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Megaproject environmental responsibility and organizational citizenship behaviors for the environment: Exploring the missing link

Abstract

Organizational citizenship behaviors for the environment (OCBEs) are essential for improving the environmental practices and performance of organizations. However, the OCBEs construct has rarely been examined in the specific and increasingly important realm of megaproject environmental responsibility (MER) practices. To fill this gap, this paper presents an individual-level analysis to empirically explore the link between the 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 contracts) are positively related to their OCBEs. This relationship is partially mediated by their environmental commitment. Conversely, project participants' perceptions of MER practices directed toward external stakeholders (i.e., the local community and general public) have an insignificant link their OCBEs. The findings provide new insights into managing MER practices to stimulate the emergence of OCBEs for improving environmental performance.

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

1. Introduction

Megaprojects are temporary endeavors (i.e., projects) characterized by: large investment commitment, vast complexity (especially in organizational terms), and long-lasting impact 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 have the characteristic of "enormous resource consumption, significant environmental impact, as well as a high level of risk, innovation, and complexity" (Flyvbjerg, 2014; Locatelli and Mancini, 2010; Locatelli et al., 2017; Van Marrewijk et al., 2008).

In the global context of sustainable development, improving environmental performance is one of the most pressing and prominent objectives for megaproject management (Locatelli and Mancini, 2013; Zeng et al., 2015). As megaprojects have a relevant influence environmental management, the key challenge is to translate formal project policies into innovative and spontaneous individual initiatives (Maier and Branzei, 2014). Otherwise, programs will be poorly implemented, regulations won't be respected, technologies will be underutilized, and problems will not be effectively resolved (Raineri and Paillé, 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 or collaborating with the environmental department to implement green technologies.

Megaproject is an exemplar case of 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; 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 system in megaprojects (He et al., 2015). In addition, OCBEs entail more than manifesting environmental extra-role behaviors. These behaviors also suggest a broader pattern of reciprocal cooperation (Braun et al., 2013) and a universal set of environmental value norms (Raineri and Paillé, 2016) that have far-reaching impacts on long-term megaproject success, including stable cooperative relationship and environmental sustainability (Turner and Zolin, 2012).

Shanghai World Expo has attached high importance to environmental protection and taken a variety of environmentally conscious initiatives (Zhang, 2013), e.g., it launched a "golden idea" activity to seek constructive suggestions from project participants. It is noteworthy that the application of such 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 environmental management (as in Shanghai World Expo), this line of research is still underdeveloped. Furthermore, the social-psychological mechanisms leading project participants to engage in OCBEs are largely unexplored.

1.2 Research purpose and question

This paper contributes to this new research area of megaproject environmental management

45 by proposing and testing a predictive model of OCBEs. The findings serve as a guide for
46 megaproject managers to promote OCBEs and thus facilitate the improvement of project
47 environmental performance. According to the burgeoning OCBEs literature, "if individuals
48 are aware that becoming sustainable is an important objective of their organization and the
49 organization demonstrates an interest in supporting environmental responsibility practices,
50 they may be more prone to reciprocate by performing OCBEs" (Paillé and Raineri, 2015;
51 Raineri and Paillé, 2016). Nevertheless, it remains largely unknown why, how, and under
52 what circumstances organizational environmental responsibility practices lead to individuals'
53 OCBEs (Paillé et al., 2014; De Roeck and Delobbe, 2012). Environmental commitment (EC)
54 refers to a sense of attachment and identification to the environmental goals and values of the
55 organization, and serves as a bridge between the organization's environmental responsibility
56 practices and individuals' OCBEs (Raineri and Paillé, 2016). Therefore, this paper presents an
57 individual-level analysis to empirically investigate the relationship between project
58 participants' perceptions of megaproject environmental responsibility (MER) practices and
59 their OCBEs, considering the mediating effect of their EC.

60 Heretofore, scholars have explored the contextual antecedents of individual-level OCBEs
61 in terms of organizational-level practices, including environmental management practices
62 (Paillé et al., 2013), organization environmental policies (Raineri and Paillé, 2016; Paillé and
63 Raineri, 2015), and human resource management (Paillé et al., 2014). The authors leverage
64 this body of knowledge, along with primary data to provide guidelines to manage OCBEs in
65 megaprojects. In order to analyze how project-level factors influence individual-level OCBEs,
66 this paper develops an empirical model in which MER practices are reflected by individual

project participants' perceptions. In the empirical survey, only on-site project participants directly involved in the MER practices are considered targeted respondents. These respondents are senior and professional individuals (with knowledge of MER practices) from project owners, contractors, and consultants.

