Construction professionals' perspectives on drivers and barriers of sustainable construction

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(Draft copy of the Article in Environment Development and Sustainability · May 2019, Received: 6 March 2019 / Accepted: 26 May 2019)

1 Introduction

Rapid increase in urbanization in developing countries led to a boom in construction activities, hence increased the detrimental impact of the sector on the environment, society, and economy (Durdyev et al. 2018a). Reportedly, the construction industry is responsible for a considerable amount of energy and resource consumption (Safinia et al. 2017). Recent studies reported that the industry is responsible for 16% of water, 25% of timber, 40% of raw materials, and 32% of total energy consumption (Serpell et al. 2013; EIA 2012). Additionally, the industry is responsible for about 40% of waste generation and one-third of carbon emissions, which is clear evidence of the devastating impact on the environment, society, and economy (Serpell et al. 2013). The adoption of a sustainability paradigm in the construction sector is therefore crucial, as it aims at reducing the industry's harmful impact and has attracted an increasing attention from the stakeholders and decision-makers of both private and public sectors of countries regardless of their socioeconomic status (Sev 2009).

Anecdotal evidence shows that, despite several initiatives, the situation in Kazakhstan is not that much different and yet, the uptake of SC is still moderate. Several studies reported that a lack of knowledge and awareness of the SC concept leads to the idea being disregarded by construction professionals (Sev 2009; Zainul-Abidin 2010). Moreover, perceived higher cost of sustainable practices and lack of promotional initiatives by the authorities are reported to be hindering factors of SC (Ahn et al. 2013). In light of reported hindering factors, the adoption of SC practices has been driven by several factors in various countries (Durdyev et al. 2018a; Whang and Kim 2015). Thus, SC practices have received broad attention from the stakeholders worldwide (Sev 2009; Qi et al. 2010; Berardi 2013; Durdyev et al. 2018b). Despite the existing reported studies on the drivers of and barriers to implementing SC, the topic is yet to match the deserved attention within developing countries. Moreover, due to the uniqueness of each country's social, economic and political environment, there is a need for country-specific diagnosis. In this regard, through the lenses of the construction professionals, this study aims to evaluate the factors that will drive implementation and barriers inhibiting SC in Kazakhstan. Construction professionals are the stakeholders that are engaged with construction projects during their lifetime. Among some of the key construction professionals could be mentioned architects, designers, engineers, consultants, managers, builders, etc. These stakeholders could be representing clients, contractors, subcontractors, and governmental agencies curating the construction projects. It was of utmost importance to engage these parties into the study as it was considered the most optimal way of understanding the state of sustainability of their respective areas of construction industry of the country. It is hoped that the findings of this study uncover the most prominent drivers of and barriers to SC adoption through the lens of developing country practitioners for further efforts of efficient resource allocation.

2 Sustainable construction (SC): overview

The construction industry plays a crucial role in providing basic infrastructure and shelters to society as well as stimulating demand for other sectors with which it has direct and indirect linkages (Durdyev and Ismail 2016). However, the construction practices that have been implemented across the globe have led to severe depletion of natural resources, economic instabilities and loss of cultural heritage (Kibert 2013). It has been reported that the impact of construction practices across the globe accounts for 40% of atmospheric emission, 42% of energy use, 30% of raw materials use, 25% water use, and 25% of waste generation (Zolfani et al. 2018). These problems have become more severe, given the rapid urbanization and growth in population, particularly in developing countries (Durdyev et al. 2018b). As such, these severe effects of the construction industry have attracted the attention of national governments and forefront construction players (Martek et al. 2019). SC defined as "ability to create and operate a healthy and resource-conscious built environment" (Kibert 2013) was first introduced to mitigate the building sector's detrimental impact on the environment. Consequently, significant changes have been experienced in project delivery methods (Kibert 2013). SC was initially perceived to be concerned only with environmental protection (Sev 2009). However, being one of the major contributors of a national economy and provider of basic infrastructure to society, other pillars of sustainability, such as economic and social, cannot be disregarded. In other words, further integration and a holistic approach are required to balance the main pillars of the sustainability paradigm (Du Plessis 2002). A further recommendation is considering the benefit of sustainability upon the triple-bottom-line, rather than the traditional measures of cost, time, and quality (Huovila and Koskela 1998).

