FACTORS INFLUENCING GREEN BUILDING DEVELOPMENT IN KAZAKHSTAN

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DECLARATION

I hereby declare that this manuscript, entitled “Factors influencing green building development in Kazakhstan,” is the result of my own work except for quotations and citations, which have been duly acknowledged.

I also declare that, to the best of my knowledge and belief, it has not been previously or concurrently submitted, in whole or in part, for any other degree or diploma at Nazarbayev University or any other national or international institution.

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Abstract

Green building has been actively spreading as a solution for sustainability issues in the construction industry of the last decades. As green building practices unfold in developing countries, the necessity of identifying factors that both hinder and drive its spread rises. Multiple studies reveal general inconsistency among results in different parts of the world, caused by environmental, economic, and social conditions of the country. Considering international green building development experience and the current state of development of green building in Kazakhstan, this study aims to spread our understanding upon the factors that obstruct and have the potential to drive green building development in Kazakhstan. A questionnaire survey was carried out among 38 industry experts in Kazakhstan to accomplish study objectives. Multiple data analysis methods were used to identify correlations among groups of experts and rank the factors. The results revealed a lack of skilled/experienced, lack of government support, and high cost of sustainable materials and products to be the most crucial barriers. Water- and energy-efficiency, and improved occupants' health, comfort, and satisfaction were identified to be the most influential drivers. By expanding knowledge about factors affecting the implementation of green building, the study uncovered common trends in the professionals' responses, providing valuable information for the field practitioners and suggesting future research recommendations.

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List of Abbreviations

GB	Green building
GBT	Green building technology
SD	Standard deviation

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Chapter 1. Introduction

1.1 General

The global building industry has a significant impact on the environment, economy, and society. The buildings' construction phase is responsible for 10%, including material manufacturing, and the buildings' operation is responsible for another 28% of global CO_2 emissions [1]. Essential needs like heating or cooking require the use of carbon-intensive sources of energy like oil, gas, and coal, consuming around 60% of the global electricity used just for building operation purposes [1]. The energy consumption of residential and nonresidential buildings takes up to 30%, and the building construction industry represents 5% of global energy use in 2019 [1]. Statistics represent a steady increase in energy consumption of 7% with increased total floor area and population in the last nine years [2]. Emission rates related to the construction industry are at a slow but steady increasing pace [2]. Besides, the building construction industry takes up to 40% of the world's consumption of materials, almost 30% of timber use, and around 15% of total water consumption [3]. On average, 40-60% of all landfill wastes are generated during construction processes [5]. Moreover, the construction industry is a significant contributor to global warming, resource depletion, air and water pollution, and the cause of various natural hazards [4,8-9].

Active measures are performed in the face of sustainable development strategies to diminish the global building industry's harmful effects. Yudelson [5] defines green building as a high-performance property that reduces its impact on the environment and humans throughout its life cycle. It is intended to utilize less water and energy. It aims to improve the built environment radically. It considers preserving non-renewable energy sources and promotes renewable sources of energy, advancing the existing technologies and construction methods. Moreover, the green building gravitates towards a healthy environment for the occupants by enhancing indoor air quality and nontoxic materials.

Many countries are successfully implementing green practices, and some are in the process of embracing them. However, despite the green building concept's rapid growth, numerous impediments prevent its adoption worldwide [6-7]. Moreover, the barriers that prevent the spread of green building vary from country to country. Factors that are more important in one place can be less critical in a different place due to country-specific characteristics like demography, culture, economy, and location [10,15]. This discrepancy arises from reconsideration and readjustment of

existing green building practices to a country's needs and capabilities. There are also risks and uncertainties related to implementing the green building concept that must be investigated [11]. Therefore, it is crucial to identify the drivers and barriers of green building to develop a proper approach for successfully promoting and implementing its practices.

1.2 Aim and objectives of the research

From experience in international green building development factors, the development of the current state of the Kazakhstani green building is considered. This thesis aims to spread our understanding of the factors that hinder and have the potential to drive green building development in Kazakhstan. The following objectives were established to achieve the thesis aim:

1. To examine the importance of green buildings in general
2. To examine the importance of green building for Kazakhstan
3. To distinguish worldwide factors influencing green building technologies (GBTs)
4. To survey the state of green building development in Kazakhstan
5. To identify and then evaluate the green building drivers and barriers in Kazakhstan

The research objectives are organized in a systematic approach called the "funneling technique," which is effectively utilized in many aspects of questioning, including researching [12]. The idea behind the "funneling technique" is to narrow the general information into practical and operable solutions [12].

First, it is essential to justify the significance of the green building to raise this study's importance. The task is specified by narrowing the importance of green building, this time around considering the importance of green building for Kazakhstan. Confirming the need for green buildings in Kazakhstan justifies the importance of investigating what factors might affect its spread. The foundation is required in the face of international experiences that hints at what factors can be used in the local survey. A literature review is by far the best method of accomplishing the relevant objectives mentioned above. However, it is impossible to rely solely on literature to identify and evaluate the green building drivers and barriers in Kazakhstan. The required studies have not yet been carried out, showing the area's research gap. To fill the gap, surveying green buildings in Kazakhstan is the most efficient and commonly used method to determine the factors.

The next step is to analyze the survey data, highlight the critical aspects, and compare them to similar case studies.

1.3 Thesis structure

Although the development of the research aims and objectives is an essential part of the methodology, it was presented in the introduction chapter. It provides valuable information on the justification of the research, highlighting a knowledge gap in the area. Similarly, the literature review is a crucial tool of the methodology of this research. However, it was presented as a substantive chapter right after the introduction part. The reason being the literature review covers a significant amount of information that requires partitioning into several sections for its better organization and, therefore, clarity. Moreover, the literature review provides valuable support for the statements in the introduction part. Consequently, it is presented right after the introduction.

The methodology chapter is presented after the literature review chapter covering questionnaire survey and data analysis methodologies. The results chapter displays the questionnaire survey and data analysis results right after the methodology chapter. Major findings of the results and key points of other sections are discussed later in the discussion chapter. Finally, considering all the chapters, the conclusion is drawn as the very last chapter providing recommendations.

Chapter 2. Literature Review

2.1 Introduction

The literature review is a crucial step of this study, as it sets the foundation for 3 out of 5 objectives. This chapter is organized in the following order. Section 2.2 provides insights on the literature review method. Section 2.3 further deepens the understanding of green building, justifying the need for this research and providing valuable information for the subsequent sections. Section 2.4 focuses specifically on proposed barriers of green building in the literature. Section 2.5 reviews the drivers proposed in the literature of eligible researches. Section 2.6 uncovers the state of green building in Kazakhstan.

2.2 Review method

The literature review's first step was identifying papers based on their titles, abstracts, and keyword in Scopus. The keywords used for the search were "green building" OR "green construction" OR "sustainable construction." The result showed over 3237 papers related to green buildings with a constant growth rate of around 20% from 2010 to 2020. These numbers represent a significant interest in the area. However, this number of papers would be impossible to review, so another layer of filtering was required. Keywords "barriers" and "drivers" were added to a limited number of papers according to relevance to the topic. The final number consisted of 73 papers between 2010 and 2020. Skimming the abstracts allowed verification of around ten articles to be similar studies carried out in other countries. Another 21 were identified as eligible for the review as they were closely related to the topic, had a good citation count, and were published in top-tier journals.

Several more articles were identified within the reference list of similar studies dating back to the early 2000s. However, the information is still relevant as researchers constantly cite the works up to date. Identified articles were enough to cover the first and third objectives of the study. Nevertheless, there are very few research articles covering Kazakhstan's green building development level in the Scopus database. Some part of the information had to be obtained through "The Green Building Information Gateway" and "The Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan" and other open-source databases.

2.3 Green building

The concept of green building or sustainable construction is the step of our community toward sustainable development. It is the care of future, and future generations as sustainability are often interpreted as utilizing resources to meet the present's needs without compromising the future generation's ability to meet their own needs [14]. There are three main pillars of sustainable construction, and multiple benefits related to them (Table 2.3.1).

Table 2.3.1: Environmental, social, and economic benefits (Ahn et al., 2013)

Environmental benefits
• Protecting air, water, land ecosystems • Conserving natural resources (fossil fuels) • Preserving animal species and genetic diversity • Protecting the biosphere • Using renewable natural resources • Minimizing waste production or disposal • Minimizing CO2 emissions and other pollutants • Maintaining essential ecological processes and life support systems • Pursuing active recycling • Maintaining integrity of environment • Preventing global warming
Social Benefits
• Improving quality of life for individuals, and society as a whole • Alleviating poverty • Satisfying human needs • Incorporating cultural data into development • Optimizing social benefits • Improving health, comfort, and well-being • Having concern for inter-generational equity • Minimizing cultural disruption • Providing education services • Promoting harmony among human beings and between humanity and nature • Understanding the importance of social and cultural capital • Understanding multidisciplinary communities
Economic Benefits
• Improving economic growth • Reducing energy consumption and costs • Raising real income • Improving productivity • Lowering infrastructure costs • Decreasing environmental damage costs • Reducing water consumption and costs • Decreasing health costs • Decreasing absenteeism in organizations • Improving Return on Investments (ROI)

It is important to note that sustainable development has its limitations. According to Barbier [15], the three pillars of sustainability (environmental, economic, and social) cannot be utilized to their full potential concurrently. Meaning development must overcome a series of continuous trade-offs, such as the trade-off between enhanced productivity or the environment's degradation [15]. Besides, due to the intense nature of development and the various ecological, economic, and social conditions, trade-offs are regularly changing [15]. Therefore, sustainable development demands have different levels of importance in other places; they are never constant and change with time. This difference directly applies to the green building concept being part of sustainable development. Therefore, there is no guarantee that successful practices in one of the ecologic, economic, and social dimensions will be similarly effective in other dimensions.

2.4 Barriers of green building

It is convenient to distribute factors according to Political, Economic, Socio-cultural, Technological, Legal and Environmental (PESTLE) categories to understand the factors affecting the development of green buildings more thoroughly. Moreover, the PESTLE method provides a bird's eye view and an organized look at the factors [18].

There are no negative impacts on the environment caused by factors related to green buildings, as the concept of green building is based on minimizing the negative effects on the environment. Therefore, barriers affecting the spread of green buildings can be distributed only among political, economic, socio-cultural, technological, and legal categories. Moreover, factors affecting the spread of green buildings are very interrelated. Some elements can correlate to several PESTLE categories, such as "lack of market demand," identified as one of the fundamental barriers by Chan et al. [20] can be underlain in the economic category and partly in the socio-cultural category. Market demand can be arisen by socio-cultural circumstances, even mainly being an economic factor. Nonetheless, in this study, the factors will be distributed according to their primary attributes, not the origin, to avoid uncertainties.

(1) Political barriers. Lack of government support and promotion can be classified as political factors. Chan et al. [20], surveying Ghana's professionals, identified the lack of government incentives as the top three most critical barriers to the development of green construction, highlighting government-role as a crucial part.

The promotion of sustainable construction resulted in the advancement of low carbon technologies that reduce the impact on the environment in the construction phase, as pointed out in a study carried on existing green buildings by Eichholtz et al. [21], making lack of promotion is the cause of the slow spread of green practices.

(2) Economic barriers. In many literature pieces, the cost is the most critical barrier to green construction as it requires more initial investment than traditional buildings [8]. Perception of higher costs causes the market to retract from green projects, as pointed out by Ahn & Pierce [17]. However, studies in the US and UAE show that the cost is not the most crucial barrier [11,16].

An extended payback period is another substantial factor in the economic category, delaying the spread of green buildings and is often ranked as the second most important barrier after cost. According to Lam et al. [18], the additional time required for a green project is a crucial factor affecting stakeholders' decisions on par with higher costs.

Darko et al. [11] also point out other barriers like lack of market demand and risks and uncertainties involved in implementing new technologies as crucial factors in the study that took place in the USA.

(3) Socio-cultural barriers. The literature represents lack of knowledge and awareness as a critical barrier to consider, as some studies suggest resolving it might solve multiple issues at once [7,16]. However, it might require much effort to raise awareness among stakeholders as it is directly bound to government incentives and educational programs [7].