This paper adopts a stakeholder-oriented conceptualization of MER practices, which refers to "megaproject environmental initiatives that take 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 four stakeholder groups manifest themselves in very different ways. In order to better explain and predict OCBEs, it is necessary to distinguish how project participants perceive four types of MER practices. All these considerations lead to the following research question:

How do project participants' perceptions of MER practices towards four stakeholder groups relate to their OCBEs with consideration of the mediating effect of their EC?

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

2. Theoretical foundation and hypotheses

2.1. Defining OCBEs in megaprojects

Recent research makes a convincing case to include voluntary pro-environmental behaviors

as part of the "organizational citizenship behaviors" (OCBs) domain—otherwise known as OCBEs (Boiral, 2009; Daily et al., 2009; Raineri and Paillé, 2016). Inspired by the taxonomy of OCBs proposed by Organ et al. (2006), Boiral and Paillé (2012) further classified the OCBEs into five main categories, including helping, sportsmanship, organizational loyalty, individual initiative, and self-development. On this basis, the possible environmental applications of these behaviors and their natures in megaprojects are as follows.

Helping includes altruism with regard to environmental protection and collaboration to promote environmental initiatives. A megaproject is characterized by a culture of uncertainty (Van Marrewijk et al., 2008). It has ambiguous role boundaries and relies on project participants in a joint effort to achieve environmental goals, e.g., helping colleagues to better understand project environmental goals and encouraging them to adopt more environmentally conscious behaviors or express their ideas and opinions on environmental issues. Consequently, the helping behavior can be considered a common cooperative effort to improve the megaproject environmental performance.

Sportsmanship refers to the tolerance of and positive attitude to the inconveniences and additional work that can result from environmental practices, e.g., the willingness to take time to support project environmental department when unexpected environmental problems occur (e.g., extreme climate events). Megaproject is carried out under conditions of high complexity (Locatelli et al., 2014), and has to face huge environmental risks (Flyvbjerg et al., 2003). Considering the complexity and diversity of environmental problems in megaprojects (Zeng et al., 2015), addressing these issues not only requires the rapid response of project environmental department, but also depends on the prompt assistance of project participants

111 from other departments (e.g., safety, quality, and labor departments).

112 Organizational loyalty means the adherence to environmental policies and goals, e.g.,
113 voluntary compliance with the formal and informal project environmental policies and
114 procedures (both stated and unwritten environmental rules) in daily work. A megaproject
115 clearly brings together differing and competing stakeholders, interests, and values (Ruuska et
116 al., 2011; Van Marrewijk et al., 2008). More often than not, the success of environmental
117 management practices inheres in the adherence of multi-stakeholders to environmental goals
118 on a discretionary basis (Daily et al., 2009).

119 Individual initiative is based on internal involvement and participation in environmental
120 activities, e.g., making suggestions to minimize construction wastes and providing early
121 warning to prevent on-site pollution accidents. Creativity is perceived as an essential
122 ingredient to ensure the success of a megaproject (Maier and Branzei, 2014). This dimension
123 aims to stimulate project participants' proactive and innovative initiatives, so as to facilitate
124 the improvement of environmental performance.

125 Self-development involves the development of personal knowledge in terms of
126 environmental protection. The role of knowledge transfer and self-learning have been
127 recognized as crucial for improving organizational adaptability, especially in complex
128 megaprojects (Van Marrewijk et al., 2008). There are two ways of self-development,
129 including active participation in the project training program (e.g., environmental protection
130 course) and effective acquisition of environmental information through self-learning in daily
131 work activities.

2.2. The relationship between EC and OCBEs

According to Meyer and Herscovitch (2001), EC is a frame of mind denoting a sense of both attachment and responsibility to environmental targets of an organization. Through the lens of reasoned action theory (Ajzen and Fishbein, 1980) and value–belief–norm theory (Stern et al., 1999), specific attitudes that are context-dependent or have behavioral direction are likely to be enacted (Raineri and Paillé, 2016). With an increasing concern on environmental issues, positive environmental performance of a megaproject may lead project participants to increase their levels of self-esteem and recognize the environmental values of the project. The EC engendered by project environmental practices makes them feel that they have shared environmental values with other project participants. Thus, they are likely to engage in discretionary extra-role behaviors (e.g., OCBEs) that benefit others in the project, and they tend to devote additional efforts to meeting the environmental goals of the project. For these reasons, the following hypothesis is proposed:

H1. Project participants' EC relates positively with their OCBEs.

