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VIETNAM GENERAL CONTRACTORS' PERCEPTIONS ON CHALLENGES TO THE DELIVERY OF GREEN BUILDING PROJECTS

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Abstract

This study focuses mainly on investigating differences in Southern and Northern general contractors' perception of challenges in executing green building projects. The questionnaire survey-based data analysis results show that there is a good consensus between general contractors (GCs) from these two regions on the top two most critical challenges in delivering green building projects. They are "lacking of legal regulations and technical codes on green building", and "more difficult to early establish a competent, integrated, and multidisciplinary green building project team". Additionally, the Mann-Whitney U-test reveals that there are a significant difference on perception of the GCs from Northern as compared with those from Southern on the five challenges, including "shortage of reliable green building materials, technologies, and equipment in the market", "lack of reliable suppliers of green products, materials, equipment", "lack of appropriate tools/laboratories specific for testing, assessing, measuring, and inspecting the green performance of construction products", "difficulty in selecting and managing subcontractors", and "difficult in comprehending the green specifications". The study may be beneficial not only for the central policy makers but also for the local governments, industrial practitioners and project stakeholders to gain a better understanding of the major challenges in executing green building projects at local or regional level. As a result, the study proposed many solutions specific for each of these regions to promote the development of the local green building industry.

Keywords: green building project; general contractor; challenges; Southern; Northern; Vietnam.

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1. Introduction

It can be said that the construction industry (CI) is one of the main sectors that has significant negative effects on the sustainability of the natural environment and society. Statistically, CI consumes approximately 40% of the total of energy produced, about 15% of water, 25% of timber, 40% of raw materials available; and it also emits about 40% of solid wastes and CO_2 [1]. In Vietnam, CI consumes over 36% of the total energy consumption and emites about 25% of the total greenhouse gas emission and a third of the total CO_2 emission.

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In order to eliminate the negative impacts of CI, green buildings (GBs) is considered as one of the most strategical solutions; and in fact, there is a considerable increase in the number of GBs built during the past 10 years worldwide [2]. In recent years, the Vietnamese Government has adopted many legal regulations, technical support, financial incentives, training programs to speed up the development of GBs [3]. Up to 09/2022, there have been over 433 certified or registered green buildings nationwide, including 81 LOTUS buildings [4], 301 LEED buildings [5], and 51 EDGE buildings [6]. It is worth noting that there is an unbalanced development of GBs in different regions across the country. These green certified or registered GBs were unevenly distributed in 41 of the total of 64 provinces; and almost of them are in Ho Chi Minh (with 141 buildings), Hanoi (63 buildings), Binh Duong (42 buildings), Dong Nai (33 buildings), Long An (22 buildings), Bac Ninh (20 buildings), Hai Phong (10), Quang Nam (10), Hung Yen (10), and Tay Ninh (10). These ten provinces have accounted for over 83.3% of the total of existing GBs (respectively 361 green buildings). Among these, provinces in Northern have 129 buildings (account for about 29.8%), provinces in the Central have only 24 buildings (respectively about 5.5%), and provinces in Southern have 283 buildings (account for appropriate 64.7%) (see Fig. 1). In addition, although the number of GBs in Vietnam is considerably increasing in recent years; this trend is still criticized being very slow as compared to other countries, such as Singapore (more than 5000 Green Mark certified projects), Taiwan (more than 3000 certified green buildings).

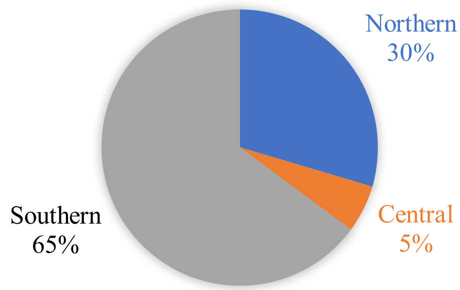


Figure 1. Number of green buildings in each region

Therefore, it is important to find out and implement suitable and effective solutions or means to promote the development of GBs in each region of Vietnam [7]. GB projects are inherently different from conventional building projects in terms of both technical and managerial issues [8, 9]. GB projects often adopt new, innovative, and environmentally friendly building technologies and involve a very large number of the business relationships amongst different stakeholders, such as client, designer, contractors, suppliers, green specialists, and relative state agencies. These bring out many challenges in executing such projects [2, 10–12]. At present, there have been several studies on barriers, challenges, drivers and successful factors of GB projects at the whole country level but little attention paid upon how much difference on perception of these factors at the various regions across the country. In order to develop the GB industry, it is critical to consider local factors in terms of climate, culture, public awareness, market of green building technologies, and technique and science infrastructure. Additionally, the previous studies focused mainly on the perspectives of investors, project managers, designers but not much on that of contractors.

