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Abstract

The importance of organizational citizenship behaviors for the environment (OCBEs) has been clearly established in the environmental literature. However, the OCBEs construct has rarely been examined in the specific and increasingly important realm of megaproject environmental responsibility (MER). To fill this gap, this paper presents an individual-level analysis that explores the impact of project participants' perceptions of MER practices on their environmental commitment and OCBEs. The results show that project participants' perceptions of MER practices directed toward *internal* stakeholders (i.e., stakeholders linked by project contracts) are positively related to their OCBEs. This relationship is partially mediated by the environmental commitment of project participants. Conversely, project participants' perceptions of MER practices directed toward *external* stakeholders (i.e., the local community and general public) have only an insignificant impact on their OCBEs. These findings provide new insights for managing MER practices to stimulate the emergence of OCBEs and thereby improve environmental performance.

Keywords: Megaproject; Environmental responsibility; Organizational citizenship behaviors for the environment; Environmental commitment; Social identity theory

1. Introduction

Megaprojects are temporary endeavors with a large investment commitment, vast complexities (especially in organizational terms), and long-lasting impacts on the economy, environment, and society (Brookes and Locatelli, 2015). In the engineering sector, megaprojects refer to large-scale infrastructure projects that are usually financed by governments and are characterized by "enormous resource consumptions, significant environmental impacts, as well as a high level of risk, innovation, and complexity" (Flyvbjerg, 2014; Locatelli and Mancini, 2010; Locatelli et al., 2017a; Van Marrewijk et al., 2008).

In the global context of sustainable development, improving environmental performance is one of the most pressing and prominent objectives in megaproject management (Locatelli and Mancini, 2013; Zeng et al., 2015). As megaprojects increase their efforts in environmental management, the key challenge is to translate formal project policies into innovative and spontaneous individual initiatives (Locatelli et al., 2017b; Maier and Branzei, 2014). Where individual involvement is insufficient, the application of environmental management policies and systems tends to be disconnected from daily activities and to be implemented symbolically rather than substantively (Boiral et al., 2016).

1.1 OCBEs in megaproject

Boiral (2009) defined organizational citizenship behaviors for the environment (OCBEs) as comprising "*individual, voluntary, and discretionary social behaviors that are not explicitly recognized by the formal management system and that contribute to effective environmental management by organizations.*" Examples of OCBEs include helping to resolve environmental issues, suggesting solutions aimed at preventing pollution, and collaborating

with environmental departments to implement green technologies.

The megaproject is an exemplary case of a complex, dynamic, and temporary organization. Compared to "regular projects," megaprojects have more ambiguous roles and boundaries, and more informal coordination activities between teams (Hanisch and Wald, 2014; Sainati et al., 2017; Van Marrewijk et al., 2008). As a form of innovative and spontaneous initiative that goes beyond the prescribed role requirements (Ekrot et al., 2016), OCBEs are essential to compensate for the limitations of formal management systems in megaprojects (He et al., 2015) and have far-reaching impacts on project success (Braun et al., 2013; Turner and Zolin, 2012).

The Shanghai World Expo project attached high importance to environmental protection and took a variety of environmentally conscious initiatives (Zhang, 2013). For example, it launched a "golden idea" activity to seek constructive suggestions from project participants and the application of these suggestions played an important role in reducing energy consumption and enhancing environmental protection (He et al., 2015). Astonishingly, although OCBEs have been extensively valued by megaproject management (as in the Shanghai World Expo), this research area remains underdeveloped. Furthermore, the social–psychological mechanisms that lead project participants to engage in OCBEs are as yet largely unexplored.

1.2 Research purpose and question

This paper contributes to megaproject management research by proposing and validating a predictive model for OCBEs. The findings in this paper can serve as a guide for megaproject managers to promote OCBEs and thereby facilitate the improvement of project environmental

45 performance. According to the burgeoning OCBEs literature, “if individuals are aware that
46 becoming sustainable is an important objective of their organization and the organization
47 demonstrates an interest in supporting environmental responsibility practices, they may be
48 more prone to reciprocate by performing OCBEs” (Paillé and Raineri, 2015; Raineri and
49 Paillé, 2016). Nevertheless, why, how, and under what circumstances organizational
50 environmental responsibility practices lead to individual OCBEs remains largely unknown
51 (Paillé et al., 2014; De Roeck and Delobbe, 2012). Environmental commitment refers to a
52 sense of attachment to and identification with the environmental goals and values of an
53 organization, and it serves as a bridge between the organization’s environmental
54 responsibility practices and individual OCBEs (Raineri and Paillé, 2016). Therefore, this
55 study empirically investigates the relationships between project participants’ perceptions of
56 megaproject environmental responsibility (MER) practices and their OCBEs, considering the
57 mediating effect of their environmental commitment.
58 To date, scholars have explored the contextual antecedents of individual-level OCBEs in
59 terms of organizational-level practices, including environmental management practices (Paillé
60 et al., 2013), organization environmental policies (Raineri and Paillé, 2016; Paillé and Raineri,
61 2015), and human resource management (Paillé et al., 2014). The authors leveraged this body
62 of knowledge, along with primary data, to provide guidelines for managing OCBEs in
63 megaprojects. To analyze how project-level factors influence individual-level OCBEs, this
64 study developed an empirical model in which MER practices were reflected by the
65 perceptions of individual project participants. In the questionnaire survey, only on-site project
66 participants who were directly involved in MER practices were considered as targeted

respondents. These respondents were senior and professional individuals (with knowledge of MER practices), including project owners, contractors, and consultants.

This paper adopted a stakeholder-oriented conceptualization of MER practices, which refers to "megaproject environmental initiatives taking into account the interests of different stakeholder groups, including governments/owners, non-owner stakeholders (i.e., contractors, consultants, designers, and suppliers), the local community, as well as the general public" (Zeng et al., 2015). MER practices directed toward the four abovementioned stakeholder groups manifest themselves in very different ways. To better explain and predict OCBEs, it is necessary to distinguish how project participants perceive the four types of MER practices. These considerations lead to the following research question:

How do project participants' perceptions of MER practices directed towards the four stakeholder groups affect their environmental commitment and, in turn, their OCBEs?

This paper is organized as follows. Section 2 provides the theoretical foundations and presents the research hypotheses based on a literature review. Section 3 illustrates the research methods and analytical procedures. Section 4 presents the data analysis results. Section 5 discusses the research findings and their implications for megaproject environmental management. Section 6 summarizes the key ideas and suggests a research agenda.

