Discovering the transition pathways toward sustainability for construction enterprises
Chang, Rui-dong; Zuo, Jian; Soebarto, Veronica; Zhao, Zhen Yu; Zillante, George; Gan, Xiao Long

Published in:
Journal of Construction Engineering and Management

DOI:
10.1061/(ASCE)CO.1943-7862.0001295

Published: 01/06/2017

Document Version:
Peer reviewed version

Link to publication in Bond University research repository.

Recommended citation (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

For more information, or if you believe that this document breaches copyright, please contact the Bond University research repository coordinator.
Discovering the transition pathways towards sustainability for construction enterprises: an importance-performance analysis

Rui-dong Chang¹; Jian Zuo²; Veronica Soebarto³; Zhen-yu Zhao⁴; George Zillante⁵; and Xiao-long Gan⁶

Abstract: There has been growing awareness and demand for construction enterprises’ transition towards sustainability with an aim to maximize the economic, social and environmental values of construction. This presents a significant challenge to both policy makers and industry practitioners as sustainability is such a complex concept that includes various aspects whereas construction firms are usually resource constrained. There is lack of studies classifying various aspects of sustainability according to their managerial priorities, thereby identifying the efficient transition pathways towards higher sustainability levels for construction enterprises. This paper proposes Transition Pathways towards Sustainability (TPS) for the construction enterprises by conducting an importance-performance analysis of the critical sustainability aspects. The construction enterprises were firstly classified into different clusters based on their sustainability performance by means of cluster analysis. Consequently, the importance-performance analysis was employed to classify the various sustainability aspects of the identified firm clusters, followed by the development of the TPS. The results show that although there is general agreement on the high importance of economic sustainability aspects, significant differences exist in the perceptions and performance of social and environmental sustainability aspects across firm groups. Therefore, there are considerably different transition pathways for the various firm groups towards higher sustainability levels. This research provides a useful reference for construction enterprises to evaluate their positions in the sustainability transition journey and to optimize their resource allocation for sustainable development.

Author keywords: Sustainability; Transition; Importance-Performance Analysis; Construction Industry; China

¹ Ph.D. Candidate, School of Architecture and Built Environment, The University of Adelaide, Adelaide 5005, Australia (Corresponding author). Email: ruidong.chang@adelaide.edu.au
² Associate Professor, School of Architecture and Built Environment; Entrepreneurship, Commercialisation & Innovation Centre (ECIC), The University of Adelaide, Adelaide 5005, Australia. Email: jian.zuo@adelaide.edu.au
³ Associate Professor, School of Architecture and Built Environment, The University of Adelaide, Adelaide 5005, Australia. Email: veronica.soebarto@adelaide.edu.au
⁴ Professor, School of Economics and Management, North China Electric Power University, Beijing 102206, China. Email: zhaozhenyuxin@263.net
⁵ Professor, School of Architecture and Built Environment, The University of Adelaide, Adelaide 5005, Australia. Email: george.zillante@adelaide.edu.au
⁶ Lecturer, School of Cultural and Social Development, Southwest University, Chongqing, China. Email: songanxl@126.com
Introduction

Sustainable development involves the simultaneous pursuit of economic prosperity, environmental quality and social equity (Elkington, 1997). Associated with creating the physical assets, the construction industry influences various aspects of economic development (Spence and Mulligan, 1995). The industry also has significant impacts on the environment, consuming enormous natural resources and producing a large amount of waste (Wang, 2014). Similarly, the construction industry is one of the major employers in most countries, accounting for around 7% of the total employment worldwide, and thus has significant influences on society (Horta et al., 2013). The environmental, social and economic considerations need to be integrated into the business strategies and daily practices of construction enterprises so that contributions can be made to sustainable development (Tan et al., 2011).

Integrating sustainability considerations into the construction industry is indeed a transition process, i.e. replacing or complementing the traditional approach of construction with more sustainable alternatives. However, firms, including construction firms, are usually resources constrained. This is compounded by the fact that sustainability is such a complex concept covering economic, social and environmental dimensions. To facilitate the sustainability transition of the construction industry, it is imperative to identify those sustainability aspects that are perceived to be the most and least important, and worst-performed and best-performed by the construction enterprises, thereby allocating the limited resources to the worst-performed yet important sustainability aspects. A number of studies have been undertaken to examine the practices improving the environmental sustainability of the construction industry, e.g. off-site construction (Mao et al., 2013), energy-saving technologies (Du et al., 2014), green construction (Shi et al., 2013) and green buildings (Seyis et al., 2015). However, few studies attempted to investigate how the various economic, social and environmental sustainability aspects, constituting the holistic sustainability concept, are perceived and performed by the construction firms. Similarly, there is lack of efforts to properly classify the aspects according to their managerial priorities and identifying the efficient pathways to facilitate construction firms’ transition towards sustainability.

Especially, the construction industry consists of numerous enterprises that have different levels of sustainability performance. Previous studies have developed various classification or phase models to understand the heterogeneity of firms’ sustainability behaviors and performance, e.g. the five-phase model (resistant, reactive, anticipatory, innovation-based, and sustainability rooted) proposed by Klewitz and Hansen (2014). Firms with various levels of sustainability performance may have different sustainability aspects to be
improved. In the context of construction industries, there is a need to answer the following research questions.

What are the sustainability aspects that construction firms of different sustainability levels value most (i.e., aspects such as quality management, energy conservation, etc.)? How do the various groups of firms perceive their performance on these aspects? How could these aspects be classified thereby revealing the appropriate pathways for construction firms with various sustainability levels to further transition towards higher sustainability levels?

Proposed by Martilla and James (1977), importance-performance analysis technique provides a useful tool for identifying the most crucial attributes regarding their need for managerial action. This paper proposes Transition Pathways towards Sustainability (TPS) for construction enterprises based on the importance-performance analysis of critical sustainability aspects. The objectives of this study are (1) to use importance-performance analysis to identify how construction enterprises of different sustainability levels perceive and perform on various sustainability aspects, thereby classifying the aspects according to their managerial priorities, and (2) to provide practical guidance for construction firms’ resource allocation for sustainability improvements by proposing the TPS based on the results of the importance-performance analysis.

**Literature review**

**Sustainability of construction enterprises**

A growing number of construction enterprises have employed the concept of sustainability at both corporate and project levels, with the corporate-level efforts establishing a sustainability strategy and the project-level efforts realizing the corporate-level strategies (O’Connor et al., 2016). This paper focuses on the corporate-level sustainability of construction enterprises.

There are various definitions of corporate sustainability. Van Marrewijk and Werre (2003), for instance, defined corporate sustainability as the efforts “demonstrating the inclusion of social and environmental concerns in business operations and interactions with stakeholders”. Similarly, Artiach et al. (2010) defined corporate sustainability as “a business and investment strategy that seeks to use the best business practices to meet and balance the needs of current and future stakeholders”. These definitions indicate corporate sustainability emphasizes the importance of meeting stakeholders’ needs as well as balancing the economic, social, and environmental dimensions of corporate operations.