In order to fill the gap, this study seeks to gain a better understanding about how different perceived challenges in executing GB projects among GCs from Northern vs. Southern in Vietnam. The role of GCs is extremely important for ensuring the greenness and sustainability of GB projects through their active and full collaboration and coordination [13, 14]. Therefore, the study's findings provide valuable practical implications for the central government, local governments, industrial practitioners and project stakeholders in ensuring the success of GB projects as well as the development of the GB industry in the future.

2. Literature review

GB projects are expected to gain not only traditional goals in terms of cost, schedule, quality, safety but also the life cycle goal of environmental sustainability, efficiency in energy, water, and other resources. Such projects have many different characteristics in comparison with traditional ones, such as using sustainable materials, environmentally friendly equipment and practices, executing more complicated construction processes, using an integrated design process, and requiring a more interdisciplinary cross-team collaboration [2, 15]. Therefore, GB projects face many challenges that are very different from those what conventional projects face.

Previous studies have investigated various challenges in terms of contract, human resources, technology, schedule, and budget in executing GB projects in both developed and developing countries [2, 16–21]. A review of Hwang and Ng [16] points out critical challenges facing GB project managers including higher construction costs, more difficult construction techniques, higher risk in contract management, higher risk in project schedule and budget management, unfamiliarity with new GB technologies, more complicated communications, and more technical changes and more time required to complete green construction practices onsite. The study of Li et al. [9] found out that construction firms in Singapore are presently facing many challenges to successfully deliver GB projects, such as lacking in commitment of all project participants, lacking in skilled designers and project managers, lacking in adequate communication channels, and lacking in financial budget. Besides, Robichaud and Anantatmula [22] cited that lacking of appropriate tools, equipment or lacking of third-party units to test and validate green products were one of the critical challenges in delivering GB projects. The study of [23] stated that it is necessary that all project practitioners should develop additional skills that might not yet have been required in their previous professional works, such as critical thinking, interdisciplinary cross-team collaboration, and a better understanding of natural processes. In GB projects, improved communication channels among stakeholders is considered as one of the key requirements to effectively manage changes and mitigate risks and unexpected costs [22].

In the context of Vietnam, there have been a few relevant studies on GB conducted; for instance, Nguyen et al. [3], Dung, et al. [7], Pham et al. [13], and Pham et al. [24]. In general, many considered challenges in delivering GB projects were discovered, such as lacking in legislative regulations, lacking in GB technical codes, standards, guidelines, lacking in competent consultants and general contractors to execute GB projects, and limited market of sustainable materials and products.

In summary, the literature review provided a list of 31 potential challenges in delivering GB projects (Table 1). These past studies tend to focus primarily on investigating country-specific but not smaller region level challenges. As a result, the present study focuses on investigating GB project challenges at the smaller region level within a country and thereby potentially provide more practical implications as well as enrich the body of knowledge for delivering GB projects.

Table 1. Potential challenges in delivering GB projects

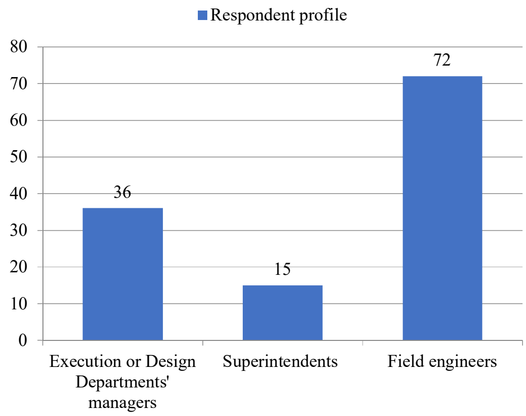
Code	Challenges	References
C1	Difficult in establishing a quality management system	[2, 3, 13, 16]
C2	Difficult in comprehending the green specifications	[16, 18, 22]
C3	Difficult in assessing quality; monitoring and surveying technical parameter onsite	[3, 16]