2.3. Effects of project participant*s'* perceptions of MER practices on their EC and OCBEs

2.3.1 Taxonomy of MER practices

Environmental responsibility is an important and distinct component of corporate social responsibility (CSR), which 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 the project practices, including both internal stakeholders (i.e., owners/governments, contractors, consultants, designers, and

154 suppliers) and external stakeholders (i.e., the local community and general public) (Zeng et al.,
155 2015). Internal stakeholders directly participate in the implementation process (e.g., financing,
156 planning, design, construction, commissioning, etc.) of a megaproject and have contractual
157 relationships with the project, while external stakeholders have not.

158 Considering the differences between project roles, internal stakeholders can be further
159 divided into two types: 1) governments (i.e., regulators and owners), and 2) non-owner
160 stakeholders (i.e., contractors, consultants, designers, and suppliers) refer to all megaproject
161 implementers other than project owners. Governments, which typically initiate megaprojects,
162 play a dual role that incorporates both supervision (in terms of laws and regulations) and
163 participation (in terms of project contracts). In contrast, contractors, consultants, designers,
164 and suppliers are linked together through project contracts only. Similarly, external
165 stakeholders can also be classified into two categories: 1) the local community, and 2) the
166 general public, including non-government organizations (NGOs) (Zeng et al, 2015). The local
167 community is directly affected by the implementation process of megaprojects, e.g., land
168 expropriation, housing demolition, as well as changes in properties value and living
169 environment. Apart from the local community, the other external stakeholders are included in
170 the general public.

171 Through the lens of social identity theory (SIT), every membership in different social
172 categories is considered a social identity that defines one's attributes as a member of that
173 group, which provides benchmarks for people to view and understand what one should feel
174 and think and how one should behave (Ashforth and Mael, 1989). A corporate organization
175 can be taken as a social categorization (Turker, 2009b). Newman et al. (2015) indicated that

when employees view their employing organizations as socially responsible (e.g., emphasis on environmental protection), organizational identification processes will promote extra-role behaviors (e.g., OCBEs) that augment the employer's CSR practices. As for megaproject, the project-based organization is a social categorization of its participants. According to SIT in combination with the insights from Newman et al. (2015), this study argues that project participants' perceptions of MER practices can motivate their engagement in OCBEs as a function of project identification processes that promote pride in, and attachment to the environmental goals and values of the project. Thus, this paper proposes Hypotheses 2, 3, 4, and 5 in the next sections.

2.3.2 MER practices toward governments

The first group of selected stakeholders is governments. The compliance of a megaproject with environmental obligations from laws, regulations, and contracts is more likely to be viewed in a positive light than a "regular project." This is due to the megaproject's high uncertainty and complexity (Van Marrewijk et al., 2008). This tendency leads project participants who engage in such a megaproject to develop high levels of self-esteem and identify themselves with the environmental values of the project. According to SIT and the insights from the OCBs literature (Carmeli et al., 2007; Newman et al., 2015), MER practices directed toward governments (MER-G) also urge project participants to exert further effort to achieve project environmental goals and transcend their job roles to assist others whom they perceive to have similar environmental values. On this basis, the following hypotheses are presented:

H2a. Project participants' perceptions of MER-G relate positively with their EC.

H2b. Project participants' perceptions of MER-G relate positively with their OCBEs.

2.3.3 MER practices toward non-owner stakeholders

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

H3a. Project participants' perceptions of MER-N relate positively with their EC.

H3b. Project participants' perceptions of MER-N relate positively with their OCBEs.

2.3.4 MER practices toward the local community

Megaproject substantially alters the regional ecological environment; and the local community is among the first to be affected. In line with SIT and previous research on OCBs (Bartels et al., 2010; Newman et al., 2015), project participants are likely to show an interest in and engage in environmental activities, as well as to identify with the environmental values, if a megaproject receives positive feedback from the local community about its environmental

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

225 **H4a.** Project participants' perceptions of MER-L relate positively with their EC.

226 **H4b.** Project participants' perceptions of MER-L relate positively with their OCBEs.

227 ### 2.3.5 MER practices toward the general public

228 Environmental responsibility toward the general public refers to the eco-friendly
229 philosophy of megaproject managers and their targeted measures for the secondary (i.e.,
230 indirect and external) stakeholders. Based on SIT and the OCBs literature (Bartels et al., 2010;
231 Newman et al., 2015), if a megaproject undertakes environmental measures that benefit the
232 whole society, even at the risk of budget overruns or schedule delays, it tends to build a sense
233 of environmental commitment in project participants via identification with, and adherence to
234 the project environmental goals. This phenomenon may lead project participants and their
235 colleagues to feel that they possess similar attributes and shared values. Instead of simply
236 focusing on achieving their own goals, MER practices directed toward the general public
237 (MER-P) make them more likely to engage in risky discretionary behaviors that benefit others
238 (e.g., OCBEs). Thus, the following hypotheses are developed:

239 **H5a.** Project participants' perceptions of MER-P relate positively with their EC.