Darko et al. [11] identified resistance to change as the most critical barrier in their study, followed by a lack of knowledge and awareness of sustainable construction benefits. Darko et al. [11] state that resistance to change can be the determining factor in the success of green building in the US.

(4) Technological barriers. An extended construction period is another factor related to time, similar to more extended payback periods affecting the spread of green buildings. However, the underdevelopment of technologies in the area is the leading cause of more extended construction periods [22], putting it in this category. Langdon [22] emphasizes that the extended construction period is due to 'soft costs' (additional time for planning and design).

Furthermore, Darko et al. [11] highlight the other significant factors: lack of experienced staff, educational programs, databases, and information.

(5) Legal barriers. Aktas & Ozorhon [23] emphasize the importance of green building regulation in their study in Turkey. It was one of the factors affecting the decision-making of owners and top managerial support. Additionally, Ulubeyli et al. [24] point out that there were difficulties adapting legislation and laws regarding green construction in Turkey.

Green labeling is another critical factor [11,23], as the lack of green building rating certifications can cause difficulties in adopting green projects [11].

Barriers from the literature are compiled into a single table and organized according to the PESTLE method in appendix A, table A.1

2.5 Drivers of green building

Drivers of green buildings are categorized similarly to barriers according to the PESTLE method.

(1) Political drivers. As lack of government support can be a critical factor affecting the spread of green buildings [20,7], contrary government incentives towards adopting green buildings can be a determining factor [7,25]. Darko et al. [25] suggest that government support could compensate stakeholders for the additional cost of building green, therefore, promoting green construction. Similarly, Alsanad [7] has drawn the same conclusion examining factors in Kuwait.

Several studies state the importance of company image and reputation when choosing green projects [26,27].

(2) Economic drivers. The common perception that although green buildings have higher implementation costs, they also possess lower operational costs, reducing overall lifecycle expenses, has driven the market for a long time [25]. Studies in Australia and New Zealand revealed reduced lifecycle cost of green buildings to be the most critical drivers [29]. A similar study presented this factor in Ghana in the top five most influential factors list [28].

Love et al. [30], examining an office building in Australia, pointed out several critical drivers, including the attraction of premium clients and high rental returns. High rental returns

reduced operational costs, and lower variability in turnover lead to improved building value, which by itself is a significant driver of green buildings [31].

(3) Socio-cultural drivers. Besides environmental benefits, green buildings improve occupants' health, comfort, and satisfaction compared to traditional buildings [32]. It also was rated the second most important factor in Ghana [28]. Also, an improved environment for occupants can attract quality employees [28]. By itself, the attraction of quality employees is an influential driver of green buildings [11].

Contrary to lack of awareness being a critical barrier to the spread of green buildings, an increase of understanding can be a determining driver. Regulations, policies, and educational programs toward green buildings can improve the level of awareness [25].

(4) Technological drivers. Green building practices advance conventional technologies, improving the efficiency of construction processes and management practices. Although Darko et al. [10] revealed a low impact of improved construction efficiency as a driver, it is worth considering the improvements green practices provide. Moreover, green projects require more technology and participants increasing need in an integrated work environment [33], which brings construction management processes to another level.

(5) Legal drivers. Andelin et al. [27] point out that the number of governmental regulations and urban policies constantly increase and are expected to rise in the future. Such steps are essential in promoting green practice.

Another crucial factor affecting the spread of green buildings is the rating systems, such as Leadership in Energy and Environmental Design (LEED) or Building Research Establishment Environmental Assessment Method (BREEAM). Findings show that besides affecting stakeholders' decision-making, the green design of the project undergoes changes depending on the requirements of the rating system [34], showing the importance and influence of certification systems.

(6) Environmental drivers. Green building is designed to minimize its harm to the environment, efficiently using water and energy resources, and considering human health and comfort [5]. Additionally, green practices encourage reducing construction and demolishing wastes.

Based on an international survey of green building experts carried out by Darko et al. [10], energy and water efficiency are the second and third most important factors driving the adoption of green buildings, respectively. Moreover, Ulubeyli et al. [24] revealed the very high importance of energy infrastructure and efficiency, ecological sustainability, and waste management in Turkey. Gathering the environmental benefits of the green concept is tremendous and influential to its spread.

Drivers of green building from the literature are compiled into a single table and organized according to the PESTLE method in appendix A, table A.2.

2.6 Green building in Kazakhstan

Kazakhstan's annual CO_2 emissions are at a steady increase since 1999, reaching 318 million tonnes in 2019 [37]. The country's energy consumption in 2019 is around 75 Mtoe, increasing from 55 Mtoe in 2015 [36]. It is important to note that Kazakhstan's economy is profoundly reliant on coal, oil, and gas, having a massive potential in renewable energy in the face of small hydro, solar, wind, geothermal, biomass, and waste recycling [36]. However, electricity generation based on coal is at 70%, natural gas at 20%, and the other 10% are renewable energy sources (including hydroelectricity) in 2019 [35]. The amount of electricity generated based on renewable energy sources did not see growth since 2015 [35]. There was a decline compared to 2016 when renewable energy sources were 12% and 11% in 2017 [35]. Furthermore, the actual utilization of renewable energy is only 1.4% in 2018 [36]. Coal is around 50% of the country's energy mix, while oil is 24%, and natural gas is about 25% [36].

Energy consumption of just residential buildings goes right after the industrial sector in Kazakhstan at 27% in 2019 [35]. The annual rate of overall floor area increase of residential buildings is around 10% [35]. According to the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan Bureau of National Statistics, 42,282 buildings were put in operation in 2019, 90% of which are residential [35]. The number of buildings in operation increases annually, with a growth rate ranging from 7 to 20% [35].

Kazakhstan has already taken the first steps toward sustainable development, settings itself ambitious goals. In 2015, Kazakhstan adopted the 2030 Agenda for Sustainable Development Goals at UN Headquarters [39]. In 2013, in response to achieving green/sustainable construction

goals, the Kazakhstan Green Building Council (KazGBC) was formed. Also, KazGBC began devising the national certification system for residential buildings in 2017 [40]. Nonetheless, there are only 74 green-certified buildings in the country, mainly located in Nur-Sultan and Almaty [6]. They are rated according to BREEAM and LEED certification, with most of the buildings achieving the lowest acceptable score [6]. Consequently, there are still obstacles to overcome, which arise when identifying barriers and potential drivers to spread green building practices.

Chapter 3. Methodology

3.1 Overview of methodology

The methodology of this study is based on four main steps: (1) development of aim and objectives, (2) literature review, (3) questionnaire survey, and (4) data analysis.

(1) Development of aim and objectives, and (2) literature review were covered in previous chapters. This chapter aims to display steps taken to conduct a questionnaire survey and perform data analysis of the results.

3.2 Identifying eligible respondents

First of all, it was essential to identify the knowledgeable respondents for the survey, as the whole study's concept is based on their responses and feedback. The most logical way of identifying majority of eligible respondents is contacting practitioners in the industry who worked on green-certified projects. The list of green-certified projects of Kazakhstan is available at the Green Building Information Gateway [6]. With access to this information, it was a matter of finding contractors of the green-certified buildings and asking them to share their employees' contacts. Insignificant difficulties were identifying the contractors, as it was not publicly available information for most of the buildings. So it took a little more time than expected and required contacting various data agencies to obtain the information.

Additionally, most construction companies did not have needed contact information on their websites, and emailing discovered companies did not respond in most cases. Therefore, alternatives were to contact companies through phone calls, social networks like Linkedin, Facebook, and personal visits to the companies' offices.

The most effective ways of gathering experts' contacts were visiting offices and social networks since most companies did not respond to the emails. Linkedin, in particular, allowed finding and contacting the experts freely. Moreover, it was very convenient to have a conversation with the experts and collect their feedback.

Multiple experts were kind by sharing the contacts of their colleagues that contributed to the study. Some experts shared the survey link themselves, so it was impossible to identify the total number of sent invitations. Nonetheless, at least 70 invitations were sent via various resources.

3.3 Preparing questionnaire survey

An online questionnaire survey was conducted to gather professionals' perceptions regarding factors affecting the spread of green buildings in Kazakhstan. A questionnaire survey is a standard method used in similar studies. Besides, an online questionnaire survey is a time-efficient approach to collecting a massive amount of data without a researcher's presence. Additionally, with the existing variety of questionnaire tools available online, it is has become more convenient to use this method. The questionnaire survey was conducted via the Qualtrics web survey tool.

Earlier in the literature review, standard drivers and barriers were compiled into separate tables. The lists included 36 barriers and 45 drivers of green building. However, it was essential to simplify and refine the lists since it would be time-consuming to rate all 81 factors and answer other questions, otherwise resulting in a low response rate. Official Qualtrics recommendations on a successful survey state that surveys over 12 minutes are prone to be boring and have low completion rates [41]. Inputting the list of 81 factors alongside basic information questions was estimated to take 16 minutes on average, according to the in-built Qualtrics estimation application [41]. Therefore, a mapping table was used to identify the literature factors' frequency of occurrence to identify their significance [42]. If a factor has a low occurrence rate and is a derivative of a more significant factor, it was removed from the list. For example, "average income per capita" was mentioned only once and can be considered as part of the "economic state of the country" factor. However, some factors having a relatively low occurrence rate are still kept in the list, such as "economic state of the country" due to its importance identified in previous studies [7].

Moreover, "GB rating systems" and "difficulties adapting to the certification system" have relatively low occurrence rates. However, they are potentially influential factors due to the lack of the national certification system in Kazakhstan, therefore, remain in the final list. The final lists of barriers and drivers used for the questionnaire survey are in Tables 3.3.1 and 3.3.2, respectively.

Besides asking respondents to rate the factors on a five-point Likert scale, basic information was collected to analyze the results further. The online questionnaire survey contained the questions regarding respondents' company, profession, years of experience in the building industry, and whether they have experience in green building projects.

Table 3.3.1: Compiled list of barriers based on the literature

ID	Barriers	Frequency of occurrence	References
B01	Lack of government support	5	[11,16,7,43,20]
B02	Higher costs of GBTs	9	[11,16,7-8,23,43-44,20,42]
B03	Lack of market demand	2	[11,20]
B04	Risks and uncertainties involved in implementing new technologies	6	[11,7-8,43-44,42]
B05	Economic state	2	[7,24]
B06	Long pay-back periods	6	[11,16,8,43,20,42]
B07	Lack of knowledge and awareness of GBTs and their benefits	8	[11,16,7-8,24,43,44,20]
B08	Conflicts of interests among various stakeholders in adopting GBTs	3	[11,43,20]
B09	Resistance to change	4	[11,7,23,20]
B10	Lack of GBTs databases and information	5	[11,16,23,43,20]
B11	Lack of reliable GBTs research and education	5	[11,16,23,43,20]
B12	Lack of skilled/experienced staff	8	[11,16,7,24,43-44,23,20]
B13	Longer construction period	4	[16,24,44,42]
B14	Lack of available and reliable GBTs suppliers	7	[11,16,8,23-24,43-44]
B15	High cost of sustainable materials and products	5	[8,23-24,43-44]
B16	Complexity and rigid requirements involved in adopting GBTs	5	[11,23,43-44,20]
B17	Fewer GB regulations available	6	[11,7,24,43-44,20]
B18	Insufficient GB rating systems and labeling programs available	3	[11,24,20]
B19	Difficulties adapting of the certification system	2	[24,43]

Table 3.3.2: Compiled list of drivers based on frequency of occurrence

ID	Drivers	Frequency of occurrence	References
D01	Government support	7	[11,7-8,42,25,46,33]
D02	Company image and reputation	6	[11,16,23,25,46,33]
D03	Reduced lifecycle costs	8	[10-11,16,8,25,45-46,33]
D04	Attract premium clients	6	[10-11,24-25,45-46]
D05	High rental returns	7	[10-11,16,25,45-46,33]
D06	Improvement in the national economy	3	[10-11,46]

D07	Increased building value	7	[10-11,16,25,45-46,33]
D08	Improved occupants' health, comfort, and satisfaction	8	[10-11,16,24-25,45-46,33]
D09	Attract quality employees and reduce employee turnover	4	[10-11,44,25]
D10	Facilitation of practice sharing	4	[10-11,16,42,]
D11	Educational programs	4	[7-8,42,25]
D12	Commitment to social responsibility	5	[10-11,8,25,45,]
D13	Increase of awareness	4	[8,24-25,42]
D14	Efficiency in construction processes and management practices	5	[10-11,25,46,33]
D15	Construction standards/Urban planning policies	4	[11,7-8,42]
D16	GB rating systems	2	[8,25]
D17	Energy-efficiency	9	[10-11,16,8,24-25,45-46,33]
D18	Water-efficiency	8	[10-11,16,8,24-25,45-46,]
D19	Low environmental impact	7	[10-11,16,25,45-46,33]
D20	Better indoor environmental quality	8	[10-11,8,23,25,45-46,33]
D21	Reduced construction and demolishing wastes	8	[10-11,16,8,24-25,45-46,]
D22	Preservation of natural resources	7	[10-11,8,24-25,45-46,]

3.4 Data analysis

The data analysis consists of three main parts:

1. Reliability test (Cronbach's Alpha)
2. Test of concordance (Kendall's W) and correlation (Spearman's rank correlation)
3. Mean score ranking.