3 Identification of drivers and barriers

Despite the slow progress, the certification (LEED, BREAM) of 39 buildings in Kazakhstan shows sufficient evidence of stakeholders' interest and driving forces (drivers) toward SC development (The Green Building Information Gateway (GBIG) 2018). These drivers have also been defined as a response to balance environmental, economic, and social issues within the construction practices (Sev 2009). Of note, the dearth of studies in the local context necessitated the acknowledgment of the international context on SC to identify potential drivers and barriers. Thus, a number of studies have documented various drivers in line with country- or region-specific priorities, which are believed to influence stakeholders' decisions on implementing SC practices (Qi et al. 2010). For example, Häkkinen and Belloni (2011) report a study from Finland, where development of the awareness among the clients about the benefits of SC, adoption of methods for SC requirement management, the mobilization of SC tools, the development of designers' competence and team-working are the most significant drivers of SC. Serpell et al. (2013) found that corporate image, cost reduction, company awareness, regulations, client demand, market differentiation, and suppliers are the most influencing drivers in Chile. Resource conversation, improvement in indoor environment quality, energy conservation, and waste reduction are reported as the most significant drivers of SC in the USA (Ahn et al. 2013). Notwithstanding the well-known benefits of SC practices, there is a need for a considerable amount of time and effort for their widespread adoption, particularly in developing countries where the existence of barriers make the adoption "impossible or unprofitable" (Evans 2006). In this regard, various studies have reported the barriers to implement SC practices in the context of different countries. The vast majority of the studies (Häkkinen and Belloni 2011; Ahn et al. 2013; Durdyev et al. 2018a, b; Ogungbile and Oke 2019; Rock et al. 2019), particularly from developing countries, reported that concerns with the cost premium of SC and lack of knowledge and awareness are the most significant barriers, which ultimately lead to the reluctance to implement the SC concept. No doubt, that SC will significantly improve economic and social conditions of people as well as reduce the environmental impact of the industry (Mahdiyar et al. 2019). In-depth review of the sustainability context reveals the similarity in the drivers and barriers of SC adoption. However, sui generis socioeconomic conditions of Kazakhstan require a particular diagnosis of the drivers and barriers according to the context where the construction industry is operated. Moreover, this diagnosis, due to contextual similarities, is hoped to guide the construction decision-makers in other Central Asian countries. Thus, Tables 1 and 2, respectively present the outcomes of a comprehensive review of the context, which are drivers of, and barriers to SC.

4 Methodology

Prioritizing of the identified drivers and barriers for a developing country context is a challenging task since it is quite likely as one can get significantly different opinions from different stakeholders on the priorities for indicators compared. No commonly agreed method of assessing the stakeholder opinions has been recognized yet; however, the process of collecting, analyzing, prioritizing, and consolidating the drivers and barriers of sustainability performance information in order to support better management decisions is addressed in most of the above-mentioned studies. As result, a separate body of literature has developed on the assessment of stakeholder opinions (e.g., prioritization of drivers and barriers of sustainability) using different procedures and methodologies (Durdyev et al. 2018a, b; AlSanad 2015; Martek et al. 2019; Ametepey et al. 2015; Atanda 2019; Luiz et al. 2018; Kamari et al. 2017; Hugé et al. 2010; Okoli and Pawlowski 2004; Hurmekoski et al. 2018). They perform their evaluations in numerous ways by underlining the importance of stakeholder theory by considering a broader range of stakeholders' expectations. This study adopts a stakeholder opinion poll pyramid (SOPP) method, which is structured according to a combined approaches used in a similar way by Atanda (2019), Luiz et al.(2018), Kamari et al. (2017) and Hugé et al. (2010). It suggests a systematic prioritization procedure. The procedure steps were as follows: (1) extraction of the sustainability drivers and barriers from the literature pool; (2) initial preselection, sorting and analysis of the parameters to be assessed by the experts; (3) obtain stakeholder grading on each parameter using a quantitative scale by employing a structured workshop and a survey, and finally (4) consolidation of all information obtained. Firstly, all potential drivers and barriers were identified through an extensive review of literature and all identified items were sent to the international panel of experts (IPE) (from New Zealand, Norway, Turkey, and Kazakhstan) for their review. This literature survey also showed that the majority of the research studies focusing on awareness, drivers, actions, and barriers of SC utilized a survey-based assessment or participation-orientated creative workshops to assess stakeholder opinions (Durdyev et al. 2018a, b; AlSanad 2015; Martek et al. 2019; Ametepey et al. 2015). Afterward, all the identified items were validated with the construction professionals to ensure the relevance of the drivers and barriers to the local context through a structured workshop and a survey study, which aimed to eliminate the negative group effects associated with the workshop (Hurmekoski et al. 2018). The significance of engaging construction professionals in this study can be explained by the fact that there is no any other viable way to understand what is hindering or driving sustainability within the construction industry of Kazakhstan. These stakeholders are the ones who make decisions and implement the construction project activities.

Table 1 Drivers of SC

	Drivers	References
Environmental	Energy efficiency/conservation	Ahn et al. (2013)
	Material/resource efficiency	Durdyev et al. (2018a)
	Water efficiency	Abidin and Powmya (2014)
	Efficient use of land	Manoliadis et al. (2006)
	Waste reduction/management	Whang and Kim (2015)
	Atmosphere	Durdyev et al. (2018a)
	Indoor environmental quality/comfort	Manoliadis et al. (2006)
	Preserving the ecology	Akadiri et al. (2012)
Economical	Competitive construction industry	Wong et al. (2010)
	Life cycle cost	Ogungbile and Oke (2019)
	Affordable construction material	Akadiri et al. (2012)
	Support of national economy	Li et al. (2013)
	Commercial viability	Whang and Kim (2015)
	Improvement in industry image/reputation	Serpell et al. (2013)
Social	Enhanced health and safety	Whang and Kim (2015)
	Collaborative working environment	Li et al. (2013)
	Preserving culture/heritage	Sev (2009)
	Secure industry	Akadiri et al. (2012)
	Community friendly industry	Ahn et al. (2013)

