indicators of projects, such as payback period, are overly highlighted in executing construction projects, including railway projects, whereas adverse environmental impacts are largely omitted, which consequently causes severe air pollution and resource waste and discourages sustainable development in railway project development. However, in line with the viewpoints of stakeholders from government agencies and internal stakeholders, project economic performance is a fundamental incentive for them to work together on a project: "If a project is of satisfactory environmental and social impact, but cannot produce the economic benefits expected, we will definitely not be interested in it." Two representatives from the general public admitted that it is understandable that economic performance is critical for encouraging various stakeholders to devote themselves to project activities, but also believe it is time for the government to think carefully about how to balance

the three components of sustainable development—economic, environmental, and social performance—when carrying out railway projects. They also mentioned that they often suffer greatly from railway project implementation and wish to engage in the project's decision-making process through more public participation.

Major Findings and Discussions

In line with the results discussed above, it is evident that great disparities in concerns over railway project sustainability exist among the four stakeholder groups investigated. Furthermore, the results also demonstrate that although their perceptions on the social sustainability of implementing railway projects are different, the greatest conflicts lie in how the various stakeholders perceive economic and environment sustainability. The survey results confirmed that each of the stakeholder groups is accustomed to perceiving railway project sustainability from its own experience

and individual interests, without fully considering the specific project situation and concerns of other stakeholder groups. To a certain degree this is understandable, given that the stakeholders choose to engage in railway projects with their own expectations, and thus it is very difficult to expect a joint attitude and action toward achieving railway project sustainability.

However, the predicament can be changed and consensus achieved if an effective mechanism to facilitate mutual dialog among diversified stakeholder groups is established, which, according to the survey, is currently missing or at least scant. Through such mutual dialog, it may be possible for different stakeholder groups to share their diversified views about understanding railway project sustainability, as well as how to achieve railway project sustainability from a much broader perspective when making project decisions. For instance, stakeholders from environmental protection organizations might have opportunities to better understand

Stakeholder Concerns	Equal Variances Assumed	Levene's Tests for Equality of Variances		T-test for Equality of Means				
		F	Sig.	t	df	Sig. (two-tailed)	Mean diff.	Std. error diff.
Ec1	Y	2.510	0.116	-5.534	126	0.000	-0.53	.096
Ec2	N	30.125	0.000	10.620	99.3	0.000	1.23	.116
Ec3	N	10.024	0.002	6.970	122.1	0.000	0.73	.105
Ec4	Y	1.148	0.286	4.736	126.0	0.000	0.64	.135
Ec5	N	8.768	0.004	6.839	109.7	0.000	0.77	.112
Ec6	Y	2.592	0.110	7.803	126	0.000	0.76	.097
Ec7	N	23.118	0.000	3.424	117.2	0.001	0.32	.093
En1	Y	3.784	0.054	-7.426	126	0.000	-0.78	.104
En2	N	17.700	0.000	-11.650	108.5	0.000	-1.15	.098
En3	N	18.256	0.000	-9.253	95.0	0.000	-1.19	.129
En4	Y	0.039	0.845	-6.927	126	0.000	-0.61	.089
En5	N	24.191	0.000	-5.577	101.1	0.000	-0.60	.107
En6	N	7.166	0.008	-3.763	122.3	0.000	-0.45	.121
En7	Y	1.585	0.210	-4.582	126	0.023	-0.27	.117
En8	Y	2.452	0.120	-2.305	126	0.023	-0.27	.117
En9	N	8.930	0.003	-11.870	126	0.000	-1.35	.113
En10	Y	1.031	0.312	-7.384	126	0.000	-0.88	.120
S1	N	61.763	0.000	-7.791	88.3	0.000	-0.95	.122
S2	N	10.780	0.001	-3.822	101.3	0.000	-0.48	.125
S3	N	6.436	0.012	3.094	113.9	0.002	0.35	.113
S4	Y	0.441	0.508	-7.320	126	0.000	-0.79	.108
S5	N	7.937	0.006	-8.209	94.0	0.000	-0.80	.098
S6	N	63.689	0.000	-8.911	80.2	0.000	-1.12	.124
S7	N	15.833	0.000	-10.310	100.8	0.000	-1.01	.098
S9	Y	2.262	.135	3.170	126	.002	.45	.141

Table 10: Stakeholder concerns with significant differences between internal stakeholders and the general public.

the importance of some economic performance criteria when perceiving railway project sustainability.