Analyses are performed using the SPSS software.

Cronbach's Alpha was used to examine the reliability of the collected data, testing internal consistency. Cronbach's Alpha coefficient is based on calculating the average of all possible split-half reliability coefficients ranging from 0 (no internal reliability) to 1 (absolute internal reliability) [47]. Some studies consider a value of 0.6 to be reliable [48], when some suggest using the rule of thumb, meaning alpha values of 0.8 or higher are acceptable [47]. Nonetheless, Alpha values above

0.7 are generally considered reliable [7,49]. In this study, Cronbach's Alpha coefficient for barriers is 0.815 and 0.895 for drivers, representing high internal consistency and reliability.

Kendall's coefficient of concordance (Kendall's W) represents the level of agreement among raters. The value ranges from 0 (no agreement) to 1 (perfect agreement) [50]. The null hypothesis (H0) for conducted tests is "the distribution of factors are the same." If Kendall's W has low significance at $p<0.05$, then the null hypothesis can be rejected, which means that there is no similarity within the distribution of drivers or barriers. Kendall's W is calculated to represent the agreement within different groups of respondents in this study.

The mean score ranking is a widely used technique in green building-related studies to rank factors according to their significance [11]. In this study, the mean score ranking is used to identify the most significant barriers and drivers affecting the spread of green buildings. It is important to note that factors with identical mean scores will be sorted according to standard deviation values. Less standard deviation represents higher consistency, therefore, higher overall rank.

Additionally, Spearman's rank correlation coefficient was calculated for different groups of respondents to display the level of association/correlation among their rankings of factors. The coefficient value ranges from -1 to +1, where +1 represents the perfect correlation of rank, 0 no correlation of ranks, and -1 perfect negative correlation. The null hypothesis for this test is "there is no correlation between groups." Alpha(α) is set at 0.05, and if $p<0.05$, then there is less than a 5% chance that the strength of the correlation occurred by the chance the null hypothesis was confirmed.

Chapter 4. Results

4.1 Overview of responses

Over 70 survey invitations were distributed among practitioners, experts, and academics/researchers. Most of the respondents are local experts, except a couple of foreign professionals who consulted and assisted local green building projects. In total, 38 responses were collected, with a response rate of around 50%.

4.2 Respondents' profiles

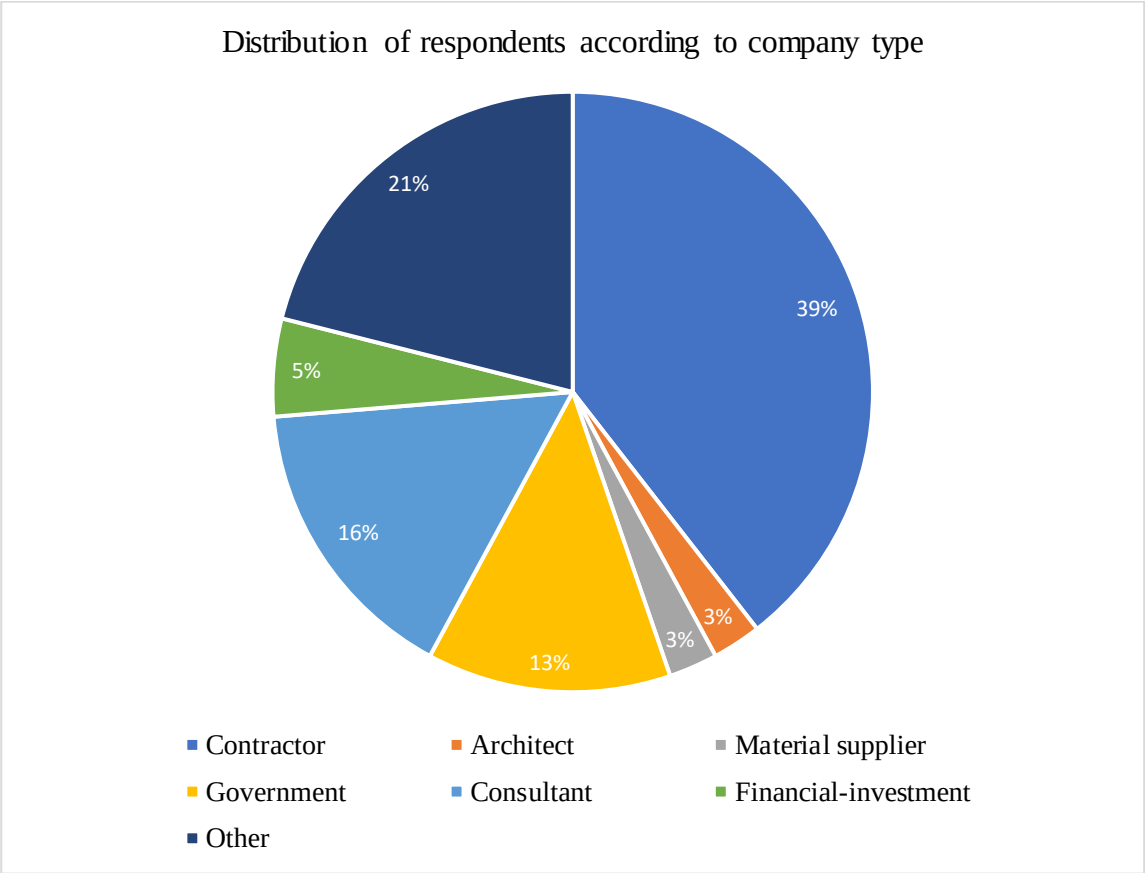


Figure 4.2.1: Distribution of respondents according to company type

The majority of the respondents come from contractors at 39%, followed by other type companies at 21%, consultant companies at 16%, government companies at 13%, financial investment companies at 5%, material supplier and architect companies both at 3% (Figure 4.2.1).

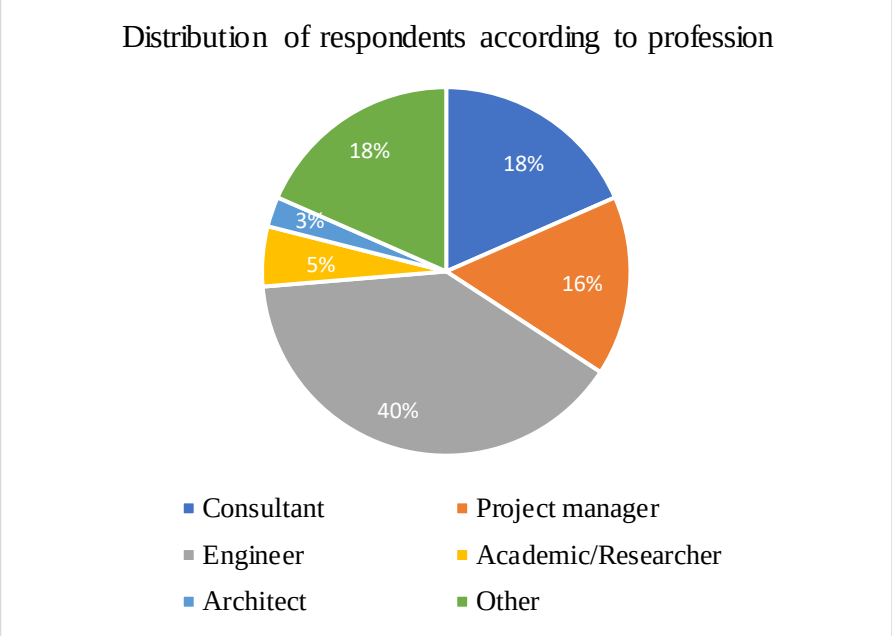


Figure 4.2.2: Distribution of respondents according to the profession

The survey revealed that most of the respondents are engineers at 40%, followed by consultants and other disciplines, both at 18%. 16% of the respondents are project managers. The minor responses are from academics/researchers at 5% and architects at 3% (Figure 4.2.2).

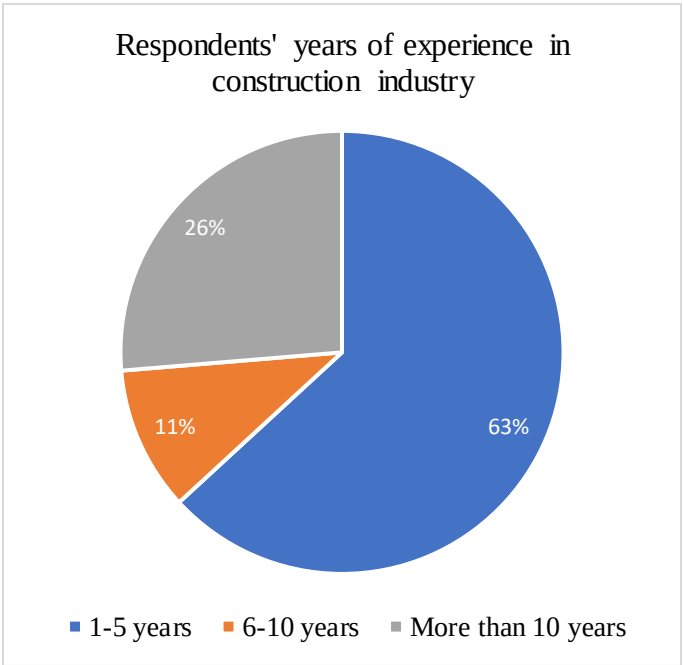


Figure 4.2.3: Respondents' years of experience in the construction industry

According to the survey results, 63% of the respondents have 1-5 years of experience in the construction industry. 26% of the respondents have more than ten years of experience, and 11% have 6-10 years of experience in the industry (Figure 4.2.3). The information related to respondents' years of experience was not used in the data analysis, but represents level of experience only.

Figure 4.2.4: Respondents' experience in green building

There were a total of 21 respondents who claimed to have a green building experience, and 17 respondents do not have a green building experience (Figure 4.2.4).

4.3 Agreement and correlations among respondent groups

(1) Company type distribution

The questionnaire survey identified multiple groups of respondents. It is crucial to identify the differences and correlations between these groups.

There are a total of 7 groups identified by the survey according to the company type of respondents. However, only four groups have a reasonable amount of responses for the test of concordance. Barrier factors' mean values and their ranks and agreement within the particular group are represented in table 4.3.1.

Barriers. Kendall's W for the "consultant" group is 0.277, which is considered a low value, representing a low level of agreement. Additionally, there is asymptotic significance identified

as $p = 0.039$, meaning that the null hypothesis (the distribution of factors are the same) is rejected. Similarly, "contractor," "government," and "other" groups have a low coefficient of concordance at 0.074, 0.304, and 0.172, respectively. However, *the p*-value is higher than 0.05, therefore, retaining the null hypothesis. This result represents the similarity within responses and a non-significant level of agreement within these groups.