Table 2 Barriers to SC

Barriers	References
Lack of promotion by government	Durdyev et al. (2018b)
Lack of regulations and policies	de Souza Dutra et al. (2017)
Lack of government incentives	Zhang et al. (2012)
Lack of enforcement	Williams and Dair (2007)
High cost of sustainable options	AlSanad (2015)
Longer payback periods	Ahn et al. (2013)
The priority is given to economic needs	Durdyev et al. (2018a)
Lack of financial incentives	Luthra et al. (2015)
Limited understanding from stakeholders	Zainul-Abidin (2010)
Knowledge on benefits of sustainable is limited	AlSanad (2015)
Knowledge on sustainable technologies is limited	Ahn et al. (2013)
Lack of green suppliers and limited information	Gou et al. (2013)
Lack of demonstration projects	Potbhare et al. (2009)
Lack of education and training for construction professionals	Gou et al. (2013)
Lack of competence in sustainability	AlSanad (2015)
Lack of professional capabilities/designers	Durdyev et al. (2018a)
Less priority is given to sustainability during the bidding stage	OECD (2015)
Lack of clients' interest	Williams and Dair (2007)
Reluctance to shift from the conventional methods	AlSanad (2015)

Their understanding of the local reality, construction standards, norms, and construction practices currently applied in Kazakhstan is considered as an asset in identifying the most prominent drivers and barriers of sustainable construction. The survey questionnaire method was deemed to be one of the most useful tools to obtain the opinions of a large number of construction industry professionals regarding the subject matter. The questionnaire length was chosen to be optimal for 5–7 min engagement time, questions were designed to be straightforward and the answers were designed in such a way that the data could be converted into sensible categories and values for analysis (using Likert scale ranking the answers from 1 to 5). The flow and type of questions, the guidelines for the survey as well as its confidential nature were very important aspects to take into account in the survey design process. As a result, the survey had 44 questions, 38 of which were related to drivers and barriers (Tables 3 and 4), four were demographics related (Table 5) and two were open-ended for any additional items that were potentially missed in the survey. Approximately 300 validated construction industry-related professionals from across Kazakhstan received the link to the survey, and 62 responses were collected. The overall number of respondents was 62, which constitutes about 20% of the total number of 300 questionnaire recipients. Such a response rate is relatively low if compared with the general 30–60% response rate in other studies. However, it should also be considered that the survey has been conducted online. Online surveys tend to have much lower response rates since it is harder to ensure participation of survey recipients (Nulty 2008). The relatively low response rate is also explained by the general trend in society where people are not very interested in engaging in surveys. Many of the respondents actually stated that this was the first survey they took part in. Since the survey was done online, almost all questions were set to be compulsory. Thus, there were no incomplete responses. The workshop was another way to obtain opinions of professionals. It was designed to allow professionals to discuss the provided list of drivers and barriers and rate them using the Likert scale. The participants of the workshop were invited from different backgrounds. The participation rate was 50%. Twenty-five participants out of 50 invitees joined the workshop, which can be considered as a good turnout. Participants represented various specializations meaning that their responses would provide perspectives of a wide range of professionals related to construction industry. The difference between this approach and the online survey was apparent as respondents had a chance to discuss the items in their respective groups (3–4 respondents per group) and provide answers that are more refined. The fact that one author of the study was mediating the workshop enabled a qualitative understanding of the choices made by the participants to be gained. The online survey and a workshop have allowed engaging construction professionals from various backgrounds and affiliations covering architects, designers, engineers, consultants, managers, builders. These participants were representing such affiliations as clients, governmental agencies, contractors, and subcontractors.

Table 3 Stakeholder representative priority lists ratings for SC drivers

Drivers	Cluster 1	Cluster 2	Workshop groups	Combined
Energy efficiency/conservation	4.65 ± 0.74	3.57 ± 1.36	4.6 ± 0.89	4.3 ± 1.1
Material/resource efficiency	4.73 ± 0.51	3.67 ± 0.97	4.2 ± 0.84	4.35 ± 0.85
Water efficiency	4.65 ± 0.58	3.52 ± 1.08	4.2 ± 1.1	4.26 ± 0.95
Efficient use of land	4.58 ± 0.81	3.43 ± 1.12	1.8 ± 0.84	4 ± 1.23
Waste reduction/management	4.9 ± 0.3	3.43 ± 1.16	4.2 ± 0.84	4.38 ± 0.99
Atmosphere	4.83 ± 0.45	3.19 ± 1.33	4.2 ± 0.84	4.26 ± 1.13
Indoor environmental quality/comfort	4.8 ± 0.46	3.86 ± 1.2	3.2 ± 1.3	4.38 ± 0.99
Preserving the ecology	4.9 ± 0.3	3.1 ± 1.22	4.4 ± 0.89	4.29 ± 1.12
Competitive construction industry	4.65 ± 0.58	2.76 ± 1.09	3.6 ± 0.89	3.97 ± 1.18
Life cycle cost	4.65 ± 0.53	2.52 ± 1.17	4 ± 1.22	3.92 ± 1.28
Affordable construction material	4.5 ± 0.78	3 ± 1.26	4 ± 0	3.98 ± 1.16
Support of national economy	4.48 ± 0.88	2.76 ± 1	3.4 ± 1.67	3.85 ± 1.26
Commercial viability	4.35 ± 0.95	3.05 ± 1.16	4.4 ± 0.55	3.94 ± 1.16
Improvement in industry image/reputation	4.45 ± 0.93	3.19 ± 1.03	3.8 ± 1.64	4 ± 1.16
Enhanced health and safety	4.7 ± 0.76	3.48 ± 1.17	4.6 ± 0.89	4.3 ± 1.07
Collaborative working environment	4.6 ± 0.78	3.38 ± 1.12	3 ± 1.22	4.09 ± 1.12
Preserving culture/heritage	4.43 ± 1.03	2.86 ± 1.15	2.6 ± 0.89	3.79 ± 1.32
Secure industry	4.43 ± 0.87	2.95 ± 1.12	4 ± 1.22	3.92 ± 1.18
Community friendly industry	4.6 ± 0.67	3.05 ± 1.2	3.6 ± 1.14	4.03 ± 1.15