In the context of construction industries, an array of studies has been conducted to investigate various sustainability issues associated with construction enterprises, e.g. the assessment of stakeholders’ needs (Zhang...
and El-Gohary, 2015); corporate sustainability policy (Zuo et al., 2012), the relationships between corporate sustainability and competitiveness (Lu et al., 2013; Tan et al., 2011), sustainable construction practices (Mao et al., 2013; O’Connor et al., 2016); assessment frameworks of corporate sustainability (Lu and Zhang, 2016; Zhao et al., 2012), and driving forces and barriers to sustainability (Seyis et al., 2015; Ye et al., 2015; Zhang et al., 2011). These studies suggest substantial barriers related to capability and resources exist which impede the construction enterprises to adopt sustainability practices. For instance, Du et al. (2014) pinpointed the stakeholder’s reluctance to use and high initial cost to be the most significant barriers to the adoption of energy-saving technologies in the Chinese building sector. In Malaysia, only large enterprises are paying attention to sustainable implementation in their projects due to limited understanding and the concerns of extra cost (Abidin, 2010). Similarly in Chile, Serpell et al. (2013) indicated that the Chilean construction firms are in an early stage of achieving sustainable development, and their attitudes towards sustainability are highly influenced by their technological capability and financial strength, reflected by their firm size. Due to various resources constraints e.g. monetary, technological and human resource limitations, construction enterprises have difficulties in implementing sustainable construction practices and transitioning towards higher sustainability levels (Shi et al., 2013).

Even though the existence of resource barriers to sustainability is well recognized, few studies provide strategic guidance for construction enterprises about how they could efficiently transition towards higher sustainability levels under constrained resources. Previous studies e.g. Shi et al. (2013), Seyis et al. (2015) and Abidin (2010) also predominantly focus on the environmental dimension of sustainability. Lu and Zhang (2016), for instance, indicated the development of corporate sustainability in the construction industry is seriously skewed towards the environmental matters while social issues are marginalized. There are limited studies investigating how the various economic, social and environmental sustainability aspects, constituting the holistic sustainability concept, were perceived and performed by construction enterprises. By proposing the TPS based on a holistic investigation of the various sustainability aspects, this study aims to further facilitate the sustainability transition of construction enterprises.

**Performance heterogeneity and transition towards sustainability of construction enterprises**

Firms have diverse scales, capabilities, strategies and positions in the business environment, and thus may have different levels of sustainability performances. Firms with different sustainability levels may have different
perceptions of sustainability. Thus, a better understanding of the firms’ performance heterogeneity is necessary to the development of the TPS.

Firms’ performance heterogeneity could be understood from two perspectives, namely the environmental determinism perspective and strategic choice perspective (Hrebiniak and Joyce, 1985; Yang et al., 2013). The environmental determinism perspective emphasizes the selection mechanisms of environments, arguing that a proper environment or an appropriate position of the firm in the environment is the primary factor determining the firm’s performance, and the mainstream theory within this perspective is the organizational ecology theory (Hannan and Freeman, 1993). By contrast, the strategic choice perspective indicates that it is firms’ deliberate planning and strategic decisions that impact their performance rather than the unpredictable environment (Korkmaz and Messner, 2008; Yang et al., 2013). It is widely recognized that these two approaches are mutually supplementary rather than exclusive (Hrebiniak and Joyce, 1985; Korkmaz and Messner, 2008). Both of firms’ strategic choices and external environments can influence firms’ performance.

Thus, under different strategic choices and business conditions, firms will have different sustainability performances. Klewitz and Hansen (2014) suggested that firms’ strategic sustainability behavior is an evolutionary process, ideally evolving from resistant and reactive, to anticipatory and innovation-based, and finally to sustainability-rooted. Similarly, construction enterprises, regardless of their current level of sustainability performance, should be encouraged to transition towards higher sustainability levels. For instance, resistant and reactive firms should aim for the transition towards anticipatory and innovation-based firms, and anticipatory firms should aim for becoming innovation-based and sustainability rooted firms.

Compared to small and medium-sized enterprises, large firms receive more scrutiny from the business environment including government, media and the public, and face a higher level of pressures to be socially and environmentally responsible (Zhang et al., 2008). Therefore, under different levels of social pressures and with various levels of resources, construction firms may have significantly different sustainability performance. To propose the TPS, it is imperative to explore the sustainability perceptions and performances of construction firms with different sustainability levels. Do the construction enterprises with various performance levels have different sustainability perceptions? What are the priorities for the firms with different performance levels?

Importance-performance analysis

Various methods have been adopted in previous studies to evaluate the sustainability perceptions and performance of construction enterprises. Some studies focus on evaluating the importance of sustainability. Jiang and Wong (2016), for instance, employed factor analysis to identify the key aspects of corporate social
responsibility perceived by the Chinese construction enterprises based on a questionnaire survey. Similarly, Zhao et al. (2016) investigated the importance of corporate social responsibility perceived by the Chinese construction enterprises using relative importance index. Some studies aim at assessing the performance of sustainability. Jones et al. (2010), for instance, adopted content analysis to investigate the corporate approaches and performance on sustainability in the U.S. construction industry by means of analyzing corporate documents. Based on survey data, Bevan and Yung (2015) developed an index to investigate the implementation levels of corporate social responsibility in small to medium sized Australian construction enterprises. Sarkis et al. (2012) proposed a model for assessing the sustainability of contractors by integrating analytic hierarchy process and the analytic network process.

Various methods (e.g. factor analysis, content analysis, relative importance index and analytical hierarchy process) have been employed in previous studies to conduct sustainability assessments. However, there are some weaknesses associated with these methods. First, factor analysis and content analysis do not aim to categorize the construction enterprises based on their level of sustainability performance. Therefore, these methods are inadequate in revealing the performance heterogeneity of the firms and identifying how firms with low sustainability may transition towards more sustainable ones. More importantly, by focusing on either the importance or performance evaluation of sustainability, very few studies holistically investigate both the importance and performance evaluations of sustainability in construction enterprises. As a result, existing studies are inadequate in identifying the crucial sustainability aspects (e.g. important yet worst-performed aspects) that require managerial actions.

Proposed by Martilla and James (1977), importance-performance analysis (IPA) technique provides a useful instrument for identifying the most crucial corporate attribute regarding their need for managerial action. It helps decision makers to set management priorities and determine how scarce resources might best be allocated. IPA is easy to be applied in various contexts and provides the capacity to present strategic recommendations together with data (Lai and To, 2010). As a result, IPA has been applied in various areas such as tourism (Pan, 2015). However, there are very limited applications of IPA in the construction industry. By employing IPA as the basis of developing the TPS, the present study is one of the earliest of its kind on using IPA in the context of the construction industry.

<Insert Fig 1 here>
The IPA model is graphically presented as a grid divided into four quadrants, which have been interpreted as “keep up the good work”, “concentrate here”, “low priority” and “possible overkill” (Martilla and James, 1977), as shown in Fig.1. The X-axis illustrates the enterprises’ performance on the attributes and the Y-axis denotes the importance of the attributes (Sörensson and von Friedrichs, 2013). Each attribute shows up according to its mean rating on the importance and performance scales (Lin et al. 2009; Martilla and James 1977).

- **Concentrate here.** Attributes in Q1 are perceived to be of high importance while the performance levels are relatively low, indicating that efforts should be concentrated here to make performance improvements.

- **Keep up the good work.** Attributes in Q2 are perceived to be of high importance, and the enterprises have high-performance levels on these attributes as well, suggesting a message of keeping up the good work.

- **Low priority.** Attributes in Q3 are of low importance, and thus, even though enterprises also have low-performance levels on these attributes, it is not an issue.