Table 4.3.1: Barriers mean ranks of company type related groups and test of concordance

ID	Consultant			Contractor			Government			Other		
	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank
B01	3.83	1.329	5	4.60	0.828	5	5.000	0.000	1	4.75	0.707	1
B02	3.83	1.329	5	4.73	0.704	3	4.200	1.095	4	4.62	1.061	2
B03	3.50	1.761	8	4.60	0.828	5	4.000	1.414	5	4.37	1.188	4
B04	4.33	1.633	3	4.40	1.056	9	4.400	1.342	3	4.00	1.069	7
B05	4.50	1.225	2	4.66	0.900	4	5.000	0.000	1	4.25	1.035	5
B06	3.83	1.835	6	4.60	1.121	6	4.600	0.894	2	3.62	1.188	9
B07	4.16	1.329	4	4.33	1.175	11	3.200	1.095	8	4.62	1.061	2
B08	4.16	1.329	4	4.00	1.363	16	3.000	1.225	10	4.12	1.246	6
B09	5.00	0.000	1	4.06	1.486	15	2.800	1.304	11	4.12	1.246	6
B10	3.16	1.602	10	4.13	1.356	14	4.000	1.414	5	4.37	1.188	4
B11	3.16	1.602	10	4.33	1.234	10	4.200	1.095	4	4.25	1.035	5
B12	5.00	0.000	1	4.53	0.990	7	4.200	1.095	4	4.50	0.926	3
B13	3.16	1.602	10	4.20	1.207	12	3.400	1.673	7	2.75	1.035	10
B14	4.50	1.225	2	4.86	0.516	2	3.600	1.342	6	3.62	1.188	9
B15	4.16	1.329	4	5.00	0.000	1	5.000	0.000	1	4.37	1.188	4
B16	3.83	1.835	6	4.46	0.915	8	3.600	1.342	6	3.75	1.488	8
B17	3.50	1.225	7	4.60	0.828	5	4.600	0.894	2	4.25	1.035	5
B18	2.50	0.837	11	4.13	1.302	13	3.600	1.342	6	4.50	0.926	3
B19	3.33	1.862	9	4.53	0.990	7	3.200	1.789	9	4.37	1.188	4
Kendall's W			0.277			0.074			0.304			0.172
Chi-Square			29.884			20.110			27.383			24.838
Degree Of Freedom			18			18			18			18
Asymp. Sig.			0.039			0.327			0.072			0.129

According to Spearman's rank correlation test of barriers rated by "consultant," "contractor," "government," and "other" groups (Table 4.3.2), we can see a general trend of low correlation among these four groups. Additionally, the significance level is higher than 0.05, which means that the null hypothesis is retained, and there is no significant correlation among group pairs. The correlation coefficient of the "consultant"-"other" pair is at -0.056, representing a slight negative correlation. However, the correlation coefficient of "contractor" and "government" is at

0.662, which is generally considered a reasonable association level, with a significance level of 0.002, showing an asymptotic significance.

Table 4.3.2: Correlation of barrier ranks of company type related groups

		Consultant	Contractor	Government	Other
Correlation Coefficient	Consultant	1.000	0.243	0.086	-0.056
Sig. (2-tailed)			0.315	0.727	0.818
N		19	19	19	19
Correlation Coefficient	Contractor	0.243	1.000	.662**	0.147
Sig. (2-tailed)		0.315		0.002	0.548
N		19	19	19	19
Correlation Coefficient	Government	0.086	.662**	1.000	0.186
Sig. (2-tailed)		0.727	0.002		0.445
N		19	19	19	19
Correlation Coefficient	Other	-0.056	0.147	0.186	1.000
Sig. (2-tailed)		0.818	0.548	0.445	
N		19	19	19	19

**. Correlation is significant at the 0.01 level (2-tailed).

Drivers. Table 4.3.3 represents the mean ranks and Kendell's W of drivers rated by "consultant," "contractor," "government," and "other" groups. There is generally a low level of agreement within each group, with a significance level higher than 0.05. Therefore, the null hypothesis is retained, and there are few similarities. On the other hand, the "other" group has a significant level of 0.014, representing a significant difference in agreement.

Table 4.3.3: Drivers mean ranks of company type related groups and test of concordance

ID	Consultant			Contractor			Government			Other		
	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank
D01	3.83	1.169	10	4.73	0.458	1	4.40	0.548	3	3.87	0.991	15
D02	4.33	0.516	3	4.33	0.900	15	4.40	1.342	4	4.25	0.707	6
D03	3.50	1.049	15	4.33	1.113	13	4.00	0.707	7	4.87	0.354	1
D04	3.66	1.033	12	4.33	1.234	14	4.00	1.225	8	3.62	1.302	18
D05	3.83	0.983	9	4.00	1.363	19	4.00	1.225	8	4.12	0.991	10
D06	3.66	0.816	11	3.86	1.246	21	3.80	1.304	9	4.12	1.126	11
D07	4.00	1.095	8	4.13	1.246	18	3.20	1.304	12	4.00	0.756	12
D08	4.50	0.548	1	4.73	0.594	2	4.60	0.548	2	4.25	1.035	7

D09	3.50	0.548	14	4.00	1.195	20	3.80	1.643	10	4.00	1.069	13
D10	3.00	1.095	18	4.53	0.743	8	3.60	1.517	11	3.62	0.916	17
D11	3.16	1.329	17	4.40	0.737	9	3.80	1.643	10	3.37	0.916	19
D12	3.50	1.378	16	4.33	1.047	12	3.80	1.643	10	3.87	0.835	14
D13	3.66	1.506	13	4.40	0.737	9	3.60	1.517	11	3.87	0.991	15
D14	4.16	0.753	5	4.26	1.163	16	4.00	0.707	7	3.87	0.835	14
D15	4.16	0.753	5	4.60	0.737	5	4.00	0.707	7	4.12	0.835	9
D16	4.00	0.894	7	4.40	0.910	10	4.20	0.837	5	3.62	0.744	16
D17	4.50	0.548	1	4.60	1.056	6	4.60	0.548	2	4.62	0.518	3
D18	4.50	0.837	2	4.53	1.060	7	4.60	0.548	2	4.75	0.463	2
D19	4.00	0.894	7	4.60	0.828	4	4.60	0.548	2	4.37	0.916	5
D20	4.33	0.816	4	4.33	0.976	11	4.80	0.447	1	4.12	0.991	10
D21	4.16	0.753	5	4.26	1.280	17	4.20	1.304	6	4.25	0.707	8
D22	4.16	0.983	6	4.60	0.507	3	4.20	1.304	6	4.37	0.744	4
Kendall's W			0.239			0.084			0.217			0.224
Chi-Square			30.090			26.330			22.821			37.600
Degree Of Freedom			21			21			21			21
Asymp. Sig.			0.090			0.194			0.354			0.014

The groups' correlation coefficients are reasonable for most pairs ranging from 0.493 to 0.778 with a significance level lower than 0.05. Only "contractor"-"other" and "consultant"-"contractor" pairs have a low association with correlation coefficients of 0.177 and 0.261, respectively (Table 4.3.4).

Table 4.3.4: Correlation of driver ranks of company type related groups

		Consultant	Contractor	Government	Other
Correlation Coefficient	Consultant	1.000	0.261	.778**	.609**
Sig. (2-tailed)			0.241	0.000	0.003
N		22	22	22	22
Correlation Coefficient	Contractor	0.261	1.000	.493*	0.177
Sig. (2-tailed)		0.241		0.020	0.432
N		22	22	22	22
Correlation Coefficient	Government	.778**	.493*	1.000	.580**
Sig. (2-tailed)		0.000	0.020		0.005
N		22	22	22	22
Correlation Coefficient	Other	.609**	0.177	.580**	1.000
Sig. (2-tailed)		0.003	0.432	0.005	
N		22	22	22	22

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

(2) Profession type distribution

According to the questionnaire survey, respondents can also be categorized according to their profession. Only 4 of the six categories are used for the test of agreement (Kendall's W) and correlation (Spearman's rank correlation) since other types of professions had a low amount of responses to consider for the test. The groups are: "engineer," "project manager," "consultant," and "other."

Barriers. Table 4.3.5 displays a low agreement level in every group value ranging from 0.088 to 0.173 with a significance level higher than 0.05. Therefore, the null hypothesis is retained, showing non-significant similarities within the responses in each group.

Table 4.3.5: Barriers mean ranks of profession type related groups and test of concordance

ID	Engineer			Project Manager			Consultant			Other		
	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank
B01	4.60	0.828	4	4.33	1.033	3	4.286	1.254	3	4.71	0.756	2
B02	4.40	1.056	6	5.00	0.000	1	4.714	0.756	1	4.00	1.291	8
B03	4.60	0.828	4	3.83	1.329	5	3.571	1.397	10	4.42	1.512	5
B04	4.40	1.056	6	3.83	1.329	5	3.714	1.704	8	4.71	0.756	2
B05	4.40	1.056	6	4.50	1.225	2	4.714	0.756	1	5.00	0.000	1
B06	4.53	0.990	5	3.16	1.602	11	3.714	1.704	9	4.71	0.756	2
B07	4.66	0.900	3	4.50	1.225	2	3.429	1.512	12	4.14	1.069	7
B08	3.86	1.302	13	3.66	2.066	8	3.714	1.254	7	4.14	1.069	7
B09	4.06	1.438	12	3.33	1.966	10	4.429	0.976	2	4.28	1.254	6
B10	3.66	1.543	14	4.00	1.673	4	3.571	1.512	11	4.71	0.756	2
B11	4.26	1.335	9	4.33	1.033	3	3.857	1.574	6	4.14	1.069	7
B12	4.86	0.516	1	4.33	1.033	3	4.429	0.976	2	4.57	1.134	3
B13	4.06	1.223	11	2.66	0.516	12	3.714	1.704	9	3.57	1.397	11
B14	4.53	0.990	5	4.33	1.033	3	4.429	0.976	2	4.28	1.254	6
B15	4.80	0.775	2	3.83	1.835	6	4.714	0.756	1	4.71	0.756	2
B16	4.26	1.100	8	4.00	1.673	4	3.857	1.574	6	4.42	0.976	4
B17	4.53	0.990	5	4.00	1.673	4	4.143	1.069	4	3.85	1.069	9
B18	4.13	1.302	10	3.66	1.633	7	3.429	1.618	13	3.71	1.254	10
B19	4.33	1.175	7	3.33	1.862	9	4.000	1.732	5	4.42	0.976	4
Kendall's W			0.088			0.173			0.128			0.156
Chi-Square			23.840			18.708			16.116			19.688
Degree Of Freedom			18			18			18			18
Asymp. Sig.			0.160			0.410			0.584			0.351

Each pair's significance levels in this category exceed the value of 0.05, which means no significant similarities. The correlation coefficient value represents a similar trend showing a low association level, values ranging from 0.106 to 0.396 (Table 4.3.6).

Table 4.3.6: Correlation of barrier ranks of profession type related groups

		Engineer	Project Manager	Consultant	Other
Correlation Coefficient	Engineer	1.000	0.396	0.286	0.291
Sig. (2-tailed)			0.094	0.236	0.226
N		19	19	19	19
Correlation Coefficient	Project Manager	0.396	1.000	0.344	0.106
Sig. (2-tailed)		0.094		0.149	0.666
N		19	19	19	19
Correlation Coefficient	Consultant	0.286	0.344	1.000	0.257
Sig. (2-tailed)		0.236	0.149		0.288
N		19	19	19	19
Correlation Coefficient	Other	0.291	0.106	0.257	1.000
Sig. (2-tailed)		0.226	0.666	0.288	
N		19	19	19	19

Drivers. Profession-based groups do not show a significant level of concordance when rating the drivers. Kendall's W stays within the range of 0.09 and 0.262, which is considered low. The p-value is higher than 0.05 for "engineer," "project manager," and "other" groups, representing a non-significant level of similarity. The "consultant" group has an asymptotic significance rejecting the null hypothesis (Table 4.3.7).