Table 4 Stakeholder representative priority lists ratings for SC barriers

Barriers	Cluster 1	Cluster 2	Workshop groups	Combined
Lack of promotion by government	4.47 ± 0.74	2.94 ± 1.35	3 ± 1.22	3.94 ± 1.2
Lack of regulations and policies	4.6 ± 0.58	2.67 ± 1.14	3.8 ± 1.3	4.02 ± 1.18
Lack of government incentives	4.47 ± 0.74	2.83 ± 1.04	3.2 ± 0.84	3.92 ± 1.11
Lack of enforcement	4.21 ± 0.97	2.44 ± 0.86	4 ± 1	3.71 ± 1.21
High cost of sustainable options	4.58 ± 0.88	3.22 ± 1.26	4.8 ± 0.45	4.23 ± 1.15
Longer pay back periods	4.58 ± 0.66	3.22 ± 1.44	4 ± 0.71	4.17 ± 1.1
Economic needs are given higher priority	4.53 ± 0.8	2.94 ± 0.94	3.4 ± 1.14	4.02 ± 1.12
Lack of financial incentives	4.4 ± 0.82	2.83 ± 1.2	3.4 ± 1.14	3.89 ± 1.18
Limited understanding from stakeholders	4.51 ± 0.67	2.5 ± 1.1	2.8 ± 0.84	3.83 ± 1.24
Knowledge on benefits of sustainable is limited	4.63 ± 0.66	2.83 ± 1.29	3 ± 1.22	4.02 ± 1.23
Knowledge on sustainable technologies is limited	4.58 ± 0.63	2.61 ± 1.24	3.2 ± 0.84	3.94 ± 1.23
Lack of green suppliers and limited information	4.3 ± 0.77	2.94 ± 1.26	2.4 ± 1.14	3.79 ± 1.18
Lack of demonstration projects	3.93 ± 1.03	3.11 ± 1.23	2.4 ± 1.67	3.59 ± 1.23
Lack of education and training for construction professionals	4.51 ± 0.67	3.06 ± 1.3	3.6 ± 1.34	4.05 ± 1.13
Lack of competence in sustainability	4.37 ± 0.79	2.83 ± 1.2	4.6 ± 0.55	3.97 ± 1.14
Lack of professional capabilities/designers	4.16 ± 0.97	2.72 ± 1.07	4 ± 0.71	3.76 ± 1.16
Less priority is given to sustainability during the bidding stage	4.44 ± 0.8	3 ± 1.37	4.2 ± 0.45	4.03 ± 1.15
Lack of clients' interest	4.07 ± 0.99	2.61 ± 1.2	3.8 ± 1.3	3.65 ± 1.23
Reluctance to shift from the conventional methods	4.44 ± 0.67	3 ± 1.08	3.6 ± 0.89	3.98 ± 1.03

Table 5 Stakeholder contributions into the clusters

Drivers							
Role		Architect	Controller	Director	Engineer	Manager	Other
Cluster	1	7.5%	10.0%	15.0%	20.0%	30.0%	17.5%
	2	4.8%	0.0%	9.5%	42.9%	33.3%	9.5%
Work		Client	Consultant	Contractor	Government	Subcontractors	
Cluster	1	40.0%	17.5%	22.5%	12.5%	7.5%	
	2	38.1%	23.8%	14.3%	14.3%	9.5%	
Experience		< 5 years	5–7 years	5–7 years	7–10 years	> 15 years	
Cluster	1	45.0%	10.0%	10.0%	17.5%	5.0%	
	2	57.1%	4.8%	4.8%	19.0%	4.8%	
Awareness		Heard	No	Yes			
Cluster	1	30.0%	7.5%	62.5%			
	2	33.3%	4.8%	61.9%			
Barriers							
Role		Architect	Controller	Director	Engineer	Manager	Other
Cluster	1	2.3%	7.0%	14.0%	25.6%	30.2%	20.9%
	2	16.7%	5.6%	11.1%	33.3%	33.3%	0.0%
Work		Client	Consultant	Contractor	Government	Subcontractors	
Cluster	1	46.5%	18.6%	16.3%	14.0%	4.7%	
	2	22.2%	22.2%	27.8%	11.1%	16.7%	
Experience		< 5 years	5–7 years	5–7 years	7–10 years	> 15 years	
Cluster	1	53.5%	9.3%	23.3%	14.0%	0.0%	
	2	38.9%	5.6%	5.6%	33.3%	16.7%	
Awareness		Heard	No	Yes			
Cluster	1	34.9%	4.7%	60.5%			
	2	22.2%	11.1%	66.7%			

In principle, such a range of professionals cover the entire life cycle of a construction project or a building starting by design stage and ending by demolition. Among the participants were also controllers, directors, researchers, and others. It was possible to identify the specialization and affiliation of respondents by introducing respective questions in the questionnaires and workshop response sheets. More details on what roles, work, experience, and awareness of sustainable construction are presented in Table 5.