- **Possible overkill.** Attributes in Q4 are of low importance levels, but the enterprises have high-performance levels on these attributes, indicating that firms expended too much effort than actually needed.

An IPA is conducted in four stages: (1) collecting the key attributes i.e. items that can be characterized by the levels of importance and performance; (2) conducting a survey to measure the perceived importance and performance levels of the items; (3) determining the means of the importance and performance scores for each item, and (4) plotting the items according to their mean importance and performance scores in the IPA grid (To et al., 2015).

Because the target population often presents the heterogeneity of importance and performance perceptions, segmentation plays a critical role in IPA to identify differences between distinct groups so that more accurate decision could be made (Bruyere et al., 2002). IPA without differentiating the respondents will produce results for an “average group” which often does not actually exist, and thus average importance and performance ratings are of limited practical value (Griffin and Edwards, 2012). Segmentation can be accomplished by performing cluster analysis, and then IPA could be carried out on each cluster (Bacon, 2003).

The performance gap analysis reflects the urgency of performance improvement for each attribute. The performance gap is defined as the mean performance ratings minus the mean importance ratings, with a positive gap (performance exceeds importance) suggesting satisfactory and negative gap (performance is lower than
importance) indicating management attention (Taplin, 2012). Attributes with a larger negative gap indicate more urgent management attention.

The IPA was conducted in this study to identify which sustainability aspects the construction enterprises consider to be most and least important, and which aspects were best- and worst-performed by these enterprises, thereby forming a basis for developing the TPS.

**Methodology**

**Identification of critical sustainability aspects**

We have identified a list of key attributes, i.e. critical sustainability aspects (CSAs) for construction enterprises in a previous study (Chang et al. 2016). Following the sustainability concept, the CSAs should cover the economic, social and environmental dimensions of sustainability. In this study, to measure the importance and performance levels of construction firms, the CSAs identified in Chang et al. (2016) were used. Formulation of the CSAs consists of two steps: (1) review of the chief sustainability reporting guidelines for construction enterprises, and (2) content analysis of the sustainability reports released by three leading construction firms. The final list of CSAs consists of 29 aspects, as shown in Table 1. The detailed procedure of proposing these sustainability aspects is introduced in Chang et al. (2016).

**Data collection**

Five-point Likert scale is a common approach adopted by the previous IPA related studies to measure importance and performance. Similarly, this study employs a five-point Likert scale to measure the importance and performance levels of the CSAs perceived by the construction enterprises. Respondents were asked to evaluate the relative importance of the identified 29 CSAs from 1 ("very unimportant") to 5 ("very important"), with 3 being neutral and 4 being important. To measure the performance level, respondents were asked to evaluate their enterprises’ performance on these CSAs, similarly on a 5-point Likert scale from 1 being “very bad” to 5 being “very good".
A formal questionnaire survey was conducted to solicit construction enterprises’ opinions on these CSAs. A brief introduction to this study and definition of sustainability was provided at the beginning of the questionnaire, followed by a section designed to collect the basic information of the respondents. Consequently, the last section investigates the importance and performance ratings of the CSAs.

Becoming the world’s largest since 2010 (GCP and OE, 2013), the Chinese construction industry offers a useful empirical case to the development of the TPS. Because the population of the entire Chinese construction industry is unknown, it is not feasible and cost-effective to conduct a true probability sampling (e.g. simple or stratified random sampling). The approach of web survey with convenience sampling was adopted in this study. The largest and reputable academic online survey platform in China, i.e. www.sojump.com, was employed in this study to collect the responses. This platform has been extensively utilized by construction researchers e.g. Mao et al. (2013), Xiang et al. (2015) and Luo et al. (2015). This academic online survey platform has maintained panels of registered enterprises operating in various industries in China, e.g. the energy, information technology and construction industry. The construction enterprises registered in this platform comprises the sampling frame of this study, and a total of 4500 questionnaires were distributed in the sampling frame from May to June 2015. A total of 262 questionnaires were returned with valid responses, resulting in a response rate of 5.8%. Compared to self-administrated approach, web surveys tend to have lower response rate because of various factors. These include the time and resource limitation, the geographical separation between the researchers and respondents, the volunteer nature and a large number of potential respondents. The similar response rate has been observed in other construction studies using web surveys, such as 2.9% in Said (2015), and 8% in Al and Kandil (2013). The valid responses were collected from various construction enterprises with different scales and business focuses, such as China State Construction Engineering Corporation Ltd, China Railway Group Ltd, etc. The sample group profile indicates over 79% of the respondents have more than five years of experience in the industry, and 41% have more than ten years of experience. 50% of the respondents are corporate or project managers while the other 50% are engineers and designers. This balanced respondent profile reduces the selection bias and improves the representativeness of sample selection (Zhao et al., 2015).

Data analysis

Cluster analysis was utilized to classify the construction enterprises into different groups according to their sustainability performances. Cluster analysis aggregates individuals based on their characteristics, forming groups with greatest possible internal homogeneity (within groups) and external heterogeneity (between groups) (Carvalho et al., 2015). The performance ratings of the CSAs were used as the input variables in the cluster
analysis, and they were standardized prior to the analysis to eliminate the potential effects of scale differences
(Milligan and Hirtle, 2003). The non-hierarchical k-means cluster analysis is employed to generate the cluster
solutions. Unlike the hierarchical agglomerative methods, the k-means cluster analysis adopts the iterative
partitioning methods which make more than one pass through the data and can handle large data sets, thereby
avoiding the major drawbacks of hierarchical agglomerative methods (Aldenderfer and Blashfield, 1986).

The first step of k-means cluster analysis is to form an initial partition by arbitrarily assigning the cases into
k groups. The value of k is user-specified, and this study attempted the two-, three-, four- and five-cluster
solution (k=2, 3, 4 and 5). Next, the Euclidean distances are calculated between the cases and the k-cluster
centroids, which are the multivariate mean of the cases within a cluster, to reassign the cases to the nearest
centroid (Aldenderfer and Blashfield, 1986). Once all these reassignments are completed and the centroids of
the new clusters are computed, the Euclidean distances are calculated again between the cases and the new
centroids, and the cases are reallocated. This step will repeat until no reassignments occur. The Euclidean
distance is defined as follows (Aldenderfer and Blashfield, 1986).

\[ d_{ic} = \sqrt{\sum_{k=1}^{p} (x_{ik} - c_k)^2} \]

Where \( d_{ic} \) is the Euclidean distance between the case \( i \) and the centroid; \( x_{ik} \) is the value of the \( k \)th variable for
the \( i \)th case; \( p \) is the total number of the variable (i.e. 29 in this paper); \( c_k \) is the value of the \( k \)th variable for the
centroid.

After examining various cluster solutions (e.g. the two-, three-, four- and five-clusters), the three-cluster
solutions is adopted based on two criteria, i.e. 1) maximum internal homogeneity and external heterogeneity,
and 2) parsimony of explanation (Klastorin, 1983). Specifically, the two- and five-cluster solutions were
abandoned since the reassignments of the cases still occur (i.e. fail to converge) after ten iterations were
performed. Thus, only the three- and four-cluster solutions are usable. The three-cluster solution was considered
superior to the four-cluster solution judged by the two criteria. First, one-way ANOVAs relating cluster
membership to the performance ratings of the CSAs indicates both the three- and four-cluster solutions passes
the internal homogeneity and external heterogeneity criteria (significant at 0.01 level). However, the mean of the
\( F \)-statistics for the three-cluster solution is 69.37, larger than 50.08 for the four-cluster solution, indicating the
three-cluster solution significantly outperform the four-cluster solution in this criteria. Second, the three-cluster
solution generates very distinct clusters that are easy to be interpreted, fulfilling the parsimony of explanation criteria.