2. Theoretical foundation and hypotheses

2.1. Defining OCBEs in megaprojects

Recent research findings make a convincing case to include voluntary pro-environmental behaviors as part of the "organizational citizenship behaviors" (OCBs) domain—otherwise known as organizational citizenship behaviors for the environment (OCBEs) (Boiral, 2009;

89 Daily et al., 2009; Raineri and Paillé, 2016). Inspired by the taxonomy of OCBs proposed by
90 Organ et al. (2006), Boiral and Paillé (2012) further classified OCBEs into five
91 categories—helping, sportsmanship, organizational loyalty, individual initiative, and
92 self-development. On this basis, the possible applications of OCBEs and their natures in
93 megaprojects are discussed as follows:

94 *Helping* includes altruism with regard to environmental protection and collaboration to
95 promote environmental initiatives. The megaproject is characterized by a high level of
96 uncertainty (Van Marrewijk et al., 2008). It has ambiguous role boundaries and must rely on
97 project participants to make a concerted effort to achieve environmental goals, e.g., helping
98 colleagues to better understand project environmental goals and encouraging them to adopt
99 more environmentally conscious behaviors or to express their ideas and opinions on
100 environmental issues. Consequently, helping behaviors can be viewed as a common
101 cooperative effort to improve the environmental performance of a megaproject (Invernizzi et
102 al., 2016).

103 *Sportsmanship* refers to the tolerance of and positive attitude toward the inconveniences
104 and additional work that can be associated with environmental practices, e.g., willingness to
105 make time to support the project environmental department when unexpected environmental
106 problems occur (e.g., extreme climate events). Megaprojects are carried out under conditions
107 of high complexities (Locatelli et al., 2014) and face huge environmental risks (Flyvbjerg et
108 al., 2003). Considering the complexity and diversity of the environmental problems in
109 megaprojects (Zeng et al., 2015), addressing these problems requires not only a rapid
110 response by the project environmental department, but also the prompt assistance of project

111 participants working in other departments (e.g., safety, quality, and labor departments).

112 *Organizational loyalty* means the day-to-day adherence to environmental policies and goals,
113 e.g., voluntary compliance with the formal and informal (i.e., both stated and unwritten)
114 project environmental policies and procedures. Megaprojects bring together differing and
115 competing stakeholders, interests, and values (Locatelli and Mancini, 2012a; Ruuska et al.,
116 2011; Van Marrewijk et al., 2008). More often than not, the success of environmental
117 management practices is based on the discretionary adherence of multi-stakeholders to the
118 overarching environmental goals (Daily et al., 2009).

119 *Individual initiative* is based on personal involvement and participation in environmental
120 activities, e.g., making suggestions to minimize construction wastes and providing early
121 warnings to prevent on-site pollution accidents. Creativity is perceived to be an essential
122 ingredient for ensuring the success of a megaproject (Maier and Branzei, 2014). The goal of
123 this dimension is to facilitate the improvement of overall environmental performance by
124 stimulating the proactive and innovative initiatives of project participants.

125 *Self-development* involves the development of personal knowledge with respect to
126 environmental protection. The roles of knowledge transfer and self-learning have been
127 recognized as crucial for improving organizational adaptabilities, especially in complex
128 megaprojects (Van Marrewijk et al., 2008). There are two approaches to
129 self-development—active participation in project training programs (e.g., environmental
130 protection lectures) and the effective acquisition of environmental information through
131 self-learning during the course of daily work activities.

2.2. The relationship between environmental commitment and OCBEs

According to Meyer and Herscovitch (2001), environmental commitment is a frame of mind that denotes a sense of both attachment and responsibility to the environmental targets of an organization. Through the lenses of reasoned action theory (Ajzen and Fishbein, 1980) and value–belief–norm theory (Stern et al., 1999), specific attitudes that are either context-dependent or have behavioral direction are more likely to be enacted and reified (Raineri and Paillé, 2016). With the growing concern about environmental issues, the positive environmental performance of a megaproject may lead project participants to feel increased levels of self-esteem and to recognize the environmental values of the project in which they play a part. The environmental commitment engendered by project environmental practices can make participants feel that they share environmental values with other project participants. As such, they are more likely to engage in discretionary extra-role behaviors (e.g., OCBEs) that benefit other project participants. In addition, they may tend to devote additional efforts to meeting the environmental goals of the project. Based on the above, the following hypothesis is proposed:

H1. The environmental commitment of project participants is positively related to their OCBEs.

2.3. Impact of project participant perceptions of MER practices on their environmental commitment and OCBEs

2.3.1 Taxonomy of MER practices

Environmental responsibility, an important and distinct component of corporate social responsibility (CSR), is typically seen as a set of environment-friendly practices intended to

positively affect stakeholders (Rahman and Post, 2012). The stakeholders of a megaproject are those who affect or are affected by project practices, including both *internal* stakeholders (i.e., owners/governments, contractors, consultants, designers, and suppliers) and *external* stakeholders (i.e., the local community and general public) (Zeng et al., 2015).

Considering the differences between project roles, *internal* stakeholders can be further divided into two types: 1) governments (i.e., regulators and owners) and 2) non-owner stakeholders (i.e., contractors, consultants, designers, and suppliers). Governments, which typically initiate megaprojects, play a dual role that incorporates supervision (in terms of laws and regulations) and participation (in terms of project contracts). In contrast, contractors, consultants, designers, and suppliers are linked only through project contracts. Similarly, *external* stakeholders can also be classified into two categories: 1) the local community and 2) the general public (Zeng et al, 2015). The local community is directly affected by the implementation process of megaprojects, e.g., land expropriation, housing demolition, as well as changes in property values and living environments. Apart from the local community, other external stakeholders are included in the general public category.

Through the lens of social identity theory (SIT), membership in different social categories is considered to convey social identity that defines one's attributes as a member of that group (Ashforth and Mael, 1989). Specifically, one's social identity provides benchmarks by which people can know what they should feel and think, as well as how they should behave. The term corporate organization can be viewed as a social categorization (Turker, 2009b). According to Newman et al. (2015), when employees view their organization as socially responsible, organizational identification processes will promote extra-role behaviors that

176 augment the employer's CSR practices. With respect to a megaproject, the project-based
177 organization serves as a social categorization of its participants. According to SIT, and in
178 combination with insights from Newman et al. (2015), this study argues that project
179 participants' perceptions of MER practices can motivate their engagement in OCBEs as a
180 function of project identification processes that promote pride in and attachment to the
181 environmental goals and values of the project. As such, this paper proposes Hypotheses 2, 3,
182 4, and 5 in the next sections.

183 *2.3.2 MER practices directed toward governments*

184 The first group of selected stakeholders is governments. The compliance of a megaproject
185 with the environmental obligations pursuant to laws, regulations, and contracts is likely to be
186 viewed in a positive light. This is due to the megaproject's high degrees of uncertainty and
187 complexity (Van Marrewijk et al., 2008). It is notable that this tendency leads megaproject
188 participants to develop high levels of self-esteem and to identify themselves with the
189 environmental values of the project. According to SIT, and based on insights from the OCBs
190 literature (Carmeli et al., 2007; Newman et al., 2015), MER practices directed toward
191 governments (MER-G) encourage project participants to exert further effort to achieve project
192 environmental goals and to transcend their job roles to assist others whom they perceive as
193 having similar environmental values. On this basis, the following hypotheses are presented:

194 **H2a.** Project participants' perceptions of MER-G are positively related to their environmental
195 commitment.