Table 4.3.7: Drivers mean ranks of profession type related groups and test of concordance

ID	Engineer			Project Manager			Consultant			Other		
	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank
D01	4.60	0.507	6	4.00	1.265	11	4.14	0.690	8	4.28	1.113	8
D02	4.33	0.976	14	4.50	0.837	4	4.28	0.488	4	4.42	0.535	4
D03	4.66	0.617	3	4.16	0.408	8	3.57	1.618	14	4.28	0.756	7
D04	4.40	1.242	13	3.83	0.753	12	3.28	1.113	16	4.14	1.069	11
D05	4.60	0.828	8	3.83	0.753	14	3.57	1.272	13	3.57	1.272	15
D06	4.46	0.915	10	3.66	1.033	15	3.28	1.254	17	3.85	0.900	14
D07	3.80	1.320	20	4.50	0.548	3	3.57	1.272	13	4.42	0.535	4
D08	4.66	0.816	4	4.66	0.516	2	4.28	0.488	6	4.57	0.787	3
D09	4.06	1.280	19	3.66	1.033	15	3.71	0.756	12	4.14	0.900	10
D10	4.13	0.915	18	4.50	0.837	5	3.42	1.397	15	4.14	0.690	9

D11	4.40	0.910	12	4.16	1.169	10	3.14	1.069	18	3.85	0.690	13
D12	4.40	0.828	11	4.66	0.516	2	3.00	1.414	20	4.28	0.488	6
D13	4.26	0.961	15	4.16	0.753	9	3.14	1.215	19	4.85	0.378	1
D14	4.53	0.516	9	3.83	1.169	13	3.71	1.380	11	4.14	0.690	9
D15	4.60	0.737	7	4.33	0.516	6	4.28	0.756	5	4.14	0.900	10
D16	4.20	1.014	16	4.16	0.753	9	4.00	0.816	9	4.14	0.900	10
D17	4.80	0.414	1	4.66	0.516	2	4.28	1.496	7	4.42	0.535	4
D18	4.73	0.458	2	5.00	0.000	1	4.28	1.496	7	4.42	0.787	5
D19	4.46	0.915	10	4.50	0.837	5	4.42	0.976	3	4.57	0.535	2
D20	4.20	1.082	17	4.50	0.837	5	4.71	0.488	1	4.28	0.756	7
D21	4.40	0.910	12	4.33	0.816	7	4.00	1.528	10	4.28	0.756	7
D22	4.66	0.617	5	4.50	0.837	5	4.42	0.787	2	4.00	0.577	12
Kendall's W			0.090			0.252			0.262			0.155
Chi-Square			28.352			31.770			38.474			22.798
Degree Of Freedom			21			21			21			21
Asymp. Sig.			0.130			0.062			0.011			0.355

The "consultant"-"other" pair shows a reasonable amount of correlation at a value of 0.673 and a significance level of 0.001 when ranking the drivers. However, other group pairs share a low correlation with *p*-values higher than 0.05 (Table 4.3.8).

Table 4.3.8: Correlation with driver ranks of profession type related groups

		Engineer	Project Manager	Consultant	Other
Correlation Coefficient	Engineer	1.000	0.221	0.275	0.036
Sig. (2-tailed)			0.323	0.215	0.875
N		22	22	22	22
Correlation Coefficient	Project Manager	0.221	1.000	0.390	.673**
Sig. (2-tailed)		0.323		0.072	0.001
N		22	22	22	22
Correlation Coefficient	Consultant	0.275	0.390	1.000	0.229
Sig. (2-tailed)		0.215	0.072		0.306
N		22	22	22	22
Correlation Coefficient	Other	0.036	.673**	0.229	1.000
Sig. (2-tailed)		0.875	0.001	0.306	
N		22	22	22	22

**. Correlation is significant at the 0.01 level (2-tailed).

(3) Green Building experience-based distribution

Responses from two groups of respondents based on their experience in the green building were analyzed on the agreement within-group itself and correlation with the other group. Group 1 refers to respondents who have experience in green building. Group 2 refers to respondents who don't have experience in green building. Additionally, the two groups are listed with the total mean rank and Kendall's W from all respondents in Table 4.3.9.

Barriers. Groups 1 and 2 have Kendall's W of 0.133 and 0.098, respectively, which is considered low. However, the significance level is lower than 0.05 for both groups, representing asymptotic significance in the results (Table 4.3.9). According to Spearman's rank correlation test, group 1 and group 2 have a correlation coefficient of 0.274 with a significance of 0.257, which is considered a low association.

Table 4.3.9: Total mean ranks of barriers, and two respondent groups and test of concordance

ID	Total			Group 1			Group 2		
	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank
B01	4.11	0.924	2	4.33	0.913	1	3.82	0.883	15
B02	3.97	0.822	5	4.00	0.837	3	3.94	0.827	6
B03	3.87	1.044	6	3.81	1.030	6	3.94	1.088	7
B04	3.68	0.904	11	3.52	1.078	10	3.88	0.600	8
B05	4.00	0.771	4	4.10	0.768	2	3.88	0.781	10
B06	3.84	1.151	7	3.86	1.276	5	3.82	1.015	13
B07	3.76	1.025	9	3.71	1.146	8	3.82	0.883	14
B08	3.47	1.133	16	3.43	1.248	13	3.53	1.007	18
B09	3.50	1.109	14	3.48	1.167	12	3.53	1.068	19
B10	3.39	1.104	17	3.10	1.221	17	3.76	0.831	16
B11	3.66	0.966	12	3.43	1.121	14	3.94	0.659	5
B12	4.11	0.831	1	3.86	0.910	4	4.41	0.618	1
B13	3.24	1.025	19	2.95	1.071	19	3.59	0.870	17
B14	3.79	0.811	8	3.52	0.873	11	4.12	0.600	3
B15	4.03	0.915	3	3.76	1.091	7	4.35	0.493	2
B16	3.58	1.030	13	3.33	1.238	15	3.88	0.600	11
B17	3.71	0.927	10	3.57	1.076	9	3.88	0.697	9
B18	3.37	1.025	18	3.00	1.049	18	3.82	0.809	12
B19	3.50	1.133	15	3.10	1.338	16	4.00	0.500	4
Kendall's W			0.081			0.133			0.098
Chi-Square			55.364			50.108			30.074
Degree Of Freedom			18			18			18
Asymptotic Sig.			0.000			0.000			0.037

Drivers. Kendall's W for group 1 is at 0.142 with a high asymptotic significance level. Meaning the null hypothesis is rejected, and there is a significant level of difference in agreement within group 1. Group 2 has a significance value of 0.533, meaning there are non-significant similarities within the group, besides having a similarly low level of agreement with group 1 (Table 4.3.10). It is important to note that the correlation coefficient between groups 1 and 2 when ranking the driver factors is significantly higher when the same group rated the barriers. The correlation coefficient value is 0.633 with a significant level of 0.002.

Table 4.3.10: Total mean ranks of drivers and two respondent groups and test of concordance

ID	Total			Group 1			Group 2		
	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank
D01	4.37	0.819	7	4.38	0.865	7	4.35	0.786	10
D02	4.29	0.835	9	4.24	0.995	10	4.35	0.606	5
D03	4.24	0.943	10	4.14	0.793	12	4.35	1.115	9
D04	3.95	1.161	20	4.00	1.000	17	3.88	1.364	20
D05	4.00	1.090	16	4.10	0.831	14	3.88	1.364	21
D06	3.92	1.075	21	4.00	0.894	16	3.82	1.286	22
D07	4.00	1.090	17	4.05	1.024	15	3.94	1.197	19
D08	4.55	0.686	3	4.62	0.498	3	4.47	0.874	1
D09	3.89	1.134	22	3.86	1.276	21	3.94	0.966	18
D10	3.97	1.078	18	3.86	1.195	20	4.12	0.928	14
D11	3.95	1.114	19	3.81	1.289	22	4.12	0.857	13
D12	4.08	1.124	14	4.14	1.153	13	4.00	1.118	17
D13	4.05	1.064	15	3.95	1.161	18	4.18	0.951	12
D14	4.13	0.906	12	3.95	0.740	19	4.35	1.057	7
D15	4.37	0.751	6	4.33	0.658	8	4.41	0.870	3
D16	4.11	0.863	13	4.14	0.793	11	4.06	0.966	16
D17	4.58	0.758	2	4.71	0.463	2	4.41	1.004	2
D18	4.61	0.790	1	4.81	0.402	1	4.35	1.057	8
D19	4.47	0.797	4	4.52	0.680	4	4.41	0.939	4
D20	4.37	0.852	8	4.43	0.746	5	4.29	0.985	11
D21	4.21	1.018	11	4.29	0.845	9	4.12	1.219	15
D22	4.39	0.790	5	4.43	0.870	6	4.35	0.702	6
Kendall's W			0.085			0.142			0.055
Chi-Square			67.863			62.811			19.812
Degree Of Freedom			21			21			21
Asymptotic Sig.			0.000			0.000			0.533

4.4 The final mean rank of factors categorized according to PESTLE

The PESTLE method is used to provide a broad view of the factors. Total mean ranks of barriers and drivers are classified according to PESTLE in tables 4.4.1 and 4.4.2, respectively. The critical thing to notice is that there are some noticeable trends in the factor distributions.

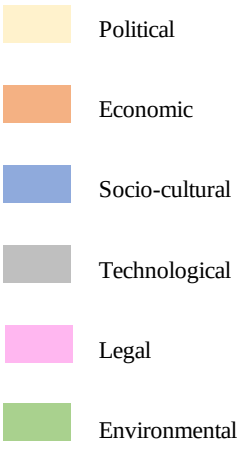
The results reveal that the top three most influential barriers to green building are:

1. "Lack of skilled/experienced staff."
2. "Lack of government support."
3. "High cost of sustainable materials and products."

According to the respondents, the first most significant barrier is from the Technological category, while other Technological barriers are ranked low, being at the bottom of the list. The second most important barrier is the "lack of government support," being the only Political factor. The third one is "high cost of sustainable materials and products," followed by other Economic factors like "economic state," "higher costs of GBTs," "lack of market demand," "long payback periods" go one after another, representing a consistent distribution. We can see the lesser importance of Socio-cultural and legal barriers than some technological, political, and economic factors. Comparing the Socio-cultural to legal barriers, the outranking of Socio-cultural barriers is noticeable.

Table 4.4.1: Mean ranks of barriers categorized according to PESTLE

ID	Rank	Barriers	Mean	SD
B12	1	Lack of skilled/experienced staff	4.11	0.831
B01	2	Lack of government support	4.11	0.924
B15	3	High cost of sustainable materials and products	4.03	0.915
B05	4	Economic state	4.00	0.771
B02	5	Higher costs of GBTs	3.97	0.822
B03	6	Lack of market demand	3.87	1.044
B06	7	Long pay-back periods	3.84	1.151
B14	8	Lack of available and reliable GBTs suppliers	3.79	0.811
B07	9	Lack of knowledge and awareness of GBTs and their benefits	3.76	1.025
B17	10	Fewer GB regulations available	3.71	0.927
B04	11	Risks and uncertainties involved in implementing new technologies	3.68	0.904
B11	12	Lack of reliable GBTs research and education	3.66	0.966
B16	13	Complexity and rigid requirements involved in adopting GBTs	3.58	1.030
B09	14	Resistance to change	3.50	1.109



B19	15	Difficulties adapting to the certification system	3.50	1.133
B08	16	Conflicts of interests among various stakeholders in adopting GBTs	3.47	1.133
B10	17	Lack of GBTs databases and information	3.39	1.104
B18	18	Insufficient GB rating systems and labeling programs available	3.37	1.025
B13	19	Longer construction period	3.24	1.025

According to the respondents, the top three most significant drivers of green building are:

1. "Water-efficiency."
2. "Energy-efficiency."
3. "Improved occupants' health, comfort, and satisfaction."

There are some noticeable trends in the drivers' mean ranking list, as 4 out of the top 5 most significant drivers are from the Environmental category. The rest of the environmental drivers are located not far from the same category drivers closer to the middle of the list. "Improved occupants' health, comfort, and satisfaction" is the only Socio-cultural driver located at the top of the list. The other five socio-cultural drivers are contrary closer to the bottom. Political and Legal drivers are in the middle of the list after the Environmental drivers. The only technological driver, "Efficiency in construction processes and management practices," is also in the middle of the list with lesser importance than environmental, political, and legal drivers. According to experts ' responses, it is noticeable that Economic and other Socio-cultural drivers are less critical than the rest.