Once three firm clusters were obtained, the traditional IPA was conducted. Firstly, the means of both the importance and performance ratings were calculated for the identified three clusters respectively. Then, performance gap analysis (performance mean minus importance mean) was conducted for each of the firm clusters to identify those aspects requiring urgent management attention. This is followed by the IPA mapping, which allocates the 29 CSAs into the appropriate quadrants. Different from the traditional IPA studies, this paper developed the last step to integrate the sustainability transition perspective into the IPA, thereby proposing the TPS for construction enterprises.

Results

Mapping firm clusters on the IPA grid

The mean scores of the 29 CSAs for each of the three clusters are shown in Table 2 and subsequently mapped onto the IPA grid, as shown in Fig 2. Similar to previous IPA studies, in Fig 2 the cross-hairs are placed at the grand means of all the 29 CSAs. Based on the average score of the means for the three clusters shown in Table 2, the three firm clusters can be labeled as low-performing firms (low importance and performance ratings), medium-performing firms (medium importance and performance ratings), and high-performing firms (high importance and performance ratings). All the 29 CSAs of high-performing firms are located at Q2, indicating “keep up the good work”, while all the CSAs of low-performing firms are located at Q3, indicating “low priority”. This suggests that both the importance and performance scores of the high-performing companies are well above the average of the whole sample, while it is the opposite for the low-performing firms. Sustainability transition of the construction industry is the process in which each firm clusters moves towards higher sustainability levels, indicated by the arrows in Fig 2.

As shown in Fig 2, the cluster analysis captures the firm groups’ divergent opinions on the importance and performance levels for various aspects of sustainability. This is different from previous studies, e.g. Zhao et al. (2016) and Bevan and Yung (2015) in which all respondents were treated as a homogeneous group without segmentation to calculate the overall mean value of indicators. Therefore, this study reveals a more granular picture of the sustainability perceptions of construction firms on the various sustainability aspects. For instance, in Fig 2, the blue dots represent the importance and performance ratings on the sustainability aspects of the medium-performing firms. For most sustainability aspects, medium-performing firms have medium-level
ratings between those of low-performing and high-performing firms, as shown in Fig 2. However, also marked by Fig 2, medium-performing firms do have very high ratings on A2 (quality management) similar to those from high-performing firms, and very low ratings on A15 (supporting community development) similar to those from low-performing firms. This indicates that medium-performing firms perceive quality management as vital important while supporting community development as less important compared to other aspects. Without differentiating the firm groups, it is unlikely to undertake such detailed examination and comparisons of various sustainability aspects.

<Insert Table 2 here>

<Insert Fig 2 here>

**Performance gap analysis**

Performance gap analysis has been utilized by previous IPA studies to identify the attributes that need urgent managerial attentions (Taplin, 2012). By calculating the performance gap (performance mean minus importance mean), the gap analysis was employed in this study to investigate the urgency of performance improvement for each of the CSAs. For the whole sample, the means of importance for 27 aspects is beyond four (which means “important”) while only two aspects have a mean score beyond four (which means “good”) in the performance evaluation. This suggests, in general, there are gaps between firms’ sustainability awareness and behavior, which is echoed by previous studies e.g. Zsóka (2008). For further comparison across clusters, performance gaps of the 29 CSAs were calculated for each of the firm clusters (see Fig 3).

<Insert Fig 3 here>

The average performance gaps within low-performing, medium-performing and high-performing firms are -0.6, -0.48 and -0.11 respectively. This indicates that compared to high-performing firms, it is more urgent for low-performing and medium-performing firms to improve their sustainability performance. Among the three
firm clusters, high-performing firms have the smallest performance gaps for all the 29 CSAs, while low-performing firms have the largest performance gaps for most of the CSAs, except for several aspects where medium-performing firms have the largest performance gaps. These exceptions include A4 (innovation system), A13 (anti-corruption and fair competition), A25 (managing impacts on biodiversity), A28 (light pollution control) and A29 (noise control). Fig. 3 shows the three groups present very different patterns of the performance gaps, except for A12 (wages and welfare) where all the three groups have large performance gap. This indicates that in general respondents are not convinced with the wages and welfare provided.

Specifically, for high-performing firms the aspects which the firms have the least motivation to further improve (i.e. lowest performance gaps) are A1 (corporate strategy) and A3 (supply chain management), while the most urgent aspects that call for improvement (i.e. largest performance gaps) are A26 (emission reduction) and A17 (caring for all employees). For medium-performing firms, the aspects with the lowest performance gaps are A15 (supporting community development) and A2 (quality management), while the aspects with the largest performance gaps are A12 (wages and welfare) and A29 (noise control). For low-performing firms, the aspects with the lowest performance gaps are A25 (managing impacts on biodiversity) and A13 (anti-corruption and fair competition), while the aspects with the largest performance gaps are A12 (wages and welfare) and A17 (caring for all employees).

The aspects with large performance gaps indicate that firms perceive these aspects are important but have lower performance levels, suggesting high urgency of performance improvement. It is important to note that the aspects with small performance gaps do not mean the firms do not need to improve on these aspects. Rather, it means the firms have similar importance and performance levels on these aspects. For instance, as low-performing firms have similar low ratings on importance and performance of A25, this aspect has a small performance gap. However, with a performance rating of 2.81, this aspect clearly could be further improved within the low-performing firms.

IPA results of firm clusters

The grand mean values of importance and performance scores for the three firm clusters were calculated separately and the scores of each aspect were compared against the grand mean value. As a result, the IPA grid positions of the 29 CSAs for the three firm clusters were identified, as shown in Table 3.

<Insert Table 3 here>
Q1: Concentrate here. The aspects in this quadrant have higher importance scores but lower performance scores than the grand mean, suggesting that firms should concentrate on these aspects. For all the three firm clusters, A12 (wages and welfare) is deemed to be a managerial focus. For low-performing firms, more resources should also be allocated to promote A11 (education and training), A20 (construction waste management), A21 (land use efficiency) and A26 (emission reduction). For medium-performing firms, A28 (light pollution control) and A29 (noise control) should be paid more attention. For high-performing firms, A4 (innovation system) and A29 (noise control) should be further improved.

Q2: Keep up the good work. The aspects in this quadrant have both higher importance and performance scores than the grand mean, suggesting that these aspects are the strengths of the firms. A1 (Corporate strategy), A2 (quality management), A6 (customer service and satisfaction) and A9 (risk management) are perceived to be the most important aspects by all the three groups, and are also highly ranked on the performance evaluations, suggesting that generally economic aspects are the strength of the construction enterprises. Especially all economic aspects, including A4 (innovation system) and A5 (corporate governance), are placed in this quadrant for the low-performing firms, indicating a focus on economic competitiveness in this group. Two social aspects are in this quadrant for all the groups, namely A10 (occupational health and safety) and A16 (obeying laws and regulation). There are no environmental aspects in this quadrant for the low-performing firms, while both medium-performing and high-performing firms have four environmental related aspects, indicating a lack of consideration of environmental issues in low-performing companies.