196 **H2b.** Project participants' perceptions of MER-G are positively related to their OCBEs.

2.3.3 MER practices directed toward non-owner stakeholders

Environmental responsibility directed toward non-owner stakeholders, e.g., contractors, consultants, designers, and suppliers, may manifest in a variety of ways. Such manifestations include suitable on-site working and living environments, commitments to justice in dealing with environmental issues, and opportunities for the development of environmental knowledge and skills. When project participants perceive that a megaproject meets their personal environmental needs and those of their colleagues, they are likely to perceive that the megaproject shares environmental values similar to their own. Through the lenses of SIT and the literature on OCBs (Newman et al., 2015; Zhang et al., 2014), MER practices directed toward non-owner stakeholders (MER-N) make project participants more likely to engage in discretionary extra-role behaviors (e.g., OCBEs) that benefit others involved in the project and to exert additional efforts to achieve project environmental goals. Given this finding, the following hypotheses are presented:

H3a. Project participants' perceptions of MER-N are positively related to their environmental commitment.

H3b. Project participants' perceptions of MER-N are positively related to their OCBEs.

2.3.4 MER practices directed toward the local community

Megaprojects substantially alter regional ecological environments and local communities are among the first to be affected. Consistent with SIT and previous OCBs research (Bartels et al., 2010; Newman et al., 2015), project participants are likely to show an interest in environmental activities, as well as to identify with the environmental values of the project, if the megaproject receives positive feedback from the local community regarding its

environmental practices. Therefore, MER practices directed toward the local community (MER-L) are likely to foster feelings of a shared environmental commitment and responsibility on the part of project participants, thereby leading them to exert additional effort to meet project environmental goals, perform at a high level, and engage in discretionary OCBEs. All of the above reasoning suggests the following hypotheses:

H4a. Project participants' perceptions of MER-L are positively related to their environmental commitment.

H4b. Project participants' perceptions of MER-L are positively related to their OCBEs.

2.3.5 MER practices directed toward the general public

Environmental responsibility directed toward the general public refers to the eco-friendly philosophy of megaproject managers and their targeted measures for secondary (i.e., indirect and external) stakeholders. Based on SIT and the OCBs literature (Bartels et al., 2010; Newman et al., 2015), when a megaproject undertakes environmental measures that benefit the whole society (even at the risk of budget overruns or schedule delays), this tends to build a sense of environmental commitment on the part of project participants via identification with and adherence to the environmental goals of the project. Moreover, this outcome may lead to the project participants and their colleagues feeling that they possess similar attributes and shared values. Rather than simply focusing on achieving their own goals, MER practices directed toward the general public (MER-P) cause project participants to be more likely to engage in risky discretionary behaviors that benefit others (e.g., OCBEs). Thus, the following hypotheses are developed:

H5a. Project participants' perceptions of MER-P are positively related to their environmental

commitment.

H5b. Project participants' perceptions of MER-P are positively related to their OCBEs.

2.4. Control variables

To isolate the variations within the organizational and project contexts (Cao et al., 2017), four control variables were included in the analysis of the relationships between project participants' perceptions of MER practices and their OCBEs. As the first control variable, project role was operationalized as a dummy variable reflecting whether or not the surveyed respondents were owners (0 = yes; 1 = no). With regard to the remaining three control variables, project size was measured by the investment value of the surveyed project (1 = below CNY 500 million; 2 = between CNY 500 and 1000 million; 3 = between CNY 1000 and 5000 million; 4 = between CNY 5000 and 10000 million; 5 = above CNY 10000 million); project type was measured as a dummy variable indicating whether or not the surveyed project is a basic infrastructure (0 = basic infrastructure; 1 = non-basic infrastructure);[1] and project duration was measured by the construction period of the surveyed project (1 = less than 24 months; 2 = between 24 and 36 months; 3 = between 36 and 48 months; 4 = between 48 and 60 months; 5 = more than 60 months).

3. Research methods

3.1. Questionnaire design

This study used a questionnaire survey to collect primary data. This questionnaire was designed and developed with the support of literature reviews, project observations, and

[1] Basic infrastructures refer to energy, transportation, and communications projects that provide fundamental and essential services for social production and everyday life. Non-basic infrastructural megaprojects, e.g., skyscrapers, exhibition facilities, and industrial parks, provide specialized value-added services for culture, business, and so on.

261 semi-structured explorative interviews conducted prior to the survey.[2]

262 The construct environmental responsibility is derived from CSR to reflect an organization's
263 social performance in dealing with environmental issues. As such, the environmental
264 responsibility section of the questionnaire was initially adapted from CSR measurement items
265 (Turker, 2009a). This kind of measurement adaptations has been validated over a large
266 spectrum of organizations and industries (De Roeck and Delobbe, 2012; Ho et al., 2012;
267 Sparks et al., 2013).

268 In this study, environmental responsibility items with respect to the general public
269 (including NGOs), the local community, non-owner stakeholders, and governments were
270 adapted based on CSR constructs related to society, customers,[3] employees, and the
271 government, respectively. All 18 related measurement items in Turker's (2009a) CSR scale
272 were modified to suit the environmental management perspective in the megaproject context.
273 Moreover, these items were further refined and validated through a series of interviews with
274 researchers and practitioners who have extensive experiences in megaproject management.

275 With respect to environmental commitment (EC), seven measurement items were adapted
276 from Raineri and Paillé (2016) to reflect project participants' sense of attachment to
277 environmental concerns in the megaproject. As for OCBEs, seven measurement items
278 developed by Boiral and Paillé (2012) were used to reflect how project participants initiated
279 innovative and spontaneous behaviors directed at environmental improvement. All the
280 OCBEs items were integrated into a construct to better understand the relationships between

[2] The four interviewed project managers from a large construction consulting corporation have engaged in several influential megaprojects in China, e.g., Shanghai World Expo, Shanghai Disney Resort, and Suzhou–Nantong Bridge. The two interviewed professors from Tongji University have conducted megaproject research for over 15 years.

[3] Construction projects are typically operated through the "production-to-order" system, with the aim to meet the demands of clients (Cao et al., 2014). Local communities are the primary users of megaprojects and play a role analogous to that of "customers" who are directly affected by the "product" (i.e., the megaproject).

project participants' perceptions of MER practices and their overall OCBEs performance.