240 **H5b.** Project participants' perceptions of MER-P relate positively with their OCBEs.

2.4. Control variables

To isolate the variations caused by the organizational and project contexts (Cao et al., 2016), four control variables were included in the analysis of the relationship 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. The questionnaire was designed and developed with the support of the literature, project observation, and semi-structured explorative interviews carried out prior the survey[2].

[1] Basic infrastructures refer to energy, transportation, and communications projects that provide fundamental essential services for social production and people's lives. Non-basic infrastructural megaprojects, such as skyscrapers, exhibition facilities, and industrial parks, aim to provide specialized value-added services for culture, business, and so on.

[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.

Environmental responsibility is derived from CSR, with a view to reflecting an organization's social performance in dealing with environmental issues. Therefore, the environmental responsibility section of the questionnaire was initially adapted from the measures of CSR (Turker, 2009a). This adaptation has been validated in a large spectrum of organizations and industries (De Roeck and Delobbe, 2012; Ho et al., 2012; Sparks et al., 2013).

In this study, all items on environmental responsibility toward the general public (including NGOs), the local community, non-owner stakeholders, and governments were adapted based on the constructs of CSR to the society, customer[3], employees, and government, respectively. All 18 related items in Turker's (2009a) scale were modified to suit the context of megaproject from the perspective of environmental management. Moreover, the items were further refined and validated through a series of interviews with researchers and practitioners who have extensive experience in megaproject management.

With respect to EC, 7 items were adapted from Raineri and Paillé (2016) to reflect project participants' sense of attachment to environmental concerns in megaproject. The OCBEs items developed by Boiral and Paillé (2012) were used to measure how project participants initiate innovative and spontaneous behaviors directed at environmental improvement. The OCBEs items were integrated into a construct to gain an improved understanding of the relationship between project participants' perceptions of MER practices and their overall OCBEs performance.

All of the items developed by Raineri and Paillé (2016) and Boiral and Paillé (2012) were

[3] Construction projects are typically operated through the "production-to-order" system, which aims 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).

281 selected for this study because they are relatively general, and thus can apply to various
282 organizations, activity sectors, occupations or circumstances. Similarly, all the items were
283 further refined and contextualized after rounds of interviews.

284 All these variables were operationalized as reflective constructs. Appendix A shows their
285 detailed measurement items. The measurement items were rated on a five-point scale ranging
286 from 1 (strongly disagree) to 5 (strongly agree). Although the questionnaire was originally
287 developed in English, it was subsequently translated into Chinese to facilitate the
288 respondents' understanding. This study employed the back-translation technique to establish
289 the linguistic equivalence of the two versions (Paillé et al., 2014).

290 ## 3.2. Participants and procedures

291 A pre-test involving 23 megaproject professionals[4] was conducted to identify ambiguous
292 expressions and test the validity of the related constructs in the questionnaire. In view of the
293 feedback from the pre-test attendants, the questionnaire was further revised, e.g., the
294 expression "environmental impacts" in the environmental responsibility item "Our project
295 implements green and low-carbon technologies to mitigate the environmental impacts" was
296 rephrased to "negative environmental impacts" in the questionnaire.

297 The survey was conducted from November 2015 to March 2016 in China. After contacting
298 with megaproject owners[5], the project departments and participants involved in MER
299 practices were preliminarily identified for this survey. There was a short communication in
300 advance of the formal questionnaire survey. The respondents were informed of the survey

[4] The 23 pre-test respondents are senior and professional individuals whose job are related to construction environmental management (e.g., environmental training and supervision). They are familiar with environmental codes, laws, and project policies; and have more than 5 years of experience in megaproject management.
[5] Megaproject owners refer to project-specific owner companies, e.g., Shanghai World Expo (Group) Co., Ltd.

purpose, assured of the data confidentiality, and offered gifts[6] for completing the questionnaire.

Under the support of megaproject owners, the questionnaire was distributed to the targeted respondents. In order to improve the representativeness of the surveyed samples, this study distributed the questionnaire to respondents who came from different megaprojects and assumed different roles in MER practices. During this survey, the respondents were asked to complete the questionnaire based on their most recently experienced megaproject. As a consequence, respondents provided a relatively clear description of the projects' environmental practices, avoiding selecting their most successful case on environmental protection, and thus reducing the risk of socially desirable responding (SDR). According to Milfont (2009), SDR has no strong impact on the way that people answer questions related to their environmental attitudes and ecological behaviors in anonymous questionnaires. For all these reasons, SDR is not considered to be a problem in this survey.