Q3: Low priority. For low-performing firms, most of the social and environmental aspects are placed in this quadrant, indicating that these firms perceive social and environmental sustainability as less important in general, and they perform worse in these aspects than the economic aspects. There are several aspects placed in this quadrant for all the three groups, including A13 (anti-corruption and fair competition), A15 (supporting community development), A17 (caring for all employees), A25 (managing impacts on biodiversity), and A27 (green innovation and product). This suggested that these sustainability aspects are not considered as a priority for construction firms.

Q4: Possible overkill. There are no aspects placed in this quadrant for low-performing firms. A3 (Supply chain management) is a possible overkill for both the medium-performing and high-performing firms. A5 (Corporate governance), A7 (communication management), A14 (human right) and A22 (water conservation
and harvesting) are also deemed to be possible overkill by either medium-performing or high-performing firms. This indicated that too many efforts have been placed on these aspects in contrast to their level of perceived significance.

**Transition pathways towards sustainability (TPS) for construction enterprises**

The previous section presents the IPA results for the identified three firm clusters. Based on the IPA results, the *Transition Pathways towards Sustainability* (TPS) could be proposed, providing managerial guidance for construction enterprises to facilitate the efficient transition towards higher sustainability levels, as shown in Fig 4.

![Insert Fig 4 here>]

Existing researches suggest firms’ sustainability behaviors and performances vary significantly (Klewitz and Hansen, 2014; Serpell et al., 2013). Similarly, the three firm clusters identified in this study have different ratings for the importance and performance of the CSAs, clearly shown in Fig 2. Compared to high-performing enterprises, low-performing and medium-performing firms have lower sustainability performance scores for all the CSAs. Meanwhile, it is more urgent for these firms to improve their sustainability performance, indicated by the gap analysis. Similar to Klewitz and Hansen (2014), this study suggests that sustainability transition of the industry consists of a series of processes in which every cluster of firms experiences continuous sustainability improvements, i.e. low-performing firms to medium-performing and high-performing firms, medium-performing firms to high-performing firms and high-performing firms towards higher sustainability goals.

The IPA was conducted for the three firm clusters separately to investigate how the CSAs were perceived by the different firm clusters. The results show that for the low-performing groups, all economic aspects were placed in the “keep up the good work” quadrant while most of the social and environmental aspects were recognized as “low priority”. This does not mean that low-performing firms perform very well on the economic aspects, as Fig.2 clearly shows that medium-performing and high-performing companies perform much better on the economic aspects than low-performing firms. Rather, it indicates that in the low-performing firms the
economic aspects have higher importance and performance values than the grand mean. This suggests the economic competitiveness paradigm is still dominant in this group of enterprises and many social and environmental aspects are ignored.

By contrast, in medium-performing and high-performing firms, several social and environmental aspects were placed in the “keep up the good work” quadrant, indicating that the importance and performance ratings of some social and environmental aspects are beyond the grand mean in these groups, surpassing some economic aspects. This is further confirmed by the fact that some economic aspects are placed in the “low priority” quadrant in the medium-performing and high-performing firms, as shown in Table 3. For instance, A5 (corporate governance) was placed in the “keep up the good work” quadrant by the low-performing firms, whereas in the “low priority” quadrant by the medium-performing firms. At the same time, none of the environmental aspects were placed in the “keep up the good work” quadrant by the low-performing firms. By contrast, four environmental aspects, e.g. A20 (construction waste management) and A24 (energy conservation), were placed in the “keep up the good work” quadrant by the medium-performing firms. This indicates that the low-performing firms perceive A5 (corporate governance) as more important than all the environmental aspects, while the medium-performing firms perceive at least some environmental aspects e.g. A24 (energy conservation) are more important than A5 (corporate governance). Compared to low-performing firms, this indicates in medium-performing and high-performing firms social and environmental sustainability starts to gain momentum and experience both awareness and performance improvements. Thus, sustainability transition of the construction industry calls for cultural changes in which construction firms rethink the appropriateness of the sole dominance of the economic competitiveness paradigm and increasingly recognize the importance of social and environmental sustainability (Zhang, 2014).

The transition perspective illustrated by Fig 4 also re-interprets and extends the managerial implications derived from the four quadrants of the IPA grid. This study suggests that there are some limitations associated with the managerial implications derived from the traditional IPA. In the traditional IPA grid, if the attributes have lower importance and performance values than the grand mean, they will be placed in the “low priority” quadrant, indicating these attributes are not organizational preferences (Martilla and James, 1977). However, are the attributes that firms perceive to be unimportant really insignificant? Exactly due to lack of awareness of environmental protection, many environmental issues emerged in the 1960’s which triggers the emergence of the “sustainable development” concept and its increasing popularity (Dresner, 2008). Firms’ understanding of sustainability is constantly changing and the CSAs which receive lower importance value than the grand mean
can only indicate that they are not priorities under the current mentality and culture of the firms. It does not necessarily mean that these aspects are not important for firms’ development. Thus, corporate sustainability should be understood from a dynamic perspective, which is exactly the focus of this study. By simultaneously investigating the sustainability perception and performance of low-performing, medium-performing and high-performing firms, this study provides the opportunity to gain a better understanding of corporate sustainability from a dynamic transition perspective.

Specifically, from a transition perspective, the critical issue is to continuously improve firms’ awareness and performance of sustainability, transitioning the aspects in the “concentrate here”, “low priority” and “possible overkill” quadrants into the “keep up the good work” quadrant. The following three areas should be paid much attention to: (1) the performance level of aspects in the “concentrate here” quadrant need to be improved; (2) the importance level of aspects in the “possible overkill” need to be improved; and (3) both the importance and performance level of aspects in the “low priority” need to be improved. Firms with limited resources could firstly focus on the aspects in the “concentrate here” quadrant, and then in the “low priority” and “possible overkill” quadrants. The arrows in Fig 4 denote these improvement processes of these aspects in the quadrants. To improve the importance levels, the concept of sustainability should be popularized in the enterprises, which could be achieved through various campaign activities. To improve the performance levels, capability building needs to be emphasized through various channels such as regular workshops, industry forums and international cooperation. Each of the identified 29 CSAs is clearly plotted into the appropriate quadrants in the IPA grid for all the three firm clusters, as shown in Fig 4. Construction enterprises could use this framework together with Table 1 and Table 2 to understand the importance or performance levels of which sustainability aspects need to be further improved with an aim to facilitate the firms’ transition towards higher sustainability levels.