The measurement items developed by Raineri and Paillé (2016) and Boiral and Paillé (2012) were selected in this study because they are relatively general and therefore applicable to a variety of organizations, activity sectors, occupations, and/or circumstances. Similarly, EC and OCBEs items were also refined and contextualized after the rounds of interviews.

All the abovementioned variables were operationalized as reflective constructs. Appendix A shows the measurement items in detail. These measurement items were rated on a five-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). Although the questionnaire was originally developed in English, it was subsequently translated into Chinese to facilitate the respondents' comprehension. This study employed the back-translation technique to establish linguistic equivalence between the two versions.

3.2. Participants and procedures

A pre-test involving 23 megaproject professionals[4] was conducted to identify ambiguous expressions and to test the validity of the related constructs in the questionnaire. In view of the feedback from those pre-test respondents, the questionnaire was further revised. For example, the expression "environmental impacts" in the environmental responsibility item "Our project implements green and low-carbon technologies to mitigate the environmental impacts" was rephrased to "negative environmental impacts" in the questionnaire.

The survey was conducted from November 2015 to March 2016 in China. After contacting the megaproject owners,[5] the project departments and participants involved in MER practices were preliminarily identified for this survey. There was a short communication prior to the

[4] The 23 pre-test respondents were senior and professional individuals with jobs related to construction environmental management (e.g., environmental training and supervision). They were familiar with environmental codes, laws, and project policies; and all had more than five years of experiences in megaproject management.

[5] Megaproject owners refer to project-specific owner companies, e.g., Shanghai World Expo (Group) Co., Ltd.

302 formal questionnaire survey. The respondents were informed of the survey purpose, assured
303 of the data confidentiality, and offered small gifts[6] for completing the questionnaire.
304 With the support of the megaproject owners, the questionnaire was distributed to the
305 targeted respondents. To improve the representativeness of the surveyed samples, this study
306 distributed the questionnaire to respondents from different megaprojects and to those who had
307 assumed different roles in MER practices. In this survey, respondents were asked to complete
308 the questionnaire based on their most recently experienced megaproject. In consequence,
309 respondents provided a relatively clear description of the projects' environmental practices
310 and thereby avoided preferentially selecting their most successful experience with
311 environmental protection, which ultimately reduced the risk of socially desirable responding
312 (SDR). According to Milfont (2009), SDR has little impact on the way people answer
313 questions related to their environmental attitudes and ecological behaviors in anonymous
314 questionnaires. For these reasons, SDR effect is limited in this survey.
315 In addition, to further determine the respondents' perceptions of their projects'
316 environmental practices, this survey included the question "Are you familiar with the
317 project's environmental policies and measures?," with the options of "Yes," "No," or
318 "Unsure." The inclusion of the "Unsure" option was based on the work of Norton et al. (2014)
319 to prevent respondents from having to make a forced-choice response. Finally, only the
320 respondents who provided a conclusive answer of "Yes" were retained, while the "No" or
321 "Unsure" answers were discarded as invalid responses. After omitting invalid responses and
322 deleting outliers, a total of 172 completed questionnaires were ultimately included in the

[6] Each of the participants was given a set of souvenirs (i.e., notepad, gel pen, and bookmark) with the Tongji logo or a cash gift through WeChat.

323 subsequent analysis. Of the 172 respondents, 58 (33.72%) were senior managers (i.e., project
324 managers), 70 (40.70%) were middle managers (i.e., department managers and professional
325 executives), and 44 (25.58%) worked at the operational level (i.e., project engineers).

326 Table 1 shows the demographic characteristics of the surveyed projects and associated
327 respondents. Of the 172 valid responses, 41.28% were collected via on-site visits and the
328 remaining 36.63% and 22.09% were collected via a survey system (http://www.sojump.com)
329 and e-mails, respectively. An analysis of variance (ANOVA)[7] indicates that no statistically
330 significant differences exist in the answers from the three response groups (p-values ranged
331 from 0.118 to 0.861).

332 <Insert Table 1>

333 *3.3. Tools for data analysis*

334 In this study, factor analysis (FA) was used to analyze the collected primary data. FA has
335 been extensively adopted as an effective statistical technique for identifying individual factors
336 that represent sets of interrelated variables (Hon et al., 2013). Exploratory FA with principal
337 component analysis (PCA) makes it possible to identify the underlying grouped factors and to
338 condense the measurement items (He et al., 2016).

339 To test the hypotheses proposed in Section 2, partial least squares (PLS) technique was
340 employed to develop an estimation method for analyzing the path model (Fig. 1). PLS is a
341 technique that combines PCA, path analysis, and regression to simultaneously estimate
342 multiple dependent variables in a single structural equation model (Ringle et al., 2012).

343 Of the two structural equation modeling (SEM) approaches, the PLS-SEM was chosen over

[7]ANOVA tests were conducted on the three response groups (on-site visits, survey system, and e-mail); the p-values for MER-P, MER-L, MER-N, MER-G, EC, and OCBEs are 0.643, 0.118, 0.861, 0.431, 0.256, and 0.601, respectively.

344 the covariance-based SEM method due to the following reasons: (1) it is distribution-free and
345 thus suitable for data from perception-based measurement items of unknown distributions
346 (Aibinu and Al-Lawati, 2010); (2) it works efficiently with small sample sizes (Hair et al.,
347 2014), whereas covariance-based SEM considers 200 to be the critical sample size for
348 accurate assessments of model fits (Hoelter, 1983); (3) it avoids factor indeterminacy by
349 estimating constructs as exact linear combinations of the measurement items (Hair et al.,
350 2011); and (4) it is most appropriately applied in early-stage theory development and testing
351 (Astrachan et al., 2014), which fits well with the exploratory nature of this study. Indeed,
352 PLS-SEM has enjoyed steady popularity as a key multivariate analysis method in the study of
353 cooperative behaviors (Aibinu et al., 2008), relational behaviors (Ning and Ling, 2013),
354 environmental behaviors (Yusof et al., 2016), and organizational citizenship behaviors (Lim
355 and Loosemore, 2017) in construction projects.

356 4. Data analysis and results

357 *4.1. Factor analysis*

358 In this study, FA was employed to investigate 18 items related to MER practices. The
359 Kaiser–Meyer–Olkin (KMO) value is 0.927 > 0.6, thereby indicating excellent sample
360 adequacy (Field, 2009). In addition, Bartlett's test of sphericity (BTS) produced an
361 approximation of $\chi 2 = 2131.110$ ($df = 153$, $p = 0.000 < 0.001$), which suggests that the
362 correlations between variables are sufficiently strong to conduct PCA (George, 2003). As
363 expected, the FA analysis extracted four factors reflecting the MER-P, MER-L, MER-N, and
364 MER-G constructs. Table 2 shows that the rotated loadings of the manifest items with regard
365 to their intended constructs are all above the recommended threshold of 0.5 and are greater

than the loadings on other constructs. These results validate the appropriateness of using the 18 listed MER items to reflect the four proposed constructs. Similarly, FA procedures were also applied to extract measurement items for EC and OCBEs. And no EC or OCBEs items were removed from the measurement model.