Code	Challenges	References
C4	Difficult in controlling and inspecting quality of materials, equipment, structural components	[3, 13, 16]
C5	Difficult in designing construction technique methods	[3, 16]
C6	Difficult in designing a plan of inspection and acceptance for building tasks, works	[9, 13, 25]
C7	Difficult in establishing a competent, multidisciplinary project team	[16, 17, 22]
C8	Lack of competent project managers, superintendents, and engineers on GB	[7, 13]
C9	Lack of skilled employees on GB	[7, 9, 16, 25]
C10	Lack of appropriate tools/laboratories specific for testing, assessing, measuring, and inspecting the green performance of construction products	[26]
C11	Lack of appropriate tools/equipment to conduct green construction practices onsite	[9, 26]
C12	Lack of appropriate guidelines specific for conducting green construction practices onsite	[3, 16, 18]
C13	Require a larger financial resource for GB projects	[9, 27]
C14	Lack of legal regulations and technical codes on GB	[17, 18]
C15	Lack of GB cost estimated norms	[7, 13]
C16	Cost sensitive of GB activities	[3, 16, 27]
C17	Conflict of interest among project stakeholders	[3, 16, 27]
C18	Unforeseen circumstances in GB projects	[3, 26]
C19	Time to implement green construction practices onsite	[9, 26]
C20	Alteration and variation during green construction process	[13, 16, 27]
C21	More communications and collaboration are required among project team members	[13, 16, 26]
C22	Difficult in preparing construction documents	[13, 16, 22]
C23	Government incentive policies are not clear, ineffective	[3, 13, 16, 27]
C24	Client's budget plan	[3, 26]
C25	Shortage of reliable GB materials/equipment in the market	[7, 13]
C26	Lack of reliable green suppliers	[7, 13, 16]
C27	Difficulty in selecting and managing subcontractors	[3, 13, 27]
C28	Low level of officials' GB awareness	[7, 13]
C29	Low level of users and public's GB awareness	[3, 13, 27]
C30	Lack of financing schemes (e.g., bank loans, surety bonds)	[7, 13]
C31	Lack of insurance for GB projects	[9, 25]

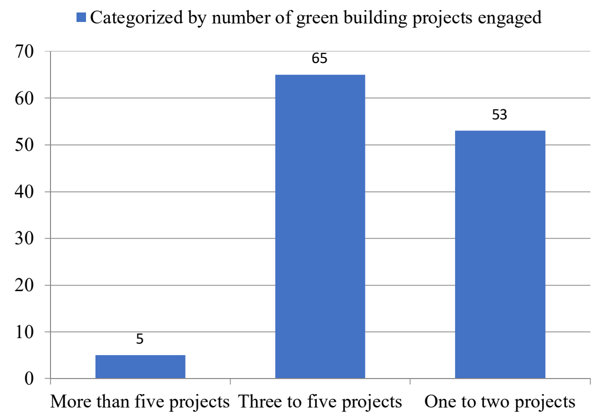
3. Research Methodology

3.1. Data collection

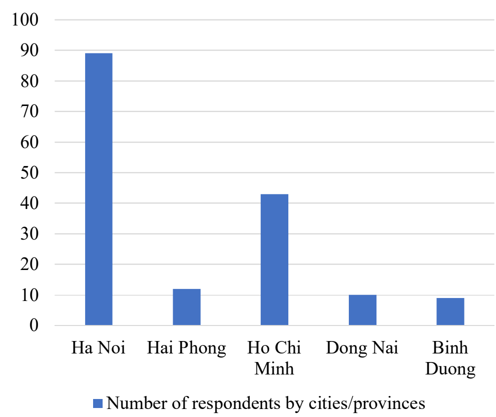
First of all, the survey questionnaire is designed and reported in detail in Tran [28] and Tran and Huang [29] - two publications belonging to the same research project. The procedure to collect data is also reported in full in the two mentioned publications. Since the present study aims to gain a better understanding about how different general contractors' (GCs) perceived challenges in executing GB projects between Northern vs. Southern in Vietnam, the respondent profiles are analyzed by their profession, number of GB projects engaged, and geography (see Fig. 2).