TwoStep Clustering Component (TSCC) was used to classify all the responses into a few representative clusters with a significant accuracy which represents the ratings of the stakeholders engaged (Park and Baik 2006; Pan and Li 2016). TSCC is able to handle both continuous and categorical variables by extending the model-based distance measure. One of the advantages of this clustering algorithm is its usability in the cases where both continuous and categorical variables exist in data sets; also, it allows the number of clusters to be determined automatically (SPSS 2001).

However, collection of the priority information only from a particular stakeholder group having similar background and experience (e.g., construction professionals either from the local/regional market or from the extant literature) may result in biased decisions (Okoli and Pawlowski 2004; Hurmekoski et al. 2018). Their information can be reliable but strongly dependent on personal skill and experiences, and implicitly local and/or explicitly global contexts. The suggested method deals with this identified problem by extending the scope of the poll with divergent expert opinions via the Delphi method, which consolidates the results of the stakeholder surveys and the expert opinion workshop (Atanda 2019; Luiz et al. 2018; Kamari et al. 2017; Hugé et al. 2010). The overall purpose of using the Delphi technique is to consolidate the opinions of the stakeholders which were collected by different methods. In the first round of the Delphi stage, the stakeholder priority lists along with their indicator ratings and the underlying assumptions were provided to the IPE. IPE members have their own research groups working in a similar area and they voluntarily agreed to participate in the research. They were asked to revise the lists and merge them into one list in the light of the decisions made by their own group of experts. After all the IPE sorted lists were returned, the agreed upon priorities for the items provided were ranked and a new list was formed with agreed and non-agreed items. After that, it was sent back to the IPE for the second round, and they were asked to revise only the non-agreed items. The rounds were continued until a general agreement was reached (it was 3 rounds in our case) on one final¨ priority list of drivers and barriers. This became our context-oriented decision support system (DSS) information for SC in Kazakhstan (Fig. 1).

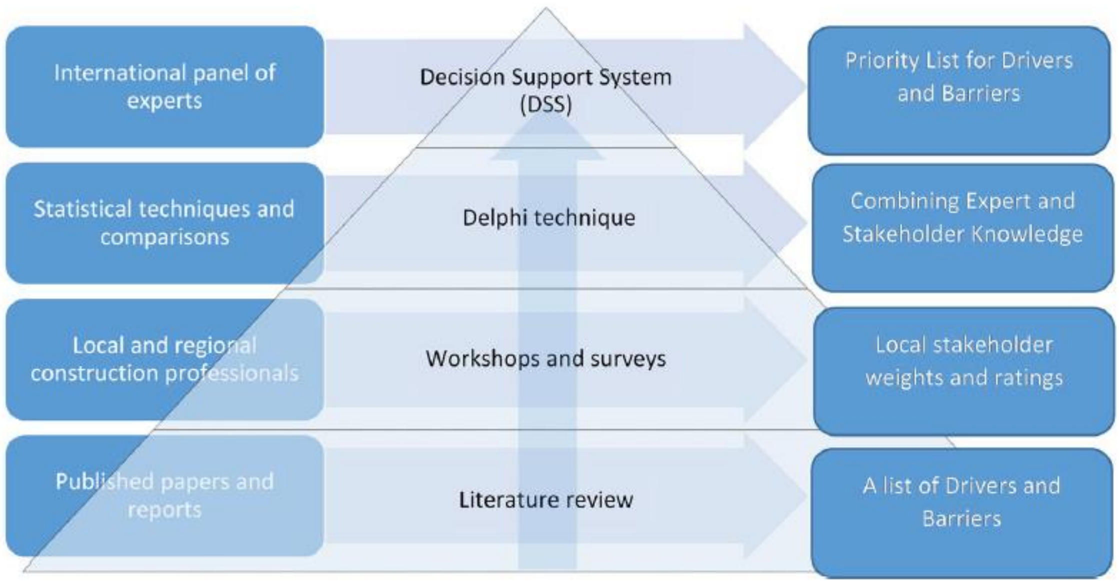

Fig. 1 SOPP with a DSS cap

5. Results

5.1 Formations of the stakeholder representative priority lists

All the survey results were statistically classified during the second stage of the study. At that point, a handful of priority lists, namely clusters, (2 in both cases) were classified. In addition to these stakeholder representative priority lists, another set of additional priority lists, that were an outcome of the construction professionals' workshop, was obtained. Mean values and standard deviations of the extracted clusters for the drivers and barriers are given in Tables 3 and 4, respectively. The role, work, experience, and awareness are the nominal parameters collected from the respondents. They were also analyzed and their contributions into the clusters are reported in Table 5.

In terms of sorting or prioritization, there are significant differences in clusters; however, the most significant difference is obtained with the given scores for all the items. Cluster 2 scores are significantly lower for all the cases; drivers range [2.52–3.86] and barriers range [2.44–3.22], while Cluster 1 scores had higher levels of estimates [4.35–4.90] and [3.93–4.63], respectively. It seems that the clustering algorithm separated the cases based on their scoring ranges. In addition to that, the workshop group evaluations provided more fluctuating scoring in the range of [1.80–4.60] and [2.40–4.80], respectively.