Furthermore, some specific measures for alleviating conflicts among the four stakeholder groups can also be developed. It is suggested that government agencies that usually initiate the development of railway projects should attempt to promote greater balance among the three dimensions of sustainability criteria. Although they face the challenge of boosting the national and local economy through railway

project development, they must divert more attention and resources from economic criteria to environmental and social aspects. This can gradually be accomplished through measures, such as encouraging more public participation in decision making on railway project development and inspecting construction sites regularly to make sure major environmental and social requirements are met. Internal stakeholders are the people who undertake work on the front line; thus they are deemed to be responsible for many

of the adverse environmental impacts caused by project implementation, including air and noise emissions. Because internal stakeholders' primary concerns are the economic benefits of projects, these stakeholders need to adopt more advanced skills, techniques, and materials to minimize pollution and simultaneously maximize economic benefits. Stakeholders from environmental protection organizations, on the other hand, seem to overreact because, by and large, they solely emphasize the environmental impacts

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Stakeholder Concerns		Sum of Squares	df	Mean Square	F	Sig.
Ec1	Between groups	32.460	3	10.820	30.306	0.000
	Within groups	79.257	222	0.357		
Ec2	Between groups	100.814	3	33.605	72.498	0.000
	Within groups	79.257	222	0.464		
Ec3	Between groups	64.766	3	21.589	46.711	0.000
	Within groups	102.602	222	0.462		
Ec4	Between groups	41.008	3	13.669	19.981	0.000
	Within groups	151.877	222	0.684		
Ec5	Between groups	64.502	3	21.501	43.818	0.000
	Within groups	108.931	222	0.491		
Ec6	Between groups	110.605	3	36.868	81.673	0.000
	Within groups	100.214	222	0.451		
Ec7	Between groups	154.743	3	51.581	85.005	0.000
	Within groups	134.709	222	0.607		
Ec8	Between groups	35.184	3	11.728	27.140	0.000
	Within groups	95.931	222	0.432		
En1	Between groups	62.790	3	20.930	44.886	0.000
	Within groups	103.516	222	0.466		
En2	Between groups	80.528	3	26.843	86.320	0.000
	Within groups	69.034	222	0.311		
En3	Between groups	93.968	3	31.323	63.194	0.000
	Within groups	110.036	222	0.496		
En4	Between groups	68.389	3	22.796	75.845	0.000
	Within groups	66.726	222	0.301		
En5	Between groups	59.035	3	19.678	44.654	0.000
	Within groups	97.832	222	0.441		
En6	Between groups	44.591	3	14.864	33.384	0.000
	Within groups	98.843	222	0.445		
En7	Between groups	48.287	3	16.096	30.799	0.000
	Within groups	116.018	222	0.523		
En8	Between groups	7.977	3	2.659	5.131	0.002
	Within groups	115.032	222	0.518		
En9	Between groups	82.337	3	27.446	68.764	0.000
	Within groups	88.606	222	0.399		
En10	Between groups	36.923	3	12.308	28.669	0.000
	Within groups	95.307	222	0.429		
S1	Between groups	30.467	3	12.308	28.669	0.000
	Within groups	122.299	222	0.429		
S2	Between groups	14.761	3	4.920	11.684	0.000
	Within groups	93.487	222	0.421		

(continued)

Stakeholder Concerns		Sum of Squares	df	Mean Square	F	Sig.
S3	Between groups	6.377	3	2.126	4.615	0.004
	Within groups	102.247	222	0.461		
S4	Between groups	26.882	3	8.961	21.562	0.000
	Within groups	92.255	222	0.416		
S5	Between groups	35.172	3	11.724	34.134	0.000
	Within groups	76.249	222	0.343		
S6	Between groups	50.863	3	16.954	35.619	0.000
	Within groups	105.672	222	0.476		
S7	Between groups	38.187	3	12.729	40.162	0.000
	Within groups	70.362	222	0.317		
S9	Between groups	12.381	3	4.127	7.517	0.000
	Within groups	121.885	222	0.549		

Table 11: Concerns with significant differences among all stakeholder groups.