For instance, for low-performing firms to efficiently transition towards sustainability, in the short term they could firstly allocate their resources to improve the performance level of the “concentrate here” quadrant, then both the importance and performance level of the “low priority” quadrant. When in the medium and long term they become medium-performing and high-performing firms, they should then allocate their resources according to the new distribution of the aspects in the four quadrants. Specifically, this study reveals that for the low-performing firms, five aspects are allocated in the “concentrate here” quadrant include such as A20 (construction waste management) and A26 (emission reduction). It indicates the surveyed low-performing firms recognized the importance of these aspects, yet performed poorly. Therefore, the low-performing firms as well as the government should assign priorities to improve the performance on these aspects. The government could,
for instance, provide more economic incentives specifically for the low-performing firms’ efforts in improving their waste management strategies and emission reduction. A total of nine aspects is allocated in the “low priority” quadrant for the low-performing firms, including A22 (water conservation and harvesting), A23 (material conservation). It indicates the firms not only have poor performance on these aspects, but also do not highly recognize their importance. Therefore, unlike those aspects in the “concentrate here” quadrant which have already gained recognition in the firms, these aspects in the “low priority” quadrant need to be improved by both propaganda and capability building activities, and thus may require more efforts. When those aspects in the “concentrate here” quadrant are improved, the firms could start to allocate resources, e.g. conducting workshops, investing on relevant technologies and software tools, and recruiting experienced employees in sustainable construction, to improve the aspects in the “low priority” quadrant. The “keep up the good work” quadrant consists twelve aspects including all the economic ones. This suggests to efficiently transition towards sustainability, the low-performing firms do not need to make additional investments on these economic aspects before they resolve their sustainability bottlenecks, i.e. the social and environmental aspects in the “concentrate here” and “low priority” quadrants. To sum up, for the low-performing firms, the following strategic plan could be initiated: (1) improving the performance on the five aspects in the “concentrate here” quadrant (e.g. construction waste management and emission reduction) through capability building activities; (2) improving both the awareness and performance levels on the nine aspects in the “low priority” quadrant (e.g. water and material conservation) through both propaganda and capability building activities; and (3) maintaining the awareness and performance levels on the twelve aspects in the “keep up the good work” quadrant (e.g. quality management and corporate governance). Once this strategic plan is implemented, it is expected that the low-performing firms will improve their overall sustainability performance and transition towards medium-performing and high-performing firms. Consequently, the firms could similarly propose the strategic plan according to the new distribution of the aspects in the IPA matrix. By classifying the various sustainability aspects into different types according to their managerial priorities, the proposed TPS assists the strategic planning of corporate sustainability in construction enterprises.

**Conclusions**

There is lack of studies on classifying the various sustainability aspects according to their managerial priority thereby providing strategic guidance for construction enterprises to transition towards sustainability. IPA is applied in this study as a diagnostic instrument to identify perceived importance and performance of
CSAs among the construction enterprises. Three firm clusters, namely low-performing firms, medium-performing firms and high-performing firms were identified based on \( k \)-means cluster analysis, and the IPA was conducted for the three clusters subsequently. Then, the Transition Pathways towards Sustainability (TPS) were proposed.

The findings show that while 27 out of 29 CSAs were deemed to be important, construction enterprises have good performance on only two CSAs. This reveals a clear gap between the importance and performance levels. Gap analysis further shows that among the three firm clusters, high-performing firms have the lowest performance gaps on all of the 29 CSAs, while low-performing firms have the highest performance gaps on most of the CSAs. This suggests it is more urgent for low-performing firms to improve their sustainability performance. IPA results of the three firm clusters reveal that in low-performing firms, the dominance of the economic competitiveness paradigm is apparent and there is a lack of consideration of social and environmental sustainability. By contrast, medium-performing and high-performing firms put more emphasis on social and environmental aspects. The proposed transition pathways clearly demonstrate which sustainability aspects need to be further improved to facilitate the firms’ transition towards higher sustainability levels.

Although this study focused on the sustainability perception and performance of the Chinese construction enterprises, the results have global implications for construction enterprises in other countries as well. This research on developing transition pathways towards sustainability for construction enterprises based on IPA contributes to the body of knowledge globally from three aspects, i.e. the methodological contribution, empirical contribution and practical contribution.

First, regarding the methodological contribution, this study offers an example of how IPA could be employed in construction-related studies. Very few existing studies have employed IPA in the context of construction industries. This study has demonstrated that IPA could be used in the context of construction industries as an effective approach to simultaneously investigate the perceived importance and performance levels of key attributes, and provide managerial suggestions for each attribute. In particular, IPA provides a streamlined approach to identify most crucial sustainability aspects to be paid more attention, e.g. those areas perceived to be most important yet worst-performed (i.e. aspects in the “concentrate here” quadrant). This provides useful inputs for making strategic decisions, e.g. determining the most appropriate way to allocate scarce resources. IPA and the associated research procedure proposed in this study have a potential to be widely used by other construction studies to investigate factor-related issues (e.g. risk factors, competitiveness factors, sustainability factors, factors causing cost overruns, etc.). For instance, IPA could be employed to investigate
the perceived importance and performance levels of construction firms on a series of factors formulating their competitiveness, thereby identifying the most important yet worst-performed competitiveness factor. The proposed TPS also offers a more holistic understanding of facilitating sustainability improvements in construction enterprises. Even though an array of researches exists about the sustainability of construction enterprises, there is a lack of studies specifically focusing on the strategic planning of sustainability transitions. By integrating a dynamic transition perspective into the traditional IPA analysis, this study proposes the TPS as a strategic guidance for construction enterprises, which has contributed to the current body of knowledge.

Second, in terms of the empirical contribution, this study contributes to the empirical knowledge in the area of corporate sustainability of construction enterprises by investigating how the different economic, social and environmental sustainability aspects are perceived and performed by various construction enterprises. Various studies have suggested that due to the different strategic choices and business conditions, construction firms have different levels of sustainability performance, such as in Ghana (Scott et al. 2013), Malaysia (Abidin 2010) and Chile (Serpell et al. 2013). However, few empirical studies holistically investigate the implementation situation of various sustainability aspects covering the economic, social and environmental dimensions. There is also lack of researches simultaneously investigating both the importance and performance levels of sustainability aspects perceived by construction enterprises. Based on the empirical evidence in China, the proposed TPS is one of the earliest of its kind in terms of demonstrating both the importance and performance levels of the sustainability concept in a holistic manner perceived by construction firms at different sustainability levels. Because the heterogeneity of sustainability performance is a global phenomenon in construction industries worldwide, this study contributes to a better understanding of corporate sustainability of construction enterprises in general.

Third, regarding the practical contribution, the proposed TPS can support sustainability decision-making of construction enterprises. The holistic sustainability concept contains various aspects. Due to resource constraints, construction enterprises could experience significant difficulties of determining how to allocate the limited resources to the various sustainability aspects. Based on cluster analysis, three firm groups are identified in this study. Then, based on IPA of 29 critical sustainability aspects, the proposed TPS classified the various aspects into four quadrants for each of the three firm groups, and revealed that aspects in the “concentrate here”, “low priority” and “possible overkill” quadrants should be transitioned towards the “keep up the good work” quadrant. The proposed TPS provides a lens through which the construction firms could view the sustainability
perceptions and performance of their peers with similar, lower or higher sustainability performance, thereby
informing the decision-making process of choosing an appropriate sustainability strategy.

Future research opportunities exist in this area of research. For instance, there are various external factors
driving or prohibiting the transition towards sustainability (e.g. policy environment) and different firm clusters
may interpret the factors differently, thereby influencing their responses to sustainability. Further research could
be conducted to investigate how firms at different sustainability levels perceive the external factors driving or
impeding sustainability transition. This helps to identify the most significant factors influencing the strategies to
the sustainability of each firm cluster. By identifying these critical factors, combined with the TPS proposed in
this study, detailed macro policy interventions could be introduced to stimulate the sustainability transition of
construction firms at various sustainability levels.

Acknowledgements

This study was supported by the National Natural Science Foundation of China (Grant No.71371072).