There is strong disagreement in the rankings in some of the priority lists, which shows some significant differences between the groups. For instance, only one item (Material/ resource efficiency) was sorted in the top five items in all the lists, and even, some top ranked items in one list, are listed in the bottom levels of the other lists (e.g., Indoor environmental quality/comfort).

The results indicate that the rating numbers are subjective and show significant variations according to respondents' profile and data collection methodology. For example, Cluster 1 in the priority list is largely clients (66.7%) and contractors (75.0%) who are mostly controllers and directors with midlevel experience (5–15 years) (Table 5), a representative group of experienced construction company managers who tend to give higher scores in each indicator. Less experienced engineers working for the government had a tendency to give lower level scores in Cluster 2.

Our findings also revealed that significantly different results were obtained by employing different tools (online surveys vs group workshops) due to their differences in procedures. In the survey method, respondents did not have in-person expert explanations but written descriptions), and moreover, they had the questions in an order without knowing what the next item was. On the other hand, workshop groups had a brief expert explanation prior to their engagement, they had a chance to ask questions, and they got all the items in a single page, which provided a higher level of understanding to make pairwise multiple comparisons by checking all the items during the given time. As a result, online and workshop-based local expert surveying methods ended up with different results in the ratings. It can be easily speculated that it is very likely to get different sets of rating scores with different procedures in every new challenge.

All the above discussions and results confirm our hypothesis, which suggests that collecting priority information from only local experts using online surveys or workshop methods may have serious limitations. Such results need to be consolidated by a higher-level expert knowledge system, e.g., the IPEs in our case, as suggested by the last stage of our proposed methodology. The following section extended the consolidated results.

5.2 Consolidation of the priority lists

The final stage of the data analysis was carried out with the help of the IPE. The IPE members, independently from each other, merged the three priority lists provided. In total, three iterations were carried out to come up with the consolidated lists of drivers and barriers of the construction industry of Kazakhstan (Tables 6 and 7, respectively). The consolidated lists present ranked drivers and barriers according to their priorities. Depending on the position in the lists, the four priority levels (PLs) were assigned to the drivers and barriers, namely extensive, significant, moderate, and minor from Level 4 to Level 1. As mentioned in the previous section, two cluster groups and the group workshop results were not similar. In the process of consolidation, the IPE aimed to streamline the priority levels of respective drivers and barriers based on a comparative analysis. This process actually allowed experts to merge the three priority lists based on their experience and knowledge of the subject matter. During the consolidation, it was evident that some of the high- or low-priority items from one list (e.g., Cluster 1) were in lower or higher positions in the final consolidated list. The study aimed to see to what extent those changes were significant. In order to assess the significance of changes, the study investigated the level of change by estimating the difference between the final and initial priority levels. So if one item from Cluster 1, for example, was initially falling under extensive priority level (Level 4) but ended up in the moderate priority level (Level 2) in the consolidated list, the extent of the change would be equal to two—meaning that the change is significant.

In the case of drivers from Cluster 1, the number of items which had no change in the priority level were 7, a change of one level were 12, and a change of two levels were 0. This is a good outcome as the consolidated list is relatively similar to this cluster's results. In case of drivers from Cluster 2, these values were 7, 10 and 2 (Efficient use of land and Preserving the ecology), respectively. For the group workshop, these values were 11, 6 and 2 (Commercial viability and Indoor environmental quality/comfort), respectively.

Table 6 Consolidated list for the drivers

Priority	Consolidated list for the drivers
Extensive	Energy efficiency/conservation
	Material/resource efficiency
	Enhanced health and safety
	Preserving ecology
	Waste reduction/management
Significant	Indoor environmental quality/comfort
	Water efficiency
	Community friendly industry
	Atmosphere
	Affordable construction material
Moderate	Life cycle cost
	Improvement in industry image/reputation
	Collaborative working environment
	Commercial viability
	Competitive construction industry
Minor	Secure industry
	Support of national economy
	Preserving culture/heritage
	Efficiency use of land

In the case of barriers from Cluster 1, the values were 12, 2, and 5 (lack of codes and regulations that cover sustainable procurement; lack of knowledge on sustainable technologies; limited understanding from stakeholders; sustainability criteria is not considered in the bi evaluation; Lack of professional expertise in sustainability); from Cluster 2 the values were 10, 6, 0 (and 3 items had change of three levels—lack of demonstration projects; limited knowledge on clear benefits of sustainable practices; lack of professional expertise in sustainability); from group workshop the values were 10, 6, 1 (lack of clients' interest), (and 2 items had change of three levels—lack of enforcement; limited knowledge on clear benefits of sustainable practices). As it can be seen from the numbers above, in the case of drivers, Cluster 1 had quite a strong similarity to the consolidated list with no items changing position more than one level. At the same time, Cluster 2 and group workshop results had only 2 items changing position 2 levels. In the case of barriers, the situation is slightly different since all the three priority lists had more than one item, which changed 2–3 positions. Another way to analyze the study results was to split the factors within drivers and barriers into priority levels. Drivers were grouped into environmental, social, and economic factors. Barriers, in turn, were grouped into factors such as government, cost, knowledge and information, workforce, client and market. In the case of drivers, it was found that most of the Extensive and Significant drivers are environment related (7 out of 10); the remaining drivers were social (2 out of 10) and economic (1 out of 10). 4 out 5 drivers ranked as moderate were economic drivers, with 1 out 5 being a social driver. The remaining 4 Minor drivers were 1 environmental, 1 economic and 2 social. It is evident from Table 6 and the data above that most of the extensively important drivers are environment-related ones. This could be explained by the conventional understanding of sustainability metaphors, e.g., a bias to think that is more of an environmental concept, although 60.5% of respondents stated that they know that sustainability is based on three pillars. In fact, the term sustainability does not have a direct translation in the local language. The closest option is "green," the term that is well connected with ecology. In turn, socioeconomic drivers are located in the second half of the table with less priority given.