Table 4.4.2: Mean ranks of drivers categorized according to PESTLE

ID	Rank	Drivers	Mean	SD
D18	1	Water-efficiency	4.61	0.790
D17	2	Energy-efficiency	4.58	0.758
D08	3	Improved occupants' health, comfort, and satisfaction	4.55	0.686
D19	4	Low environmental impact	4.47	0.797
D22	5	Preservation of natural resources	4.39	0.790
D15	6	Construction standards/Urban planning policies	4.37	0.751
D01	7	Government support	4.37	0.819
D20	8	Better indoor environmental quality	4.37	0.852
D02	9	Positive company image and reputation	4.29	0.835
D03	10	Reduced lifecycle costs	4.24	0.943
D21	11	Reduced construction and demolishing wastes	4.21	1.018
D14	12	Efficiency in construction processes and management practices	4.13	0.906
D16	13	GB rating systems	4.11	0.863

Political
Economic
Socio-cultural
Technological
Legal
Environmental

D12	14	Commitment to social responsibility	4.08	1.124
D13	15	Increase of awareness	4.05	1.064
D05	16	High rental returns	4.00	1.090
D07	17	Increased building value	4.00	1.090
D10	18	Facilitation of practice sharing	3.97	1.078
D11	19	Educational programs	3.95	1.114
D04	20	Attract premium clients	3.95	1.161
D06	21	Improvement in the national economy	3.92	1.075
D09	22	Attract quality employees and reduce employee turnover	3.89	1.134

Chapter 5. Discussion

5.1 Questionnaire survey results overview

In this study, 38 responses are collected from professionals in the construction industry in Kazakhstan. The professionals shared their opinions on factors affecting the spread of green building in Kazakhstan by rating potential 22 drivers and 19 barriers on a Likert scale from 1 (Strongly agree/Not critical) to 5 (Strongly agree/Very critical). Later, statistical data analysis was performed to verify the reliability of the results. After validating the results' reliability, several analyses were performed to identify the differences and correlation among responses. Finally, a statistical data analysis method was used to rank the factors. Cronbach's alpha coefficient was used to assess the reliability of the data. The alpha value was 0.815 for barriers and 0.895 for drivers, which is higher than the acceptable threshold of 0.7, representing high internal consistency, therefore, reliability of the collected data.

5.2 Data analysis test results

Overview. The responses were categorized into several groups, according to the respondents' profiles, such as consultant, contractor, government, other according to company type; engineer, project manager, consultant, other according to the profession; and two groups, one being experienced in green building and other not. Each group was tested on the level of agreement within its respondents using Kendall's concordance coefficient (Kendall's W). Additionally, group responses were ranked and analyzed with Spearman's rank correlation coefficient to represent the association level among various groups of respondents.

Kendell's concordance coefficient revealed a generally low level of agreement among respondents of the groups, as Kendall's W did not go over 0.3 for any of the groups. However, this does not necessarily mean that all results are non-significant. In multiple cases, the significance level was lower than the probability value of 5% (p=0.05), representing statistical significance. In the cases where the significance level was otherwise exceeding the p-value would mean that there is still an agreement, but it is considered non-significant. It is crucial to note that more significance is identified among the experienced/inexperienced groups than in company type or profession type based groups. In fact, there was only one case, agreement within the group with no previous experience in green building rating drivers when the result had a non-significant outcome.

However, this could be due to smaller sample size for groups based on company type or profession compared to experienced and inexperienced groups.

Spearman's rank correlation coefficient tests showed a generally low to medium concordance level among group pairs. There is a noticeable trend within correlation tests when results favor driver factors representing a more consistent medium correlation coefficient with high significance values. The trend is shared for company-type groups, profession-type groups, and experienced and inexperienced groups. Mean values of driver factors generally have a lower standard deviation, and it is more prominent in the results of experienced and inexperienced groups rating driver factors, where the experienced group had a lower standard deviation in the ratings. That is very reasonable as experienced people should have more consistent answers.

As factors were rated according to the Likert scale, statistically, the value of 3 (neither agree nor disagree) is considered neutral. If the mean values of the factors are statistically different from 3, then the result is considered significant. Mean value results showed that the barriers and drivers are different from 3, therefore, significant. However, driver factors have a higher minimum mean value of 3.89, where barrier factors only 3.24. So, we can assume that driver factors results are more significant than barrier factors' results.

Experienced vs. inexperienced groups. Comparing rankings of experienced and inexperienced groups on barriers revealed a low correlation with the non-significant result. We can notice this pattern in multiple rankings, such as for barriers, the experienced group ranked "lack of government support as 1st (highest importance), and inexperienced group ranked the same barrier as 15th out of 19. "Economic state" was ranked 2nd by the experienced group and 10th by the inexperienced group. Nevertheless, the ranks were not negatively correlated as the correlation value was low (0.274) but not zero or negative. "Lack of skilled/experienced staff," as an example, was ranked 1st by the inexperienced group and 4th by the experienced one, or "high cost of sustainable materials and products" was ranked 2nd by the inexperienced group and 7th by the experienced one, showing correlation.

On the other hand, the same two groups ranking the driver had a medium level of correlation with a significance level of 0.002, and the correlation coefficient between the groups was at 0.633. It is notable where both groups ranked "energy-efficiency" as the second most crucial driver, or

"improved occupants' health, comfort, and satisfaction" was ranked 1st by inexperienced and 3rd by experienced groups.

Such difference between results of barriers and drivers might have been caused by a relatively low sample size when completely different response patterns were used, resulting in a low consistency and correlation or the actual inconsistency in the respondents' knowledge and awareness, meaning respondents are generally less confident about barrier factors. The first theory, reasoning low correlation and consistency of groups rating barriers being a low sample size, seems more reasonable and favoring. However, it also contradicts relatively consistent and statistically significant results of driver factors. Nonetheless, the results for both barriers and drivers are reliable as the calculated Cronbach's alpha was higher than 0.7.

5.2.1 Total mean ranks results

Barriers. "Lack of skilled/experienced staff" and "lack of government support" are rated as the first and second most important barriers, both sharing an identical mean value of 4.11. However, "lack of skilled/experienced staff" has a lower standard deviation than "lack of government support." The third most important barrier is the "high cost of sustainable materials and products." Looking into the literature, we can see similar issues in the UAE [16] and Malaysia [8], where a lack of professionals was identified as similarly significant. This makes sense since Kazakhstan is in its early stages of adopting the green building concept. Therefore, the lack of experienced people in the industry is expected.

The "lack of government support" was rated as the second most important driver in this study. A study in Kuwait [7] identified the importance of government support, suggesting various incentives. Similar cases can be observed in Ghana [28] and Singapore [44], where the lack of government incentives was in the top 3 most critical barriers.

"High cost of sustainable materials and products" was rated as the third most crucial driver. It is closely related to the high cost of GBTs mentioned as critically important in other studies [8,17].

It is an interesting finding that the least critical barriers are considered "longer construction period" alongside "insufficient GB rating systems and labeling programs available." Since longer implementation time of green projects was considered one of the most critical barriers in Australia

[52], and Zhang et al. [43] point out that longer construction times often cause excessive and not attractive pay-back periods. The reasoning "longer construction period" is rated low could be, that in general, all existing green-certified projects in Kazakhstan did not face the issue of more extended construction periods.

Although Kazakhstan does not have a national certification system, another low-rated barrier is "insufficient GB rating systems and labeling programs available." This can be related to several successful implementation examples of LEED, BREEAM certifications in recent years. Before 2018, there were no "gold-certified" projects by LEED in Kazakhstan, whereas, today there are 7 "gold-certified" buildings [6].

Drivers. Professionals rated "water-efficiency" as the most critical driver, with a mean value of 4.61. "Energy-efficiency" was rated the second most crucial factor at a 4.58 mean value, and "improved occupants' health, comfort, and satisfaction" was the third most important factor at 4.55 mean value. All three factors have very similar mean values and low standard deviation values. In the US, studies carried by Darko et al. [11] represent the significance of "water-efficiency," "energy-efficiency," "improved occupants' health, comfort, and satisfaction" on a similar level of significance. "Water-efficiency" alongside "energy-efficiency" were top 2 ranked drivers revealed by Darko et al. [11], and the "improved occupants' health, comfort, and satisfaction" was the fourth most crucial driver. There are multiple benefits of green buildings, like reduced lifecycle costs. Around 40% of reduced lifecycle costs of green buildings can be related to water and energy efficiency [5], and this justifies why local experts rated water and energy efficiency as the most significant drivers.

Although the energy efficiency was rated as the second most important driver, we can easily say that the first and second spots are very tight together. Energy efficiency was the highest-rated driver by Ahn et al. [8] and a similar study in Greece [51], as it is a high priority in many countries [11]. Energy efficiency is one of the most effective, cost-efficient approaches to mitigate climate change and improving air quality [11].

Other significant drivers rated by the respondents include "low environmental impact," "preservation of natural resources," "construction standards/urban planning policies," "government support," which are all commonly known benefits of green buildings.

Drivers like "attract quality employees and reduce employee turnover" and "improvement in the national economy" were rated as the least crucial drivers to green building comparing to other drivers. Nonetheless, they represent significant importance as the means values are close to 4.00, and their significance was mentioned in other studies [11].

5.3 Application of PESTLE

It is hard to make a statement that the highest-rated factors in both barriers and drivers are drastically more important than the second ones or the second ones than the thirds. However, we can see observe trends in the rank distribution of PESTLE categories (Table 4.4.1). Using PESTLE distribution, we can now state the significance of the Political category. Also, Economic barriers are tightly clustered together, which shows the consistency in respondents rating related to it. This shows the viability of use PESTLE analysis to categorize the factors, as it provides another perspective view on existing data and lets us draw interesting conclusions.

Chapter 6. Conclusion

Green building was presented as a solution to multiple environmental, economic, and social issues our time. It is a progressively developing concept spreading across the world. However, green building is driven and obstructed by multiple factors, which are constantly studied. Study results vary in different places due to the uniqueness of the area and the time the study is carried out, and the development of green building has to compensate for continuous trade-offs.

Lack of skilled/experienced staff was considered the most hindering barrier to green building by Kazakhstan professionals. A possible reason for the respondents' decision is that Kazakhstan is at an early development level of green building, lacking qualified professionals in the area. The same barrier was similarly crucial in other countries like UAE and Malaysia.

Water efficiency and energy efficiency were rated as the most crucial drivers of green building in Kazakhstan. The water and energy efficiency of the green buildings tend to reduce lifecycle costs by around 40%, and they are generally known benefits of green buildings Additionally, the energy efficiency of the country is considered low due to outdated technologies, which may have affected the respondents' opinions.

6.1 Recommendations

Categorizing the responses according to company types and profession types of the respondents revealed valuable information. However, the results were generally non-significant, which might have been caused by the relatively low sample size for each category. It is recommended to either not conduct a similar analysis due to low correlation among groups or increase the sample size and discover whether correlation level was heavily affecting by sample size.

Analyzing experienced and unexperienced groups in green building revealed statistically significant results. It is recommended to enhance the analysis by increasing the sample size to increase the level of confidence in the results.

Comparing drivers to barriers results reveals a higher level of confidence among respondents rating the drivers, having higher mean values. Additionally, driver factors results were generally more correlated.

Application of PESTLE analysis on the existing data showed significant trends, and it is recommended to enhance the analysis by increasing the sample size and normalizing the number of factors for each PESTLE category.

Government plays a vital role in the adoption of green practices, as discussed earlier. Moreover, the survey results revealed that lack of government support is the second most important barrier. So it is recommended that government provides heavier incentives toward sustainable development. Additionally, the need for experienced employees could be resolved or stimulated to be solved by the government by providing education programs or encouraging companies to do so.

Also, there is a lack of proper, user-friendly databases to observe the country's current state of sustainability. The information about existing green-certified buildings in the country was obtained through an international database. Obtaining the information in the area should not be difficult. Besides, contacting the experts or finding their contacts was relatively troublesome. Although companies can not publish their employees' personal information to open sources, it is recommended that local companies provide viable alternatives to contact them as such change might promote more research in the area, therefore, advancing it.

Further investigations are recommended as statistics reveal a relatively low progression level toward sustainability of Kazakhstan. Discovered results of the study are applicable for field professionals and further investigations in the area.