<Insert Table 2>

4.2. Evaluation of the measurement models

The validity of all measurements was further assessed in terms of internal consistency, convergent validity, and discriminant validity. Internal consistency was assessed by estimating the composite reliability. Table 3 shows that the composite reliability values are all greater than 0.7, thereby indicating a satisfactory reliability level of the internal indicators for each construct (Hair et al., 2011). Convergent validity measures the extent to which the items underlying a particular construct actually represent this conceptual variable. Initial evidence of convergent validity was reflected by the values of the average variance extracted (AVE). Table 3 shows that the AVE values are all greater than 0.5, thereby suggesting a satisfactory level of convergent validity of the constructs (Hair et al., 2011). Further evidence of convergent validity was provided by the factor loadings of each measurement item. The standardized factor loadings of all the respective constructs of the items are above the threshold of 0.7 and there was no evidence of any cross-loading problem (Table 4). In addition, the square roots of AVE (i.e., values on the diagonal of the correlation matrix in Table 3) are all greater than the absolute value of the inter-construct correlations (i.e., off-diagonal values), which indicates that the constructs have satisfactory discriminant validity.

388 <Insert Table 3>

389 <Insert Table 4>

390 Harman's single-factor test was used to analyze the possibility of common method bias.
391 The test results reveal no single dominant factor, with the largest factor accounting for only
392 14.72%[8] of the total measurement variances. Therefore, common method bias is limited in
393 this survey.

394 *4.3 Comparative analysis*

395 The respondents had a mix of project roles, including 41.86% project owners, 35.47%
396 contractors, and 22.67% consultants (Table 1). Compared with project owners and consultants,
397 contractors had more direct experiences in the implementation of project environmental
398 initiatives and provided more positive feedback on MER practices, as shown in Table 5.
399 However, ANOVA test results indicate that none of these differences are statistically
400 significant at the 5% level (p-values range from 0.125 to 0.758). Furthermore, the ANOVA
401 test for OCBEs reveals no significant difference in environmental-behavior-related decision
402 making between project owners, contractors, and consultants. All these results provide
403 evidence that differences in project roles have insignificant impacts on the surveyed
404 respondents' perceptions of MER practices and their OCBE performance.

405 <Insert Table 5>

406 *4.4 Hypothesis testing and results analysis*

407 To compute standard errors and test the statistical significance of the path coefficients, a
408 bootstrapping procedure with 5,000 resamples was performed (Fig. 1). The R^2 value of the

[8] Harman's one-factor test was performed for both independent and dependent variables (MER-P, MER-L, MER-N, MER-G, EC, and OCBEs) and for four control variables. The five largest factors account for 14.72%, 13.25%, 12.92%, 12.25%, and 7.76% of the total variances.

409 dependent variable (i.e., OCBEs) is 0.459, thereby suggesting that most of the variances in the
410 construct are explained by the research model. Figure 1 shows that the influence of EC on
411 OCBEs is significant ($\beta = 0.239$, $p < 0.01$); thus, Hypothesis 1 is supported. The results of the
412 bootstrapping analysis also indicate that the MER-G–EC link ($\beta = 0.158$, $p < 0.05$),
413 MER-N–EC link ($\beta = 0.349$, $p < 0.001$), MER-L–EC link ($\beta = 0.175$, $p < 0.01$), and
414 MER-P–EC link ($\beta = 0.233$, $p < 0.01$) are all significant, thereby providing evidence
415 supporting Hypotheses 2a, 3a, 4a, and 5a, respectively.

416 <Insert Fig. 1>

417 Regarding the relationships between MER practices and OCBEs, only the influences of
418 project participants' perceptions of MER practices directed toward *internal* stakeholders (i.e.,
419 MER-G and MER-N) are found to be significant when the effect of EC is included ($\beta = 0.181$,
420 $p < 0.05$; $\beta = 0.218$, $p < 0.05$). Thus, Hypotheses 2b and 3b are supported. Together with the
421 significant links between MER-G and EC and between EC and OCBEs, this finding further
422 indicates that the influence of MER-G on OCBEs is partially mediated by EC. A similar
423 conclusion is also reached for MER-N.

424 To further investigate the effects of project participants' perceptions of MER practices on
425 their OCBEs, an alternative model without the mediator was tested. Figure 2 presents the PLS
426 analysis results for the alternative research model. Although the intermediating effect of EC is
427 excluded, the direct influences of MER-L and MER-P on OCBEs are still insignificant.
428 Therefore, Hypotheses 4b and 5b are not supported by the data. In addition, with regard to the
429 control variables, project duration, project type, project role, and project size, all exert
430 insignificant influences on OCBEs in both models.

<Insert Fig. 2>

5. Discussion and implications

5.1 Discussion of findings

Currently, unprecedented levels of urbanization have led to massive government-financed megaprojects in China. With the emergence of newly built, restructured, or expanded megaprojects, environmental issues have become increasingly prominent and have aroused considerable concerns among megaprojects managers. The success of megaproject environmental management lies in the willingness of project participants to support continuous change and take responsibility for environmental protection on a discretionary basis. Therefore, OCBEs play an important role in improving the efficiency of megaproject environmental practices, specifically through the development of preventive approaches that call for the voluntary commitment of project participants to environmental protection.

Different types of environmental responsibility practices affect OCBEs differently. The project participants' perceptions of MER-N emerge as the principal predictor of their OCBEs, with a path coefficient of 0.292 (Fig. 2). Such a strong link between MER-N and OCBEs was expected at the beginning of the survey, because the related items are all closely connected with the respondents' rights and interests, e.g., working conditions, training opportunities, and procedural equalities. According to Maslow's hierarchy of needs, the MER-N practices in megaprojects fill a high-order need for individual self-actualization. Establishing environmental management systems (e.g., ISO 14000) and introducing green technologies have become increasingly popular in megaprojects, whereas there are few incentives for megaprojects to invest in "soft areas" (i.e., human considerations). The empirical results of

453 the current study provide evidence that MER-N practices are perhaps implemented to reap
454 organizational rewards for promoting project participants' OCBEs. Although the initial
455 investments in human capital and training may be unattractive to megaproject managers,
456 continuous MER-N efforts are likely to pay off over the long term by eliciting high levels of
457 EC among project participants.