of railway projects, which is similar to government agencies that are criticized for overemphasizing economic performance. After all, contributions to the national and/or local economy is sometimes an important indicator for evaluating the feasibility of railway projects, especially for some mega-railway projects. Therefore, stakeholders from environmental protection organizations are advised to broaden their perspectives by combining other assessment criteria in addition to environmental concerns. The study found that the role the general public plays in Chinese railway project development is currently negligible, which may be a reason why environmental and social criteria are not vital concerns. Although an effective public participation mechanism can theoretically be an approach for improvement, the promotion of effective public participation is far from satisfactory, partially because of China's special political, social, and economic backgrounds. The general public often gets frustrated because they greatly suffer from the implementation of railway projects, yet their demands for avoiding adverse environmental and social impacts are rarely heard by other stakeholder groups. A better way of ameliorating the situation is to engage the participation of stakeholders from

the general public in the early stages of project evaluation, which may also be useful in promoting mutual dialog among all of the major stakeholder groups.

Conclusions

Fulfilling the assessment criteria under the umbrella of sustainable development is increasingly critical to ensuring the overall success of railway projects. However, the diversified stakeholders involved tend to have very different concerns when it comes to achieving railway project sustainability. The present study investigated the concerns of four major stakeholder groups involved in railway projects—government agencies, environmental protection organizations, internal project stakeholders, and the general public—about their perceptions of railway project sustainability. The relative concerns of each stakeholder group were ranked and the main differences in the concerns between each pair of stakeholder groups compared. The results show that there are obvious disparities among the stakeholders' perceptions regarding the achievement of railway project sustainability, and the greatest concern conflicts lie in economic and environmental criteria. Specifically, government agencies paid more attention to

the economic performance of developed railway projects because this is an important factor when it comes to attracting private parties to engage in projects, such as providing funds for the project, and because the government also faces the challenge of driving the local economy in the long term. Environmental protection organizations ranked environmental criteria with relative more importance because they believe that their principal duty is to ensure that the project is implemented in an environmentally friendly manner. The top three most important concerns of internal project stakeholders are all economic criteria, whereas the general public perceives the social aspects as most important.

The results also showed that the four stakeholder groups possess different viewpoints on 26 of 27 criteria within the framework of achieving railway project sustainability, revealing that there is a great deal of conflict in stakeholder perceptions. Three groups of stakeholders, including government agencies and environmental protection organizations, government agencies and internal stakeholders, and government agencies and the general public, perceive both economic and environmental sustainability criteria very differently. Two groups of

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stakeholders—including environmental protection organizations and internal stakeholders, and environmental protection organizations and the general public—had the greatest concern disparities in economic sustainability. Furthermore, the three dimensions of railway project sustainability criteria are perceived very differently by internal project stakeholders as opposed to the general public.

There is a pressing need to establish a more effective dialog mechanism among major stakeholder groups in developing railway projects, which would be helpful in promoting a relationship of reciprocal understanding among all of the involved groups. Government agencies should take a leading role in attempting to reach a balance among the three dimensions of railway project sustainability, given that the traditional development pattern of overly emphasizing the economic performance of a project is unsustainable and also because there has been an increasing demand to minimize environmental impact and satisfy societal concerns. Another challenge is how to engage more public participation in the decision-making processes of railway project development; doing so will be quite helpful in alleviating the tension between the general public and other project stakeholders.

Based on the above findings, further research can be directed toward measuring the degree of consensus and conflict between each pair of stakeholder groups when it comes to perceiving railway project sustainability in a quantitative manner. Additional research might also explore how the different concerns about railway project sustainability can be shared to formulate a joint effort, which would be valuable to the successful development of such projects.

Acknowledgments

The study is financially supported by the National Natural Science Foundation of China (71573216), the Sichuan Science and Technology Program

(2017ZR0150), and the Fundamental Research Funds for the Central Universities (26816WCX01).

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Hongping Yuan is an Associate Professor in the School of Economics and Management, Southwest Jiaotong University, China. He holds the position

of editorial officer of *The International Journal of Construction Management*. His main interests include sustainable built environment and project management. He has published a series of articles in refereed international journals and conferences in the disciplines of construction and demolition waste management during the past few years. He can be contacted at hpyuan2005@gmail.com

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