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Appendices

Appendix A

Table A.1 Barriers to green building adoption according to PESTLE

Political	Lack of government support Lack of promotion
Economic	Higher costs of GBTs Lack of market demand Risks and uncertainties involved in implementing new technologies Economic state Lack of financing schemes (e.g. bank loans) Long pay-back periods High market prices, rental charges Long-term savings are not reflected in service fee structure High cost of sustainable materials and products
Socio-cultural	Lack of knowledge and awareness of GBTs and their benefits Lack of clear benefits of GB Unfamiliarity with GBTs Conflicts of interests among various stakeholders in adopting GBTs Top managerial level does not prioritize environmental benefits Low motivation of workers Distrust in GBTs Lack of interest Resistance to change Lack of demonstration projects
Technological	Lack of GBTs databases and information Lack of reliable GBTs research and education Lack of skilled/experienced staff Longer construction period Difficulties in providing GB technological training Lack of available and reliable GBTs suppliers Lack of integrated work environment Limited experience with the use of non-traditional procurement methods Lack of tested and reliable GBTs Complexity and rigid requirements involved in adopting GBTs Difficulties managing/supervising construction process
Legal	Fewer GB regulations available Insufficient GB rating systems and labeling programs available Lack of technical standard procedures for green construction Difficulties adapting of the certification system

Table A.2 Drivers of green building adoption according to PESTLE

Political	Government support Positive company image and reputation Subvention Tax policy Political stability Customs policy
Economic	Reduced lifecycle costs Attract premium clients High rental returns Improvement in the national economy Better ways to measure/account for cost Importance of materials manufacturers New partnerships and project stakeholders Increased building value Real estate prices Interest rates Exchange rates Inflation rates Average income per Capita Recognition of commercial buildings as productivity assets
Socio-cultural	Improved occupants' health, comfort, and satisfaction Better workplace environment Attract quality employees and reduce employee turnover Improved performance of job creation Facilitation of practice sharing Educational programs Commitment to social responsibility Increase of awareness New customer needs Population growth and its demographic structure
Technological	Efficiency in construction processes and management practices Product and/or material innovation Integrated building design approach
Legal	Construction standards/Urban planning policies GB rating systems Green design guidelines Performance-based standards and contracts
Environmental	Energy-efficiency Water-efficiency Low environmental impact Better indoor environmental quality Reduced construction and demolishing wastes Preservation of natural resources Preservation of non-renewable energy sources Commitment to environmental sustainability

Appendix B

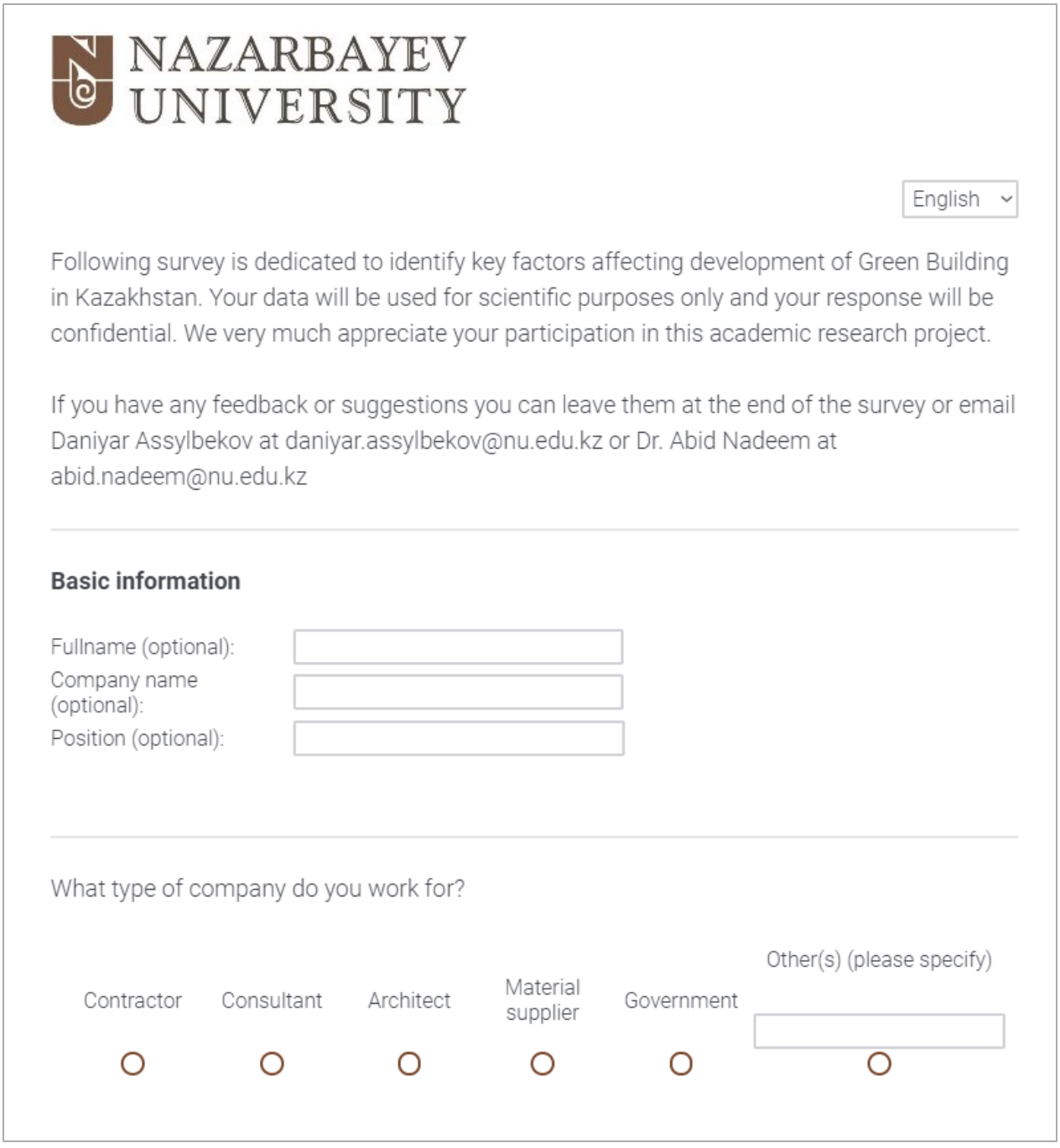


Figure B.1 Questionnaire survey screenshot 1

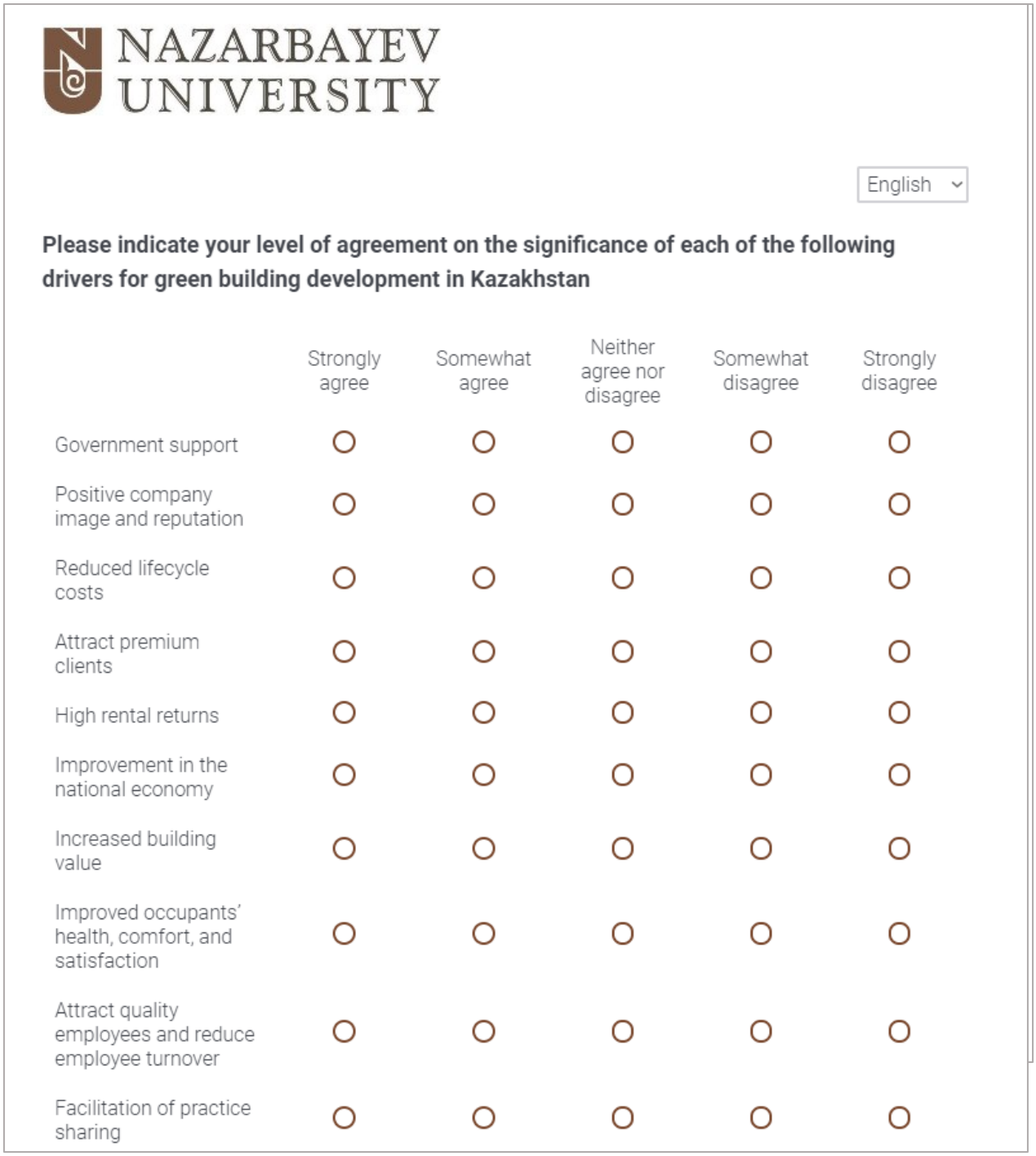
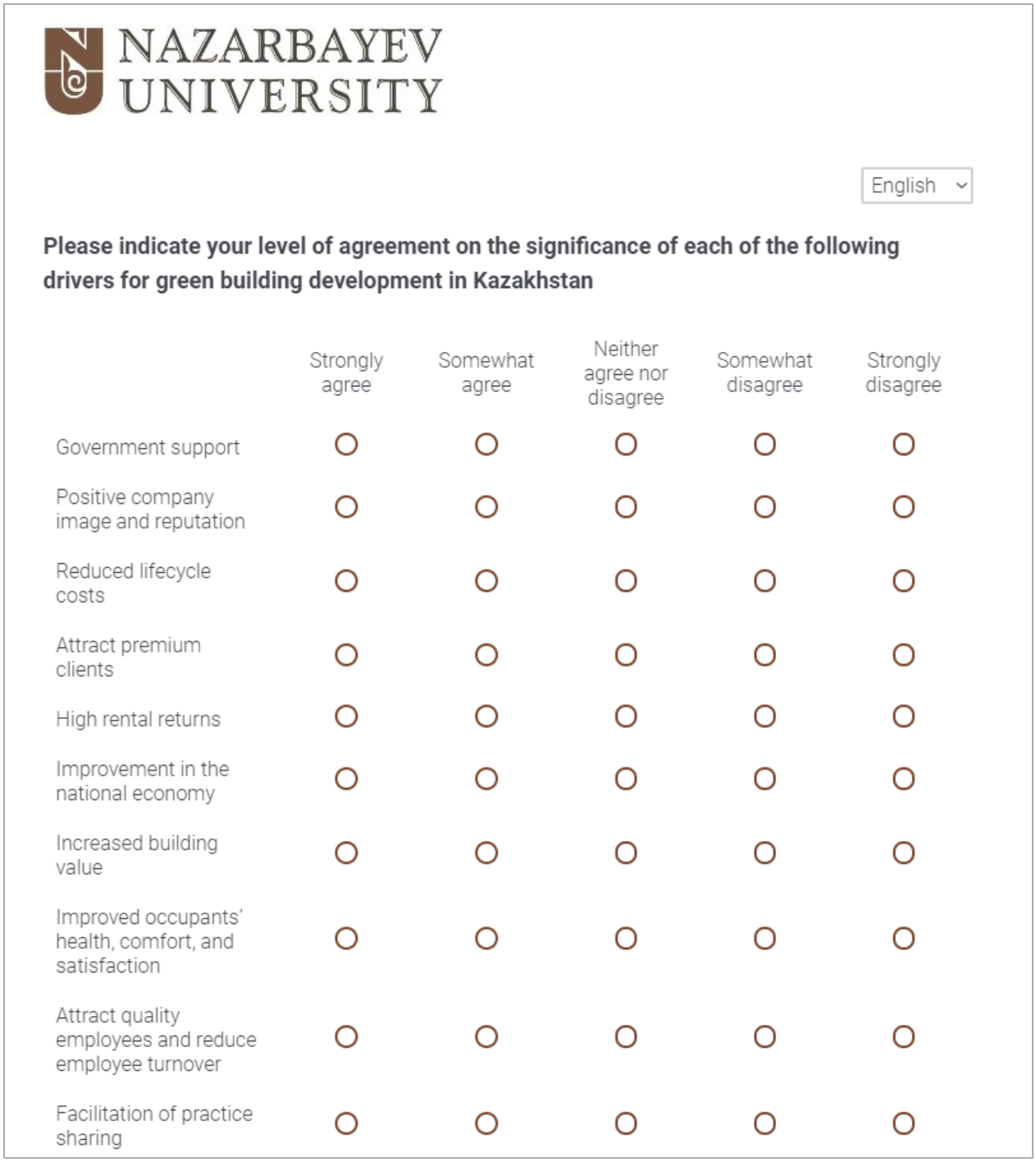