458 Project participants' perceptions of MER-G emerge as the second principal predictor of
459 their OCBEs, with a path coefficient of 0.222 (Fig. 2). Interestingly, the effect of MER-G on
460 EC and OCBEs is inconsistent with the findings of previous research. In particular, Turker
461 (2009b) determined that employees' perceptions of CSR practices directed toward
462 governments are insignificant factors affecting their organizational commitment. Meanwhile,
463 Newman et al. (2015) argued that employees' perceptions of CSR practices directed toward
464 governments do not result in high levels of OCBs. The findings of the current study may be
465 explained by the dual governmental roles. In China, most megaprojects are initiated by the
466 central or local governments while also involving environmental supervisory departments
467 (e.g., the Ministry of Environmental Protection) (Zeng et al., 2015). Therefore, governments
468 have partially achieved a role transition in megaprojects from external supervisors to internal
469 stakeholders (i.e., owners). MER-G practices are expected to meet both the legal requirements
470 of regulators and the contractual agreements with owners. Megaprojects in China that perform
471 MER-G practices are likely to be considered significant endeavors due to the complexity and
472 diversity of the environmental issues. This perspective might lead project participants who
473 work for such megaprojects to develop high levels of self-esteem and to identify with the
474 environmental values of the project.

475 Project participants' perceptions of MER-L and MER-P represent the least significant set of
476 predictors of their OCBEs. Interestingly, the effects of MER-L and MER-P on OCBEs, as
477 determined in this study, also differ from those of prior empirical studies. As noted by
478 Newman (2015), employees' perceptions of CSR directed toward social and nonsocial
479 stakeholders (e.g., the local environment and general public) strongly influenced their OCBs.
480 The results of the current study may be related to the essential mission of megaprojects.
481 Megaprojects are committed to providing fundamental public services that benefit local
482 communities and, consequently, the country in general. The ecological protection of the local
483 natural environment is the primary objective of megaprojects. Thus, the more the project
484 participants take MER-P or MER-L for granted, the more ineffective they will perceive it to
485 be. This perspective might lead project participants to respond less positively to MER-P or
486 MER-L than to MER-G and MER-N practices.
487 Although MER-P and MER-L practices have received considerable attention, megaprojects
488 have not demonstrated ideal environmental performance. In the course of preliminary
489 interviews with megaproject managers, several interviewees were skeptical about the real
490 effectiveness of MER-P and MER-L practices. Some MER-P and MER-L practices are little
491 more than environmental slogans and have yet to achieve their expected goals. For example,
492 an interviewee with more than 15 years of experience in managing megaprojects indicated
493 that "*a substantial part of the MER-P and MER-L practices are more often established to*
494 *gain a better social reputation rather than to improve actual environmental performance or*
495 *project participants' environmental skills*"—otherwise known as "green-washing." In this
496 regard, "green-washing" appears to be the external projection of a positive image of a

497 megaproject that is not reflected in its internal initiatives regarding environmental issues
498 (Testa et al., 2015). On this basis, a megaproject's MER-P and MER-L practices are unlikely
499 to engender high levels of project identification or to subsequently affect OCBEs.

500 *5.2. Implications*

501 This study makes several contributions to the fields of megaproject management,
502 environmental responsibility, and OCBs. First, it extends previous research on the
503 environmental citizenship in permanent corporate organizations and the OCBs in temporary
504 project organizations by providing further insights into the mechanisms underlying project
505 participants' willingness to sustain and support the environmental efforts of megaprojects.
506 Although most previous studies have tended to consider environmental responsibility, the
507 current study shows that MER practices directed toward the four groups of stakeholders
508 account for the unique variance at the EC level, thereby affecting OCBEs differently. The
509 analysis of empirical data supports the claim of Raineri and Paillé (2016) that EC plays a
510 pivotal role in connecting organizational environmental practices with OCBEs. However, this
511 study indicates that OCBEs are only positively related to project participants' perceptions of
512 MER practices directed toward *internal* stakeholders, whereas these behaviors have no
513 significant association with MER practices directed toward *external* stakeholders.

514 Slogan propaganda, which highlights concerns related to the local community and general
515 public, is often posited as an effective approach for enhancing individual awareness of
516 environmental issues and promoting their participation in environmental protection. Although
517 the findings of the current study confirm this key role, macro-policy advocacy is insufficient
518 for encouraging the pro-environmental behaviors of project participants. Megaproject

managers should be aware of the priority to improve MER practices directed toward *internal* stakeholders. They should also provide project participants with increased opportunities to access environmental training and to obtain equal rights in expressing environmental appeals. MER practices directed toward *external* stakeholders have often been described as "a means of increasing social reputation" in megaprojects. In the implementation process of project environmental policies, establishing clear goals and supportive measures is a method by which to avoid confusion on the part of project participants regarding the goal of MER practices. Initiatives aimed at improving environmental performance should be accompanied by effective internal communication and project participants' involvement in environmental practices to ensure their positive perceptions of MER practices.

Secondly, this study is novel as it investigated how the principal dimensions of OCBs could be applied to the environmental practices of megaprojects. Successful environmental practices are linked with the input of a multitude of social, economic, and technical elements that cannot be entirely covered by prescribed tasks (Locatelli and Mancini, 2012b). Daily et al. (2009) indicated that the success of environmental practices may hinge on individual behaviors that are beyond the scope of formal contractual systems. Therefore, extra-role OCBEs are necessary to promote the implementation of formal management systems and to compensate for their deficiencies, facilitate tacit knowledge sharing, and stimulate collaboration in dealing with environmental issues (Boiral, 2009). OCBEs do not underestimate the value of formal management practices or undermine the establishment of considerably robust management systems, but can co-exist with formal environmental methods. Building an integrated and reasonable system of rewards and punishments that go

541 beyond contractual agreement is necessary to encourage the emergence of OCBEs.

542 6. Conclusions

543 OCBEs are constituted by individual, informal, and discretionary behaviors that contribute
544 greatly to the efficiency of environmental practices. Prior studies on environmental
545 management have overlooked the key role of OCBEs in megaprojects. However, megaproject
546 managers have realized their importance in dealing with the increasing challenges of
547 environmental management, e.g., the complexity of environmental issues, the deficiencies of
548 formal management systems, the need to consider tacit knowledge, the significance of helping
549 relationships, and the promotion of the environmental legitimacy of projects. Under the
550 increasing pressures to ensure environmental protection, project participants become
551 considerably aware of environmental issues during the implementation of megaprojects. The
552 research presented in this paper takes an SIT perspective and addresses how project
553 participants' perceptions of MER practices directed toward four stakeholder groups influence
554 their EC and OCBEs.

555 The strong link between project participants' perceptions of MER practices and their EC
556 indicates that investments in environmental responsibility practices, particularly those
557 directed toward *internal* stakeholders, yield significant benefits. This paper also clarifies how
558 MER practices directed toward the four stakeholder groups could be used to effectively
559 stimulate the emergence of OCBEs in megaprojects. If they are to foster the widespread
560 "buy-in" of project participants, MER practices should be genuine (i.e., internalization) as
561 opposed to symbolic (i.e., "green-washing"). With this perspective, internalization refers to
562 the substantive rather than superficial integration of specific practices and principles proposed

563 by MER in daily project activities.