References

Abidin, N. Z. (2010). "Investigating the awareness and application of sustainable construction concept by

Construction Engineering and Management, 139(10), 06013002.


performance.” Accounting & Finance, 50, 31-51.

of Market Research, 45(1), 55-73.


segmentation." Journal of Travel & Tourism Marketing, 12(1), 81-95.


Table 1. List of CSAs for construction enterprises

<table>
<thead>
<tr>
<th>Critical sustainability aspects</th>
<th>Code</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Corporate strategy</td>
<td>A1</td>
<td>Consider the macroeconomic or political trends affecting the organization</td>
</tr>
<tr>
<td>• Quality management</td>
<td>A2</td>
<td>Implement quality control throughout the whole construction process, including design, procurement, preparation for construction, construction and completion of construction</td>
</tr>
<tr>
<td>• Supply chain management</td>
<td>A3</td>
<td>Choose suppliers, i.e. material suppliers, equipment suppliers, sub-contractors and labor service companies based on the quality of their products, the safety of their production process, and their labor practices</td>
</tr>
<tr>
<td>• Innovation system</td>
<td>A4</td>
<td>Enhance technological and managerial innovation to improve economic competitiveness</td>
</tr>
<tr>
<td>• Corporate governance</td>
<td>A5</td>
<td>The proper mechanisms by which corporations are controlled and directed to support economic efficiency, sustainable growth and financial stability.</td>
</tr>
<tr>
<td>• Customer service and satisfaction</td>
<td>A6</td>
<td>Satisfy the needs of clients, such as the requirements of quality, schedule, cost and safety, and at the same time minimize the risks</td>
</tr>
<tr>
<td>• Communication management</td>
<td>A7</td>
<td>Identify stakeholders and clarify their requirements and expectations, and then properly communicate with them</td>
</tr>
<tr>
<td>• Network building</td>
<td>A8</td>
<td>Form strategic alliance with other enterprises, universities and banks</td>
</tr>
<tr>
<td>• Risk management</td>
<td>A9</td>
<td>Have risk and crisis awareness and establish relevant risk management and crisis prevent plans</td>
</tr>
<tr>
<td>Social</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Occupational health and safety</td>
<td>A10</td>
<td>Establish a complete safety management system, and conduct both physical and psychological examination to check the health status of employees</td>
</tr>
<tr>
<td>• Education and training</td>
<td>A11</td>
<td>Invest on education and training programs for employees and design career paths for them</td>
</tr>
<tr>
<td>• Wages and welfare</td>
<td>A12</td>
<td>Establish a salary payment distribution system considering both efficiency and equity, and provide necessary welfare for employees</td>
</tr>
<tr>
<td>• Anti-corruption and fair competition</td>
<td>A13</td>
<td>Should not receive money from sub-contractors and should establish the anti-corruption mechanism</td>
</tr>
<tr>
<td>• Human right</td>
<td>A14</td>
<td>Employees should be treated equally regardless of their gender, race, religion, and marital status, and forced labor and child labor are forbidden</td>
</tr>
<tr>
<td>• Supporting community development</td>
<td>A15</td>
<td>Involve localized operations, charitable donations and employee volunteers</td>
</tr>
<tr>
<td>• Obeying laws and regulations</td>
<td>A16</td>
<td>Conduct training on legislation and regulations, and establish corporate general counsel system</td>
</tr>
<tr>
<td>• Caring for all employees</td>
<td>A17</td>
<td>Care for all employees, including female employees, front-line workers, and employees with tremendous difficulties</td>
</tr>
<tr>
<td>• Promoting the development of the industry</td>
<td>A18</td>
<td>Participate in national research projects and industry conferences</td>
</tr>
<tr>
<td>Environmental</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Environmental management</td>
<td>A19</td>
<td>Establish environmental management system and try to obtain relevant certification such as the ISO14001 certification</td>
</tr>
<tr>
<td>• Construction waste management</td>
<td>A20</td>
<td>Pay attention to the recycling of construction waste, and the adoption of environmentally friendly materials and advanced construction techniques to reduce the amount of construction waste</td>
</tr>
<tr>
<td>• Land use efficiency</td>
<td>A21</td>
<td>Have policies on land assessment and remediation and optimize the site design of buildings</td>
</tr>
<tr>
<td>• Water conservation and harvesting</td>
<td>A22</td>
<td>Have policies on water use management through all stages of project life cycle to reduce water consumption and enhance water recycling</td>
</tr>
<tr>
<td>• Material conservation</td>
<td>A23</td>
<td>Promote the use of green building materials and select local building materials if possible</td>
</tr>
<tr>
<td>Category</td>
<td>Action</td>
<td></td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Energy conservation</td>
<td>A24 Establish a holistic energy management system and actively invest in renewable energy application in construction</td>
<td></td>
</tr>
<tr>
<td>Managing impacts on biodiversity</td>
<td>A25 Protect rare plants and animal species and their natural habitats, reducing the negative impacts on biodiversity</td>
<td></td>
</tr>
<tr>
<td>Emission reduction</td>
<td>A26 Take measure to reduce emissions including greenhouse gas (GHG) emissions, ozone-depleting substances, and other significant air emissions</td>
<td></td>
</tr>
<tr>
<td>Green innovation and product</td>
<td>A27 Develop green products to mitigate environmental and end user health impacts.</td>
<td></td>
</tr>
<tr>
<td>Light pollution</td>
<td>A28 Use shielding measures and rationally distribute site lighting to reduce light pollution</td>
<td></td>
</tr>
<tr>
<td>Noise control</td>
<td>A29 Use the equipment of low vibration and noise, and adopt sound insulation and seismic isolation measures</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------------------------------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>A1</td>
<td>Corporate strategy</td>
<td>3.67</td>
</tr>
<tr>
<td>A2</td>
<td>Quality management</td>
<td>3.84</td>
</tr>
<tr>
<td>A3</td>
<td>Supply chain management</td>
<td>3.60</td>
</tr>
<tr>
<td>A4</td>
<td>Innovation system</td>
<td>3.53</td>
</tr>
<tr>
<td>A5</td>
<td>Corporate governance</td>
<td>3.56</td>
</tr>
<tr>
<td>A6</td>
<td>Customer service and satisfaction</td>
<td>3.67</td>
</tr>
<tr>
<td>A7</td>
<td>Communication management</td>
<td>3.60</td>
</tr>
<tr>
<td>A8</td>
<td>Network building</td>
<td>3.63</td>
</tr>
<tr>
<td>A9</td>
<td>Risk management</td>
<td>3.67</td>
</tr>
<tr>
<td>A10</td>
<td>Occupational health and safety</td>
<td>3.58</td>
</tr>
<tr>
<td>A11</td>
<td>Education and training</td>
<td>3.51</td>
</tr>
<tr>
<td>A12</td>
<td>Wages and welfare</td>
<td>3.60</td>
</tr>
<tr>
<td>A13</td>
<td>Anti-corruption and fair competition</td>
<td>3.14</td>
</tr>
<tr>
<td>A14</td>
<td>Human right</td>
<td>3.53</td>
</tr>
<tr>
<td>A15</td>
<td>Support community development</td>
<td>3.14</td>
</tr>
<tr>
<td>A16</td>
<td>Obey laws and regulations</td>
<td>3.58</td>
</tr>
<tr>
<td>A17</td>
<td>Caring for all employees</td>
<td>3.47</td>
</tr>
<tr>
<td>A18</td>
<td>Promoting the development of the industry</td>
<td>3.47</td>
</tr>
<tr>
<td>A19</td>
<td>Environmental management</td>
<td>3.30</td>
</tr>
<tr>
<td>A20</td>
<td>Construction waste management</td>
<td>3.60</td>
</tr>
<tr>
<td>A21</td>
<td>Land use efficiency</td>
<td>3.58</td>
</tr>
<tr>
<td>A22</td>
<td>Water conservation and harvesting</td>
<td>3.42</td>
</tr>
<tr>
<td>A23</td>
<td>Material conservation</td>
<td>3.42</td>
</tr>
<tr>
<td>A24</td>
<td>Energy conservation</td>
<td>3.35</td>
</tr>
<tr>
<td>A25</td>
<td>Managing impacts on biodiversity</td>
<td>3.09</td>
</tr>
<tr>
<td>A26</td>
<td>Emission reduction</td>
<td>3.49</td>
</tr>
<tr>
<td>A27</td>
<td>Green innovation and product</td>
<td>3.28</td>
</tr>
<tr>
<td>A28</td>
<td>Light pollution</td>
<td>3.05</td>
</tr>
<tr>
<td>A29</td>
<td>Noise control</td>
<td>3.14</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>3.47</td>
</tr>
</tbody>
</table>