In addition, this survey used a question "Are you familiar with the project environmental policies and measures?" to further determine how the respondents perceived a project's environmental practices, with the options of "Yes," "No" or "Unsure." The inclusion of an "Unsure" option was inspired by the work of Norton et al. (2014), with the aim of preventing respondents from having to make a forced-choice response. Finally, only the respondents who provided a conclusive answer of "Yes" were retained, while the "No" or "Unsure" answers were considered invalid responses. After the omission of invalid responses and deletion of outliers, a total of 172 completed questionnaires were ultimately included in the subsequent

[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.

322 analysis. Fifty-eight (33.72%) respondents of the 172 respondents were senior management
323 (i.e., project manager), 70 (40.70%) were middle management (i.e., department manager and
324 professional executive), and 44 (25.58%) were from operational level (i.e., project engineer).
325 Demographic characteristics of the surveyed projects and related respondents are shown in
326 Table 1. Of the 172 valid responses, 41.28% were collected via on-site visits, while the
327 remaining 36.63% and 22.09% were collected via a survey system (http://www.sojump.com)
328 and e-mails, respectively. An analysis of variance (ANOVA)[7] indicates that no statistically
329 significant difference exists in the answers from the three groups of responses (p-values
330 ranged from 0.118 to 0.861).
331 <Insert Table 1>
332 3.3. Tools for data analysis
333 Factor analysis (FA) was used in this study to analyze the collected primary data. FA has
334 been extensively adopted as an effective statistical technique in identifying individual factors
335 that represent sets of interrelated variables (Hon et al., 2013). Exploratory factor analysis with
336 principal component analysis (PCA) can identify the underlying grouped factors and
337 condense the measurement items (He et al., 2016).
338 To test the hypotheses proposed in Section 2, partial least squares (PLS) technique was
339 employed to form the estimation method for analyzing the path model (Fig. 1). PLS is a
340 technique that combines PCA, path analysis, and regression for the simultaneous estimation
341 of multiple dependent variables in a single structural equation model (Ringle et al., 2012).
342 Of the two types of structural equation modeling (SEM) approaches, the PLS-SEM was

[7]ANOVA tests were similarly conducted on the three groups of responses (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.

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

4. Data analysis and results

4.1. Factor analysis

In this study, FA was employed to investigate 18 items related to the MER practices. The Kaiser–Meyer–Olkin (KMO) value is 0.927 > 0.6, thereby indicating meritorious sample adequacy (Field, 2009). In addition, Bartlett's test of sphericity (BTS) produces an approximation of $\chi 2 = 2131.110$ (df = 153, p = 0.000 < 0.001), which suggests that correlations between variables are sufficiently strong to conduct PCA (George, 2003). As expected, the analysis results in the extraction of four different factors reflecting the MER-P, MER-L, MER-N, and MER-G constructs. Table 2 shows that the rotated loadings of the

365 manifest items on their intended constructs are all above the recommended threshold of 0.5
366 and are larger than the loadings on other constructs. These results validate the appropriateness
367 of using the 18 listed MER items to reflect the four proposed constructs.

368 <Insert Table 2>

369 FA procedures were also applied to extract the measurement items of EC and OCBEs. All 7
370 items of EC were analyzed. KMO is 0.899 > 0.6, thereby indicating satisfactory sample
371 adequacy (Field, 2009). Furthermore, the BTS test produces an approximation of $\chi 2$ =
372 760.334 (df = 21, p = 0.000 < 0.001), which suggests that the correlations between variables
373 are sufficiently strong to conduct PCA (George, 2003). A component with an eigenvalue of
374 4.674 is extracted from the 7 items, accounting for 66.768% of the variance. The loadings for
375 each of the 7 items are 0.850, 0.845, 0.840, 0.827, 0.822, 0.792, and 0.737. Accordingly, no
376 EC items were removed from the measurement model.

377 Similarly, all 7 items of OCBEs were analyzed. KMO is 0.916 > 0.6, thereby indicating
378 meritorious sample adequacy (Field, 2009). The BTS test produces an approximation of $\chi 2$ =
379 731.847 (df = 21, p = 0.000 < 0.001), which suggests that the correlations between variables
380 are sufficiently strong to conduct PCA (George, 2003). A component with an eigenvalue of
381 4.650 is extracted from the 7 items, accounting for 66.422% of the variance. The loadings for
382 each of the 7 items are 0.863, 0.857, 0.850, 0.799, 0.789, 0.779, and 0.761. Thus, no OCBEs
383 items were removed from the measurement model.