564 Despite its valid contributions, this study has limitations and open questions that call for
565 future research. Firstly, this study focused on China's megaprojects. Although some of these
566 are international megaprojects (e.g., Shanghai World Expo and Shanghai Disney Resort), this
567 sampling technique limits the generalizability of research findings with respect to other
568 geographic contexts. Considerable variance in terms of MER practices in different
569 geographical contexts might amplify the significance of research findings.

570 Secondly, after analyzing the social–psychological processes (i.e., antecedents) leading
571 project participants to engage in OCBEs, a natural extension of the current study would be to
572 investigate the consequences (or impacts) of OCBEs. Specifically, future studies could
573 address how different OCBEs categories at the project-level—including helping,
574 sportsmanship, organizational loyalty, organizational compliance, individual initiative, and
575 self-development—make an impact on project environmental performances.

576 Thirdly, leadership has been recognized as one of the most critical factors influencing the
577 emergence of OCBEs. However, it remains unclear which leadership styles are most suitable
578 in fostering project participants' OCBEs. Future research could explore these relationships
579 and bridge the gap between emerging OCBE research and more established literature based
580 on leadership theory (e.g., transformational and transactional leadership) and environmental
581 management.

582 Conflict of interest

583 There is no conflict of interest.

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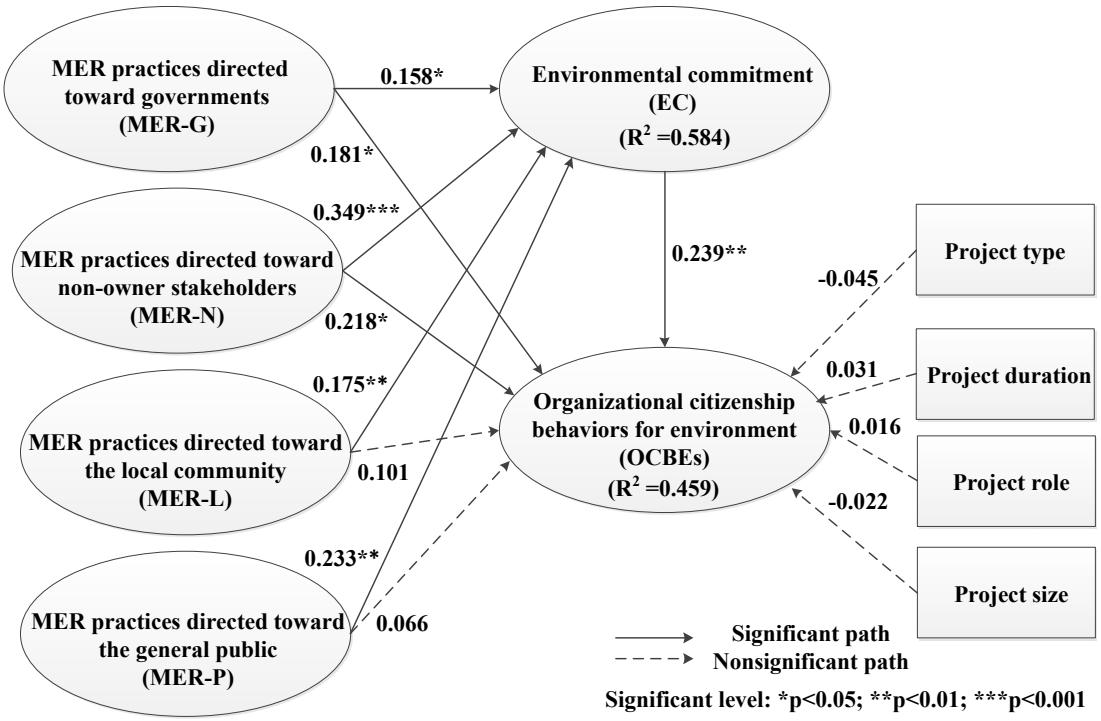

Fig. 1. Results of PLS analysis for the research model.

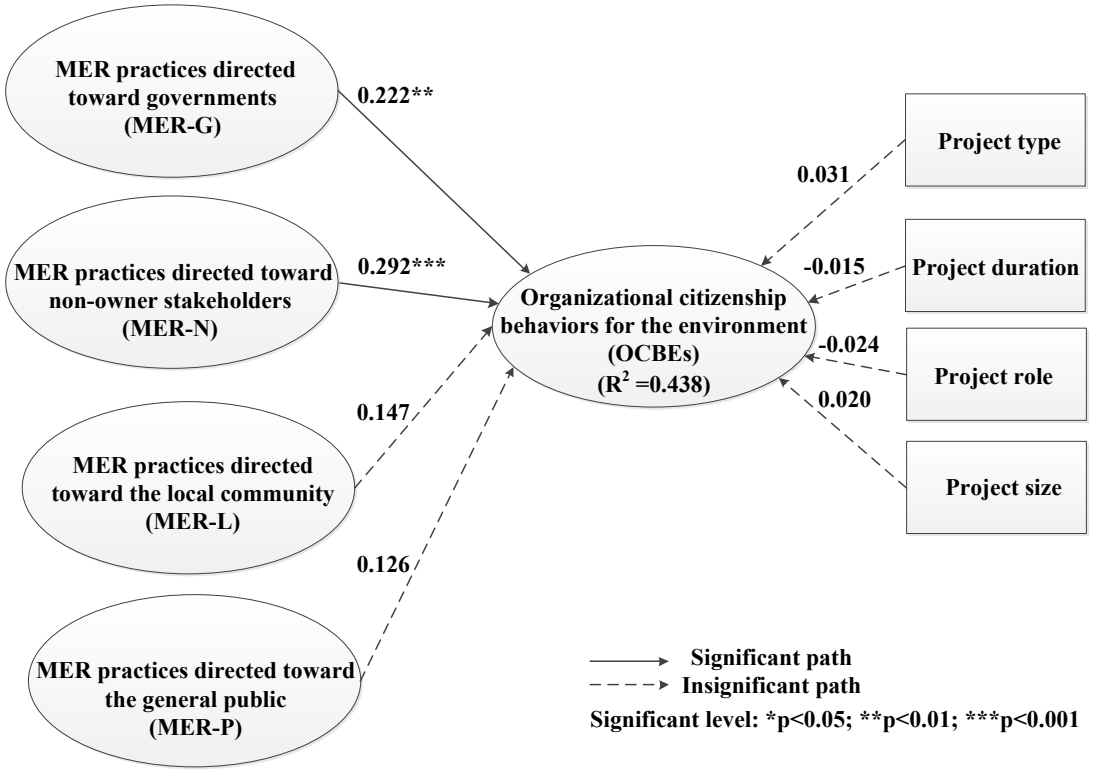

Fig. 2. Results of PLS analysis for the alternative research model.