Note: I (importance); P (performance).
<table>
<thead>
<tr>
<th>Code</th>
<th>Critical sustainability aspects</th>
<th>Low-performing firms</th>
<th>Medium-performing firms</th>
<th>High-performing firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Corporate strategy</td>
<td>Keep up the good work</td>
<td>Keep up the good work</td>
<td>Keep up the good work</td>
</tr>
<tr>
<td>A2</td>
<td>Quality management</td>
<td>Keep up the good work</td>
<td>Keep up the good work</td>
<td>Keep up the good work</td>
</tr>
<tr>
<td>A3</td>
<td>Supply chain management</td>
<td>Keep up the good work</td>
<td>Possible overkill</td>
<td>Possible overkill</td>
</tr>
<tr>
<td>A4</td>
<td>Innovation system</td>
<td>Keep up the good work</td>
<td>Low priority</td>
<td>Concentrate here</td>
</tr>
<tr>
<td>A5</td>
<td>Corporate governance</td>
<td>Keep up the good work</td>
<td>Low priority</td>
<td>Possible overkill</td>
</tr>
<tr>
<td>A6</td>
<td>Customer service and satisfaction</td>
<td>Keep up the good work</td>
<td>Keep up the good work</td>
<td>Keep up the good work</td>
</tr>
<tr>
<td>A7</td>
<td>Communication management</td>
<td>Keep up the good work</td>
<td>Possible overkill</td>
<td>Low priority</td>
</tr>
<tr>
<td>A8</td>
<td>Network building</td>
<td>Keep up the good work</td>
<td>Low priority</td>
<td>Low priority</td>
</tr>
<tr>
<td>A9</td>
<td>Risk management</td>
<td>Keep up the good work</td>
<td>Keep up the good work</td>
<td>Keep up the good work</td>
</tr>
<tr>
<td>A10</td>
<td>Occupational health and safety</td>
<td>Keep up the good work</td>
<td>Keep up the good work</td>
<td>Keep up the good work</td>
</tr>
<tr>
<td>A11</td>
<td>Education and training</td>
<td>Concentrate here</td>
<td>Low priority</td>
<td>Low priority</td>
</tr>
<tr>
<td>A12</td>
<td>Wages and welfare</td>
<td>Concentrate here</td>
<td>Concentrate here</td>
<td>Concentrate here</td>
</tr>
<tr>
<td>A13</td>
<td>Anti-corruption and fair competition</td>
<td>Low priority</td>
<td>Low priority</td>
<td>Low priority</td>
</tr>
<tr>
<td>A14</td>
<td>Human right</td>
<td>Keep up the good work</td>
<td>Low priority</td>
<td>Possible overkill</td>
</tr>
<tr>
<td>A15</td>
<td>Support community development</td>
<td>Low priority</td>
<td>Low priority</td>
<td>Low priority</td>
</tr>
<tr>
<td>A16</td>
<td>Obey laws and regulations</td>
<td>Keep up the good work</td>
<td>Keep up the good work</td>
<td>Keep up the good work</td>
</tr>
<tr>
<td>A17</td>
<td>Caring for all employees</td>
<td>Low priority</td>
<td>Low priority</td>
<td>Low priority</td>
</tr>
<tr>
<td>A18</td>
<td>Promoting the development of the industry</td>
<td>Low priority</td>
<td>Keep up the good work</td>
<td>Low priority</td>
</tr>
<tr>
<td>A19</td>
<td>Environmental management</td>
<td>Low priority</td>
<td>Low priority</td>
<td>Keep up the good work</td>
</tr>
<tr>
<td>A20</td>
<td>Construction waste management</td>
<td>Concentrate here</td>
<td>Keep up the good work</td>
<td>Low priority</td>
</tr>
<tr>
<td>A21</td>
<td>Land use efficiency</td>
<td>Concentrate here</td>
<td>Keep up the good work</td>
<td>Keep up the good work</td>
</tr>
<tr>
<td>A22</td>
<td>Water conservation and harvesting</td>
<td>Low priority</td>
<td>Possible overkill</td>
<td>Keep up the good work</td>
</tr>
<tr>
<td>A23</td>
<td>Material conservation</td>
<td>Low priority</td>
<td>Keep up the good work</td>
<td>Keep up the good work</td>
</tr>
<tr>
<td>A24</td>
<td>Energy conservation</td>
<td>Low priority</td>
<td>Keep up the good work</td>
<td>Low priority</td>
</tr>
<tr>
<td>A25</td>
<td>Managing impacts on biodiversity</td>
<td>Low priority</td>
<td>Low priority</td>
<td>Low priority</td>
</tr>
<tr>
<td>A26</td>
<td>Emission reduction</td>
<td>Concentrate here</td>
<td>Low priority</td>
<td>Low priority</td>
</tr>
<tr>
<td>A27</td>
<td>Green innovation and product</td>
<td>Low priority</td>
<td>Low priority</td>
<td>Low priority</td>
</tr>
<tr>
<td>A28</td>
<td>Light pollution</td>
<td>Low priority</td>
<td>Concentrate here</td>
<td>Low priority</td>
</tr>
<tr>
<td>A29</td>
<td>Noise control</td>
<td>Low priority</td>
<td>Concentrate here</td>
<td>Concentrate here</td>
</tr>
</tbody>
</table>
Q1: Concentrate here

Q2: Keep up the good work

Q3: Low priority

Q4: Possible overkill

Performance

Importance
Figure 2

Importance ratings

Performance ratings

Low-performing firms
Medium-performing firms
High-performing firms

Sustainability goal

Q1
Q2
Q3
Q4

A15
A2
Type 1: Low-Performing Group
Dominance of the economic competitiveness paradigm. Lack awareness of many social and environmental sustainability aspects.

Type 2: Medium-Performing Group
Rethinking the factors formulating economic competitiveness.

Type 3: High-Performing Group
Growing awareness and performance of social and environmental aspects. Further cultural changes and awareness improvement.

Importance:
- Awareness improvement axis

Performance:
- Capability building axis

Journey towards sustainability

Sustainability goal

Transition Pathway