384 ## 4.2. Evaluation of the measurement models

385 The validity of all measurements was further assessed in terms of internal consistency,
386 convergent validity, and discriminant validity. Internal consistency was assessed through the

387 estimate of composite reliability. Table 3 shows that the composite reliability values are all
388 greater than 0.7, thereby indicating a satisfactory level of reliability of internal indicators with
389 each construct (Hair et al., 2011). Convergent validity measures the extent to which the items
390 underlying a particular construct actually represent the same conceptual variable. Initial
391 evidence of convergent validity was reflected by the values of average variance extracted
392 (AVE). Table 3 shows that the AVE values are all greater than 0.5, thereby suggesting a
393 satisfactory level of convergent validity of the constructs (Hair et al., 2011). Further evidence
394 of convergent validity was provided by the factor loadings of each measurement item. The
395 standardized factor loadings of all of the items on their respective constructs are above the
396 threshold of 0.7, and no cross-loading problem exists (Table 4). In addition, the square roots
397 of AVE (i.e., values on the diagonal of the correlation matrix in Table 3) are all greater than
398 the absolute value of the inter-construct correlations (i.e., off-diagonal values), which
399 indicates that the constructs possess satisfactory discriminant validity.

400 <Insert Table 3>

401 <Insert Table 4>

402 Harman's single-factor test was used to analyze the possibility of common method bias.
403 The test results show that no single dominant factor exists and that the largest factor only
404 accounts for 14.72%[8] of the total variances in the measurements, thereby indicating that
405 common method bias is not a problem in this survey.

406 ## 4.3 Comparative analysis

407 The respondents are from a mix of project roles, including 41.86% project owners, 35.47%

[8] Harman's one-factor test is 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.

408 contractors, and 22.67% consultants (Table 1). Compared with project owners and consultants,
409 contractors have more direct experiences in the implementation process of project
410 environmental initiatives and provide more positive feedback on MER practices, as shown in
411 Table 5. However, ANOVA tests indicate that none of these differences are statistically
412 significant at the 5% level (p-values range from 0.125 to 0.758). Furthermore, the ANOVA
413 test for OCBEs also reveals that there is no significant difference in environmental-behavior-
414 related decision-making between project owners, contractors, and consultants. All these
415 results provide evidence that the differences in project roles have insignificant impacts on the
416 surveyed respondents' perceptions of MER practices and OCBE performance.

417 <Insert Table 5>

418 ## 4.4 Hypothesis testing and results analysis

419 A bootstrapping procedure with 5,000 resamples was performed to compute standard errors
420 and test the statistical significance of the path coefficients. The results of the bootstrap-based
421 PLS analysis are presented in Fig. 1. The R^2 value of the dependent variable (i.e., OCBEs) is
422 0.459, thereby suggesting that most of the variances in the construct are explained by the
423 research model. Fig. 1 shows that the influence of EC on OCBEs is significant ($\beta = 0.239$, $p <$
424 0.01); thus, Hypothesis 1 is supported. The results also show that the MER-G–EC link ($\beta =$
425 0.158, $p < 0.05$), MER-N–EC link ($\beta = 0.349$, $p < 0.001$), MER-L–EC link ($\beta = 0.175$, $p <$
426 0.01), and MER-P–EC link ($\beta = 0.233$, $p < 0.01$) are all significant, thereby providing
427 evidence for Hypotheses 2a, 3a, 4a, and 5a, respectively.

428 <Insert Fig. 1>

429 Regarding the relationships between MER practices and OCBEs, only the influences of

project participants' perceptions of MER practices directed toward internal stakeholders (i.e., MER-G and MER-N) are determined to be significant when the effect of EC is included (β = 0.181, $p < 0.05$; β = 0.218, $p < 0.05$). Thus, Hypotheses 2b and 3b are supported. Together with the significant links between MER-G and EC and between EC and OCBEs, this finding further indicates that the influence of MER-G on OCBEs is partially mediated by EC. A similar conclusion is also reached for MER-N.

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

<Insert Fig. 2>

5. Discussion and implications

5.1 Discussion of findings

Currently, unprecedented urbanization has led to massive government-invested infrastructure megaprojects in China. With the emergence of newly built, restructured or expanded megaprojects, environmental issues have become increasingly prominent and 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. 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 substantially (Boiral et al., 2016). Therefore, OCBEs play an important role in improving the efficiency of megaproject environmental practices, specifically through the development of preventive approaches calling for the voluntary commitment of project participants to environmental protection.