Figure B.2 Questionnaire survey screenshot 2


NAZARBAYEV UNIVERSITY

English

Please indicate your level of agreement on the significance of each of the following drivers for green building development in Kazakhstan

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Government support	○	○	○	○	○
Positive company image and reputation	○	○	○	○	○
Reduced lifecycle costs	○	○	○	○	○
Attract premium clients	○	○	○	○	○
High rental returns	○	○	○	○	○
Improvement in the national economy	○	○	○	○	○
Increased building value	○	○	○	○	○
Improved occupants' health, comfort, and satisfaction	○	○	○	○	○
Attract quality employees and reduce employee turnover	○	○	○	○	○
Facilitation of practice sharing	○	○	○	○	○

Figure B.3 Questionnaire survey screenshot 3

Figure B.4 Questionnaire survey screenshot 4

Please indicate how critical each of the following barriers is to green building development in Kazakhstan

	Not critical	Less critical	Neutral	Critical	Very critical
Lack of government support	○	○	○	○	○
Higher costs of GBTs	○	○	○	○	○
Lack of market demand	○	○	○	○	○
Risks and uncertainties involved in implementing new technologies	○	○	○	○	○
Economic state	○	○	○	○	○
Long pay-back periods	○	○	○	○	○
Lack of knowledge and awareness of GBTs and their benefits	○	○	○	○	○
Conflicts of interests among various stakeholders in adopting GBTs	○	○	○	○	○
Resistance to change	○	○	○	○	○
Lack of GBTs databases and information	○	○	○	○	○
Lack of reliable GBTs research and education	○	○	○	○	○
Lack of skilled/experienced staff	○	○	○	○	○

Figure B.5 Questionnaire survey screenshot 5

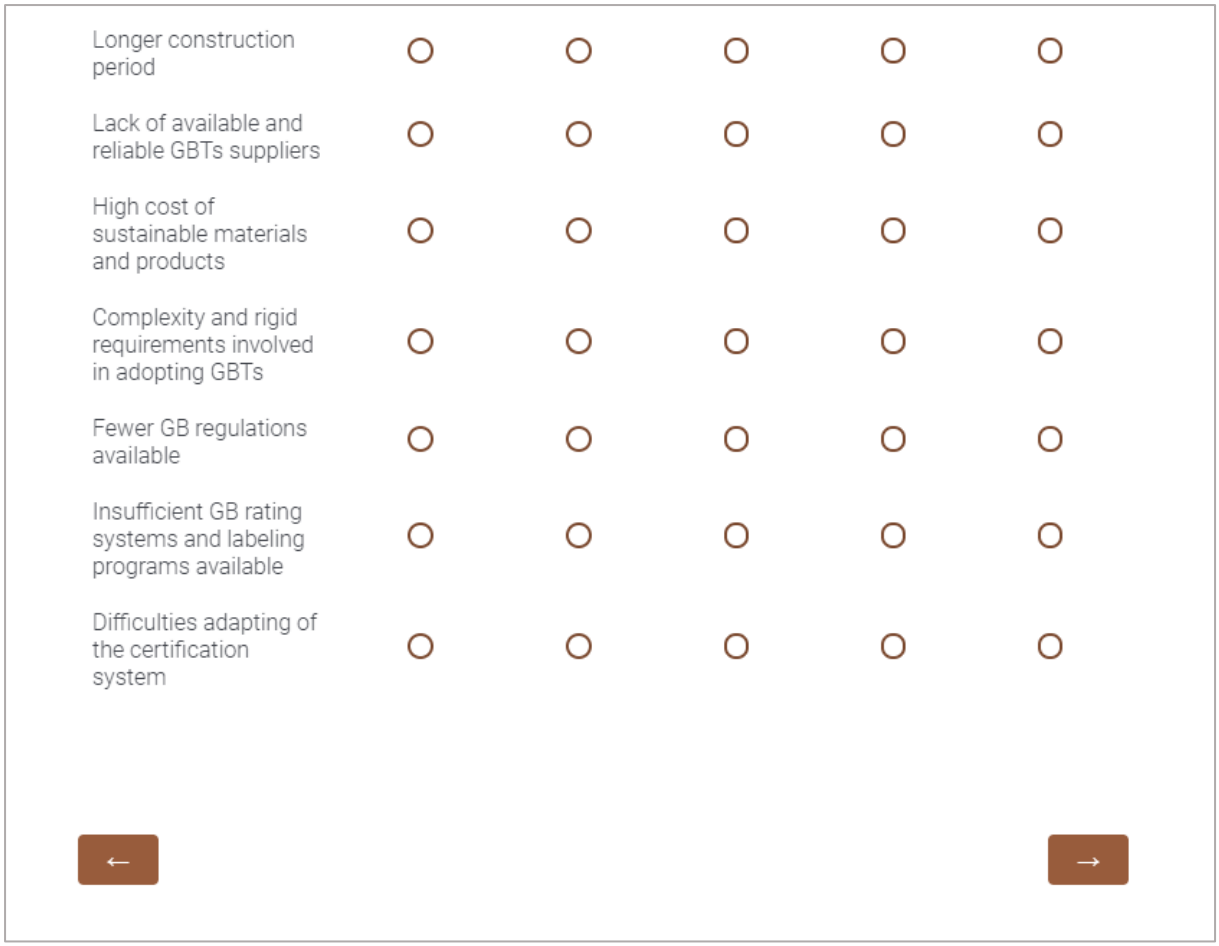


Figure B.6 Questionnaire survey screenshot 6

Figure B.7 Questionnaire survey screenshot 7

Appendix C

Table C.1 Raw questionnaire respondents' profile data.

N	Company type	Profession type	Experience in the construction industry	Experience in green/sustainable construction	Experience in green building projects in Kazakhstan
1	Contractor	Engineer	1-5 years	Yes	Yes
2	Contractor	Project manager	1-5 years	No	No
3	Consultant	Consultant	6-10 years	Yes	Yes
4	Other(s) (please specify)	Other(s) (please specify)	1-5 years	No	No
5	Contractor	Engineer	1-5 years	No	No
6	Contractor	Other(s) (please specify)	1-5 years	Yes	No
7	Government	Project manager	6-10 years	Yes	Yes
8	Government	Academic/Researcher	More than 10 years	Yes	Yes
9	Consultant	Consultant	1-5 years	Yes	Yes
10	Contractor	Engineer	1-5 years	No	No
11	Contractor	Engineer	1-5 years	Yes	Yes
12	Other(s) (please specify)	Engineer	1-5 years	No	No
13	Other(s) (please specify)	Engineer	1-5 years	No	No
14	Other(s) (please specify)	Engineer	1-5 years	No	No
15	Other(s) (please specify)	Consultant	1-5 years	Yes	No
16	Architect	Architect	More than 10 years	Yes	Yes
17	Contractor	Engineer	1-5 years	Yes	Yes
18	Other(s) (please specify)	Other(s) (please specify)	More than 10 years	Yes	Yes
19	Contractor	Engineer	1-5 years	Yes	Yes
20	Contractor	Engineer	1-5 years	No	No
21	Consultant	Other(s) (please specify)	1-5 years	No	No
22	Consultant	Project manager	More than 10 years	Yes	Yes
23	Contractor	Engineer	6-10 years	No	No
24	Contractor	Engineer	1-5 years	No	No
25	Government	Other(s) (please specify)	More than 10 years	No	No
26	Consultant	Engineer	More than 10 years	Yes	Yes
27	Government	Consultant	1-5 years	Yes	No
28	Government	Engineer	More than 10 years	Yes	Yes
29	Financial-investment	Other(s) (please specify)	More than 10 years	Yes	Yes
30	Contractor	Project manager	More than 10 years	Yes	Yes
31	Other(s) (please specify)	Project manager	1-5 years	Yes	Yes
32	Contractor	Consultant	More than 10 years	No	No
33	Other(s) (please specify)	Consultant	1-5 years	No	No
34	Material supplier	Academic/Researcher	6-10 years	Yes	Yes
35	Contractor	Other(s) (please specify)	1-5 years	No	No
36	Contractor	Engineer	1-5 years	No	No
37	Financial-investment	Project manager	1-5 years	Yes	Yes
38	Consultant	Consultant	1-5 years	No	No

Table C.2 Raw questionnaire drivers data.

N	D01	D02	D03	D04	D05	D06	D07	D08	D09	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22
1	5	5	5	5	5	4	4	4	5	5	4	4	4	4	4	5	5	5	5	5	5	5
2	5	5	4	4	5	2	5	5	4	5	5	5	3	5	5	5	5	5	5	5	5	5
3	3	4	3	4	3	3	4	4	3	3	3	4	4	3	3	3	4	4	3	4	3	3
4	2	4	5	2	2	4	4	5	4	4	4	4	5	4	3	3	5	5	5	5	4	4
5	4	4	3	5	4	4	5	5	3	4	4	5	4	5	3	2	4	4	2	2	2	4
6	5	4	4	5	4	3	4	5	5	5	3	5	5	5	5	5	5	5	4	4	5	4
7	4	5	4	4	4	3	5	5	5	5	5	5	4	4	4	4	5	5	5	5	5	5
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10	5	5	5	1	5	5	1	5	5	3	5	4	5	5	5	5	5	5	5	5	5	5
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12	4	3	4	4	5	5	3	5	5	4	4	4	3	4	3	4	5	5	5	3	5	5
13	5	5	5	5	4	5	5	4	4	4	4	4	4	4	5	3	4	4	4	4	4	4
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37	5	3	4	3	4	4	4	4	2	5	5	5	5	5	5	4	5	5	5	5	3	3
38	4	4	5	3	5	4	2	5	4	3	3	3	3	5	4	4	5	5	3	5	4	4

Table C.3 Raw questionnaire barriers data.

N	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19
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3	3	3	2	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3
4	3	2	3	3	3	3	5	3	3	3	3	3	3	3	3	3	3	3	3
5	3	3	3	3	5	5	3	3	3	2	3	3	3	3	5	3	3	3	3
6	5	3	5	3	5	5	3	5	3	3	3	2	2	3	5	5	3	2	3
7	3	3	3	5	5	3	3	3	5	5	5	5	3	3	3	3	3	3	5
8	5	5	5	3	5	5	3	2	2	3	3	3	1	2	5	2	3	3	1
9	5	3	3	1	3	1	5	2	3	1	1	3	1	3	3	1	5	1	1
10	5	5	3	3	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5
11	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
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