Table 1 Demographic information of respondents.

Variable	Category	Number of respondents	Percentage
Project role	Owner/Government	72	41.86
	Contractor	61	35.47
	Consultant	39	22.67
Project type	Large-scale exhibition facility/ industry zone	54	31.40
	Urban metro system	35	20.35
	Integrated transport hubs	31	18.02
	Energy source bases	23	13.37
	High speed railways	16	9.30
	Long-span bridge	13	7.56
Location[a]	East China	76	44.19
	South China	32	18.60
	North China	29	16.86
	West China	21	12.21
	Central China	14	8.14
Position	Project manager	58	33.72
	Department manager	29	16.86
	Professional executive	41	23.84
	Project Engineer	44	25.58
Years of experience	≤5 year	45	26.16
	6-10 year	51	29.65
	11-15year	42	24.42
	16-20 year	19	11.05
	＞20 year	15	8.72

Location[a] refers to the project site where the respondent was employed at the time of the survey.

Table 2 Component list of MER practices.

Measurement items	Factor loadings			
	Factor 1	Factor 2	Factor 3	Factor 4
MER-N4	**.915**	.089	.136	.083
MER-N5	**.902**	.088	.146	.059
MER-N1	**.813**	.128	.189	.265
MER-N2	**.707**	.345	.181	.274
MER-N3	**.703**	.470	.184	.151
MER-N6	**.584**	.408	.305	.333
MER-P4	.236	**.815**	.245	-.004
MER-P5	.186	**.795**	.336	-.006
MER-P6	.221	**.785**	.188	.107
MER-P2	.159	**.755**	.061	.393
MER-P1	.064	**.668**	-.048	.525
MER-P3	.150	**.559**	.371	.456
MER-L1	.154	.325	.773	-.066
MER-L2	.237	.242	**.721**	.249
MER-L3	.092	-.248	**.697**	.412
MER-L4	.416	.284	**.579**	.074
MER-G2	.358	.164	.195	**.723**
MER-G1	.302	.198	.412	**.550**
Variance explained (%)	23.99	22.73	15.18	11.15
Variance cumulatively explained (%)	23.99	46.72	61.90	73.05

Bold values represent the factor loadings of each measurement item on its intended construct.

Table 3 Measurement validity and construct correlations.

Construct	CR	AVE	Correlation matrix					
			MER-P	MER-L	MER-N	MER-G	EC	OCBEs
MER-P	0.92	0.66	**0.81**					
MER-L	0.86	0.61	0.58	**0.78**				
MER-N	0.94	0.74	0.58	0.60	**0.86**			
MER-G	0.89	0.81	0.54	0.58	0.59	**0.90**		
EC	0.93	0.67	0.62	0.61	0.68	0.59	**0.82**	
OCBEs	0.93	0.66	0.50	0.52	0.59	0.55	0.59	**0.81**

CR = composite reliability; AVE = average variance extracted. Bold values on the diagonal represent the square root of AVE.

Table 4 Cross loadings for measurement items.

Code	Item loadings					
	MER-P	MER-L	MER-N	MER-G	EC	OCBEs
MER-P1	**0.76**	0.32	0.38	0.42	0.46	0.36
MER-P2	**0.85**	0.42	0.48	0.46	0.51	0.33
MER-P3	**0.80**	0.61	0.51	0.50	0.63	0.47
MER-P4	**0.83**	0.50	0.50	0.39	0.41	0.35
MER-P5	**0.83**	0.52	0.48	0.41	0.48	0.42
MER-P6	**0.83**	0.46	0.49	0.42	0.52	0.48
MER-L1	0.47	**0.77**	0.40	0.38	0.38	0.33
MER-L2	0.51	**0.86**	0.51	0.50	0.55	0.45
MER-L3	0.32	**0.71**	0.35	0.42	0.42	0.33
MER-L4	0.50	**0.79**	0.57	0.49	0.53	0.50
MER-N1	0.42	0.51	**0.87**	0.52	0.57	0.52
MER-N2	0.57	0.51	**0.86**	0.57	0.62	0.51
MER-N3	0.64	0.53	**0.87**	0.51	0.61	0.55
MER-N4	0.34	0.45	**0.87**	0.46	0.54	0.44
MER-N5	0.34	0.44	**0.86**	0.42	0.50	0.47
MER-N6	0.65	0.61	**0.83**	0.56	0.66	0.50
MER-G1	0.49	0.57	0.52	**0.90**	0.54	0.51
MER-G2	0.47	0.46	0.55	**0.89**	0.52	0.48
EC1	0.52	0.55	0.63	0.53	**0.84**	0.54
EC2	0.42	0.45	0.50	0.40	**0.82**	0.48
EC3	0.40	0.46	0.50	0.40	**0.73**	0.34
EC4	0.60	0.58	0.62	0.56	**0.81**	0.53
EC5	0.50	0.50	0.54	0.45	**0.83**	0.45
EC6	0.65	0.47	0.58	0.55	**0.85**	0.53
EC7	0.41	0.45	0.47	0.45	**0.84**	0.48

OCBEs1	0.35	0.44	0.45	0.40	0.42	**0.77**
OCBEs2	0.44	0.45	0.51	0.49	0.53	**0.87**
OCBEs3	0.38	0.36	0.44	0.37	0.42	**0.76**
OCBEs4	0.42	0.43	0.43	0.42	0.45	**0.79**
OCBEs5	0.45	0.42	0.45	0.47	0.49	**0.80**
OCBEs6	0.41	0.46	0.56	0.47	0.56	**0.86**
OCBEs7	0.40	0.42	0.49	0.50	0.51	**0.85**

Bold values represent standardized factor loadings of the items on their respective constructs; and T-values are for these loadings.

Table 5 Results of descriptive and comparative analysis.

Construct	Full sample		Project owners		Contractors		Consultants		ANOVA	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	F-test	p-value
MER-P	3.35	0.62	3.31	0.65	3.40	0.587	3.33	0.621	0.296	0.744
MER-L	3.63	0.50	3.60	0.51	3.70	0.48	3.60	0.51	0.751	0.474
MER-N	3.75	0.68	3.74	0.67	3.86	0.69	3.58	0.65	2.101	0.125
MER-G	4.17	0.55	4.13	0.60	4.21	0.51	4.17	0.53	0.415	0.661
EC	3.84	0.63	3.82	0.66	3.88	0.60	3.79	0.65	0.277	0.758
OCBEs	4.03	0.60	3.98	0.63	4.08	0.56	4.08	0.59	0.586	0.558

Mean = arithmetic means, SD = standard deviation.