Different types of environmental responsibility affect OCBEs differently. First, 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 is 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 equal procedures. The MER-N practices in megaprojects fill a high-order need for self-actualization according to Maslow's hierarchy of needs. Currently, establishing environmental management systems (e.g., ISO 14000) or introducing green technologies has become increasingly popular in China, whereas incentives for megaprojects to invest in "soft areas" (i.e., human aspects) are still scant. The aforementioned results provide evidence that the MER-N practices are perhaps implemented to reap organizational rewards in promoting the project participants' OCBEs. Although the initial investments in human capital and training may be unattractive to megaprojects, continuous efforts in MER-N are likely to pay off over the long term by eliciting high levels of EC among project participants.

Project participants' perceptions of MER-G emerge as the second principal predictor of their OCBEs, with a path coefficient of 0.222 (Fig. 2). Interestingly, the effect of MER-G on

EC and OCBEs is inconsistent with the findings of previous research. In particular, Turker (2009b) determined that employee perceptions of CSR practices directed toward governments are insignificant factors affecting their organizational commitment. Moreover, Newman et al. (2015) argued that employee perceptions of CSR practices directed toward governments do not result in high levels of OCBs. The findings of this study could result from the dual role of governments. In China, most megaprojects are initiated by the central or local governments, while the environmental supervisory departments (e.g., the Ministry of Environmental Protection) are also involved (Zeng et al., 2015). Therefore, governments have partially achieved the role transition from external supervisors to internal stakeholders (i.e., owners) in megaprojects. MER-G is expected to meet both legal requirements from regulators and contractual agreements from owners. Megaprojects in China that perform MER-G practices are likely to be considered significant endeavors because of the complexity and diversity of environmental issues. This perspective might lead project participants who work for such a megaproject to develop high levels of self-esteem and to identify with the environmental values of the project.

Project participants' perceptions of MER-L and MER-P represent the least significant set of predictors of their OCBEs. Interestingly, the effects of MER-L and MER-P on OCBEs are also different from prior empirical research. As noted by Newman (2015), employee perceptions of CSR directed toward social and nonsocial stakeholders (e.g., the local environment and general public) strongly influenced their OCBs. The results of this study could be related to the essential missions of megaprojects, which are committed to providing fundamental public services for the benefit of local communities and consequently, the

country in general. The ecological protection of the local natural environment is the primary objective of megaproject. That is, the more project participants take MER-P or MER-L for granted, the more ineffective they will perceive it to be. This perspective might lead project participants to respond less positively to MER-P or MER-L than to MER-G and MER-N practices.

Although MER-P and MER-L practices have received considerable attention, megaprojects have not had ideal environmental performance. In the course of preliminary interviews with megaproject managers, several interviewees were skeptical about the real effectiveness of MER-P and MER-L practices. Some of MER-P and MER-L practices are little more than environmental slogans and have yet to achieve the expected goals. Moreover, an interviewee with more than 15 years of experience in megaproject management indicated that "a substantial part of the MER-P and MER-L practices are more often for a better social reputation rather than for the improvement of real environmental performance, as well as project participants' environmental skills"—otherwise known as "green-washing." In this regard, "green-washing" appears as an external projection of a positive image of a megaproject, which is not reflected in its internal initiatives regarding environmental issues (Testa et al., 2015). On this basis, a megaproject's MER-P and MER-L practices are unlikely to engender high levels of project identification and subsequently to affect OCBEs.

5.2. Implications

This study makes several contributions to the fields of megaproject management, environmental responsibility, and OCBs. First, it extends previous research on environmental citizenship in permanent corporate organizations and OCBs in temporary project

518 organizations by providing further insights into the mechanisms underlying project
519 participants' willingness to sustain and support the environmental efforts of a megaproject.
520 Although most previous studies have tended to consider environmental responsibility, the
521 current study shows that MER practices directed toward the four groups of stakeholders
522 account for the unique variance at the level of EC, thereby affecting OCBEs differently. The
523 analysis of empirical data supports the claim of Raineri and Paillé (2016) that EC plays a
524 pivotal role in connecting organizational environmental practices and OCBEs. However, this
525 study found that OCBEs only positively relate to project participants' perceptions of MER
526 practices directed toward internal stakeholders, while these behaviors have no significant
527 association with MER practices directed toward external stakeholders.