In case of the barriers, the highest ranked ones are directly related to economic and knowledge related aspects. In fact, two out of five Extensive barriers are cost related. This is most likely related to the fact that stakeholders tend to believe that a prohibitively high cost of sustainability measures plays a hindering role. These are followed by the government related issues such as lack of government promotion and incentives. Two out five significant barriers were government related. The remaining barriers were spread across the priority levels. This implies that stakeholders believe that sustainable construction is hindered by a set of factors combining the availability of knowledge and information, the issues related to workforce, and the readiness of clients and the market.

6 Discussion

As it can be seen from Table 6, the majority of the most essential drivers of sustainable construction are environment related. For example, such drivers as "Energy efficiency/conservation, Material/resource efficiency, Preserving ecology, Waste reduction/management, Water efficiency, and Atmosphere" were ranked as the most critical ones. These findings, in fact, can be supported by the results of the previous study by the authors (Tokbolat et al. 2018). In this previous study, all buildings in Kazakhstan, Astana, which was chosen as a representational city, were grouped as "new" and "old" buildings with subcategorization based on their class and materials that were used for construction. The study concluded that within the "new" economy class, with buildings, which were found to be least sustainable, greater attention, should be paid to environment-related aspects, particularly to improving the sustainability level using surrounding ecosystems such as land and water. With all "new" buildings regardless of their class, it was suggested that attention be paid to waste management and use of materials. In the case of "old" buildings, the highest priority was given to waste management, use of materials, energy consumption, and sustainable use of ecosystems. In the case of the barriers, the highest ranked ones are primarily related to economic, governmental support and knowledge associated aspects, such as "The higher cost of sustainable building option, Longer payback periods, Lack of professional expertise in sustainability, Sustainability criteria is not considered in the bid evaluation, Limited knowledge on clear benefits of sustainable practices, Higher priority is given to economic needs, Lack of training and education for professionals, Lack of promotion by government, Lack of government incentives." Another study by Tokbolat and Calay (2015), that attempted to understand the awareness level of sustainability concepts among construction companies and general public in the UK and Kazakhstan, supports the outcomes of the current research confirming that the key barriers of sustainable construction in Kazakhstan are economic, governmental support, and knowledge related. The study found that Kazakhstan's construction companies see "economic restrictions, strict regulations, poor awareness of sustainability and a short period focus" as the main barriers of sustainable construction. The same study reported that in the public's view the main barriers are "a lack of experience and practice of the construction workers, poor legal enforcement, poor understanding of the concept, and economic burdens." The interactions between the identified drivers and barriers based on the findings indicate a worthy of note result. The priorities in Table 6 and 7 are convincingly related to (1) "stakeholders' knowledge/awareness", (2) "customer perceived value" and (3) "legislation" factors. For example, due to a higher level of awareness in environmental issues in Kazakhstani society (e.g., desiccation of the Aral Sea, air pollution problems in cities, nuclear and hazardous waste contamination, desertification of former agricultural lands, etc.), environmental factors seem to be located mostly in higher ranks. The results show the similar patterns in drivers and barriers on those expectations of direct cost parameters along with the indirect customer perceived value factor such as with being able to relax in the immediate neighborhood as well feeling safe in the neighborhood. As a result, it can be generalized that the items listed in higher priority levels in both groups are more related to these three factors, while the minor level drivers and barriers may not be easily linked with them at a personal or local level.