528 Slogan propaganda, which highlights concerns related to the local community and general
529 public, is often posited as an effective approach in enhancing individuals' awareness of
530 environmental issues and promoting their participation in environmental protection. Although
531 the findings of this study confirm this key role, macro-policy advocacy is insufficient to
532 encourage project participants' pro-environmental behaviors. Megaproject managers should
533 be aware of the priority of improvements in MER practices directed toward internal
534 stakeholders and should provide project participants with increased opportunities to access
535 environmental training and obtain equal rights in expressing environmental appeals. In
536 addition, MER practices directed toward external stakeholders have often been described as
537 "a means of increasing social reputation" in megaprojects. In the implementation process of
538 project environmental policies, establishing clear goals and supportive measures is a method
539 to avoid project participants' confusion about the intention 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.

Second, this study is novel since it discusses how the principal dimensions of OCBs could be applied to the environmental practices of a megaproject. The successful environmental practices of a megaproject are linked with the input of a multitude of social, economic, and technical elements that cannot be entirely covered by prescribed tasks. As noted by Daily et al. (2009), 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 a formal management system and compensate for its deficiencies, facilitate tacit knowledge sharing, and stimulate collaboration in dealing with environmental issues (Boiral, 2009). It is worth noting that OCBEs do not underestimate the value of formal management practices or undermine the establishment of considerably robust management systems. OCBEs can co-exist with formal methods. Building an integrated and reasonable system of rewards and punishments beyond contractual agreement is necessary to encourage the emergence of OCBEs.

6. Conclusions

Addressing environmental issues largely depends on the voluntary sharing of tacit knowledge derived from individual experiences that are difficult to formalize through structured and explicit environmental practices (Boiral et al., 2015). Furthermore, the success of environmental management requires the informal and tacit resources of people in spontaneous cooperation, as well as innovative and volunteering behaviors (Raineri and Paillé,

562 2016). OCBEs are constituted by these individual, informal, and discretionary behaviors that
563 greatly contribute to the efficiency of environmental practices.

564 Prior studies on environmental management overlooked the key role of OCBEs in
565 megaprojects. However, megaproject managers have realized the importance of OCBEs in
566 dealing with the increasing challenges of environmental management, e.g., the complexity of
567 environmental issues, the deficiencies of formal management systems, the need to consider
568 tacit knowledge, the significance of helping relationships, and the promotion of
569 environmental legitimacy among projects. Under the increasing pressures of environmental
570 protection, project participants become considerably aware of environmental issues in
571 megaproject implementation. The research presented in this paper investigates, from the SIT
572 perspective, how project participants' perceptions of MER practices directed toward four
573 stakeholder groups influence their EC and OCBEs.

574 The strong link between project participants' perceptions of MER practices and their EC
575 indicates that investment in environmental responsibility practices, particularly those directed
576 toward internal stakeholders provides significant benefits. This paper also clarifies how MER
577 practice directed toward the four stakeholder groups could be exercised to effectively
578 stimulate the emergence of OCBEs in megaprojects. MER practices should be genuine (i.e.,
579 internalization) as opposed to symbolic (i.e., "green-washing") (Raineri and Paillé, 2016), if
580 they are to foster the widespread "buy-in" of project participants. In this perspective,
581 internalization refers to the substantial rather than superficial integration of specific practices
582 and principles proposed by MER in megaprojects' daily activities.

583 Despite its contributions, this study has limitations and open questions that pave the way to

584 future research.

585 Firstly, this study is focused on Chinese megaprojects. Although some were international
586 megaprojects (e.g., Shanghai World Expo and Shanghai Disney Resort), this sampling
587 technique still limits the generalizability of research findings to other geographic contexts.
588 Considerable variance in terms of MER practices in different geographical contexts might
589 likely amplify the significance of research findings.

590 Secondly, after analyzing the social-psychological processes (i.e., antecedents) leading
591 project participants to engage in OCBEs, a natural extension of the current study is to
592 investigate the consequences (or impacts) of OCBEs. Specifically, future studies could
593 address how different categories of OCBE at the project-level—including helping,
594 sportsmanship, organizational loyalty, organizational compliance, individual initiative, and
595 self-development—make an impact on project environmental performance.

596 Thirdly, leadership has been recognized as one of the most critical factors influencing the
597 emergence of OCBEs (Boiral et al., 2015). However, it remains unclear what leadership style
598 is most suitable to foster project participants' OCBEs. Future research could explore such link
599 and bridge the gap between the emergent research on OCBEs and the more established
600 literature based on leadership theory (e.g., transformational and transactional leadership) and
601 environmental management.

602 # Conflict of interest

603 There is no conflict of interest.

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