6.1 Implications for the construction frontline

In the global perspective, the outcomes of this study would deepen the understanding of the impact of barriers and drivers of sustainable construction in a typical developing country's reality. At the same time, the findings of this research article are of high significance in the local context, particularly for the construction industry of Kazakhstan. As Kazakhstan's government strives to comply with the commitments made in the framework of various sustainability-related international conventions and agreements, such as for example, the Paris Agreement, it rigorously seeks ways to reduce greenhouse gas emissions and at the same time efficiently use its energy resources. The government of Kazakhstan and society in general tend to understand that continuous economic development, which does not take into account the environmental and social aspects, could potentially lead to significant ecological and societal problems in both the short and long run. Various experiences of such impacts were evident in case of other industries predominant in the country. For example, numerous factories and industrial plants across the country in the continuous chase of profit have been polluting the nearby ecosystems and human settlements. They detrimentally affected the biodiversity, polluted lakes and rivers, and caused serious health problems and significantly affected the well-being of nearby communities. The same impact can be and is already caused by the construction industry. Unsustainable practices of extracting and transporting construction materials, inefficient use of resources and energy, uncontrolled discharge of construction waste, etc. are the only few disadvantages of the booming construction industry. Therefore, the attempts of the current research to identify and present the drivers and barriers of sustainable construction in the specific local context can be considered as a very important contribution to overall sustainability of the country. The findings of the study are hoped to advance the research in the respective field, provide guidance and knowledge to the players of the construction industry and make changes in the perception of sustainable construction in society. The country's construction industry, which is among the most significant energy consumers and GHG emitters, is experiencing pressure from the government to be more sustainable than it is now. Therefore, the construction industry would benefit from the outcomes of this study as it suggests the ways to achieve sustainability by identifying and prioritizing respective barriers and drivers. Although players of Kazakhstan's construction industry tend to refer to various drivers and barriers of sustainability, there was a lack of structured understanding of their impact and their priority level. This study fills this gap. Both the government and construction industry-related stakeholders are provided with comprehensive priority lists of barriers and drivers they should address in order to meet the targeted sustainability objectives. These lists are believed to be valuable indicators for decision-making at all levels by respective parties. It is thought that addressing drivers and barriers according to their priority level can be among some of the most effective ways of increasing sustainability levels in the construction industry.

However, it must be realized that the priority levels of particular drivers and barriers can change over time due to changing economic and political reality, technological advancement and increasing awareness of sustainability and pressing needs of climate change mitigation and adaptation. Although the findings of the study provide useful guidelines for various stakeholders engaged in the construction process, the special importance of the consolidated lists of drivers and barriers could be observed, among others, for construction project managers. The reason behind this importance and usefulness could be linked to the fact that the construction managers are the ones who make most of the decisions throughout the life cycle of any construction project. In conjunction with other professionals, they decide which particular design and/or construction measure to use, where to allocate financial and human resources, which risks are more important than others are, etc. Construction project managers are the ones who should be able to have more holistic views than other stakeholders, since they are the ones that participate in the project from the beginning to the end. Project managers should be able to link all the activities, resources, materials, labor, etc., giving due consideration to environmental and socioeconomic reality not only of the project but also of the surrounding ecosystem and communities. Understanding the bigger, system-based picture, is an important prerequisite of successfully addressing impediments (barriers) and integrating drivers of sustainability within the construction projects.

7 Conclusions

Sufficient evidence shows that there has been an increasing trend in promotion of sustainable building technologies and practices to reduce natural resource consumption, and the threatening environmental impact of the built environment. As in other developing countries, Kazakhstan has been experiencing a rapid urbanization and the construction industry undertakes a crucial role. Therefore, there is a need to investigate factors that are potential triggers and barriers inhibiting the adoption of SC in the local context of Kazakhstan.

This study, through an original methodological perspective, has identified the priority lists for drivers and barriers for implementation in the context of Kazakhstan. These lists are thought to be useful indicators for stakeholders to use throughout their decision-making processes. Specifically, in the case of SC drivers, the utmost importance should be given to aspects related to environmental issues in Kazakhstan, such as energy efficiency/conservation and recourse efficiency. There is also a high level of agreement that drivers related to social sustainability are significant compared to, for example, economic drivers. Drivers such as enhanced health and safety, indoor environmental quality/comfort and community friendly industry are some of the highest ranked social drivers. It can be concluded that for SC to be advanced in Kazakhstan, aspects related to environment and social reality can be the strongest motivating force. This can be explained by the fact that although Kazakhstan is a relatively wealthy country with significant investments in the construction industry, there is no significant change in the level of sustainability, so the financial aspect does not seem to be changing the sustainability-related paradigm in the country. Opposite to this, a great portion of SC barriers are related to economic aspects, such as initial cost of sustainable building options, longer payback period and lack of governmental support in implementing sustainable practices. In developing countries, such as Kazakhstan, critical success factor for any construction project is whether the project has been completed within the estimated budget, therefore, justifies the results of this study. The frontline of the construction industry would benefit from addressing the significant drivers and barriers. However, to address the issues of SC, all the drivers and barriers should be addressed at a system level since the concept of sustainability, in general, requires complex solutions and simultaneous transformation of all aspects. On top of these drivers and barriers, the study calls for a shift of attention from lack of awareness and knowledge on SC, which believed to be not only the most significant barrier hindering its adoption, but also a driver that can motivate the construction stakeholders.

This study contributes to the body of knowledge and provides lessons learned from a typical developing setting, Kazakhstan. Apart from this, the findings of this study can be applicable (due to contextual and cultural similarities) in the Central Asian countries; however, the limitations need to be acknowledged and findings must be treated with caution, particularly prior to the application in other contexts. Future studies are recommended to provide insight into country-specific factors that may motivate or hinder the shift toward SC, rather than deriving them from the international context, which was utilized due to the dearth of studies on the subject in Kazakhstan. Finally, the discussion of proactive actions toward the implementation of SC principles and measures to overcome the barriers are limited in this study. Hence, the limitations of this study provide a fertile ground for future studies.

Acknowledgements Mr. Farnush Nazipov, a student from Nazarbayev University, is acknowledged for his assistance in data collection. The support of Nazarbayev University and Ara Institute of Canterbury is acknowledged.

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