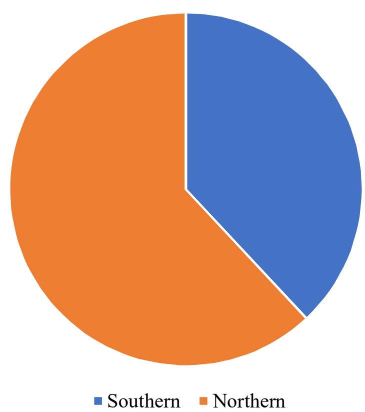
(a) Categorized by professions



(b) Categorized by number of green building projects engaged



(c) Number of respondents by cities/provinces



(d) % respondents by Southern vs. Northern

Figure 2. Respondent profiles

Accordingly, most of the respondents held senior positions in their enterprises. They all reported that they have involved in actual (certified or registered) GB projects in the past time; in which about 55% of them engaged with more than 3 GB projects. Out of the 163 responses available for further analysis, 62 ones (equivalently about 38%) were from Ho Chi Minh city, Binh Duong, and Dong Nai (belonging the Southern) and the remaining (about 62%) was from Hanoi, Bac Ninh and Hai Phong (belonging the Northern). These six cities/provinces are the areas having the highest number of certified or registered GBs in Vietnam. Therefore, it can be said that the reliability of the study is high.

3.2. Data analysis

The data was analyzed by using the SPSS statistical package. First of all, the data collected from each of the regions (Southern vs. Northern) was statistically tested for their reliability and credibility through the *Cronbach's Alpha coefficient*. The α value ranges from 0 to 1; the higher the value, the higher the reliability of the data. In common, an α value above 0.7 is acceptable.

In order to conduct the intended analysis of the present study, the experts were categorized into two main groups: experts from Southern and those from Northern. It can be assumed that these two categories may have different opinions on what are the main challenges in executing GB projects. First, Kendall's coefficient of concordance test (*Kendall's W*) was used to examine the agreement between respondents within each particular geographical region on their rankings of the challenges. The null hypothesis of the W-test is that "there is no consensous among the rankings given by the experts within each group". If the significance level of the Kendall's W value is low (less than 0.001) then the null hypothesis can be rejected. And therefore, it can be said that there is agreement among the experts within each group in ranking the challenges. As acknowledged, the W-test does not require any prior assumption on data distribution; however, this test is considered being more suitable if the number of objects to be ranked (N) is less than or equal 7. In the case of more than 7 and sample size is greater than 20, Chi-square test is adopted as the best option for a near approximation. Chi-square provides an approximate distribution with N-1 degrees of freedom (df) for determining the significance of an observed W. In this study, N = 31 and sample sizes were 101 and 62 for the group of Southern and Northern, respectively; therefore, Chi-square test was adopted.

Then, the mean values were calculated and ranked for each of the two groups to determine the relative importance of individual challenges. The statistical t-test of the mean values at a significant level of 0.05 and against a test value of 3.5 (on the Likert scale of 5 points) were adopted to consider whether each challenge was significantly important.

Furthermore, the *Mann-Whitney U-test* was adopted to examine whether or not there was any statistically significant difference amongst the two groups of Southern respondents vs. Northern respondents on each of the challenges. It is worth noting that the U-test does not require any prior assumption on data distribution; and this test can be used even in the case of the sample sizes of various groups being different [1]. The U-test converts the scores on each continuous measure to ranks across two groups; then assesses whether or not the ranks for the two groups significantly vary. The H_0 of the U-test is that 'there is no difference between two groups'. The H_0 will be rejected if the U value exceeds its critical value at $a \leq 5\%$ significance level. The W-test and U-test were also adopted by many previous studies with similar research objectives; for example, Darko et al. [1], Shi et al. [30], Chan et al. [31].

4. Results and discussions

4.1. Credibility and reliability of data collected from each of groups

The Cronbach's alpha coefficient (α) was calculated for the 31 challenges in executing GB projects. In this study, the α values for the 31 challenges for data collected from Southern vs. Northern were 0.834 and 0.795, respectively (both greater than 0.7 – an acceptable threshold of α). This indicates a good reliability and credibility of the data collected from each of the regions at the 5% significance level; and therefore the data surveyed from each group can be treated as a whole, and suitable for further analyses (e.g. ranking analysis).

4.2. Results of ranking analysis on the two respondent groups

In order to examine whether or not various respondents within each of the Southern vs. Northern groups agreed on the ranking of challenges, the Kendall's W-test and Chi-square test were conducted (see Table 1). In accordance, the results indicated that there was statistically significant agreement between experts in each group on ranking the challenges in delivering GB projects.

Table 2. The result of mean ranking analysis and Mann-Whitney U-test on challenges in delivering green building projects by general contractors from Northern and Southern in Vietnam

Code of challenges	Group "Northern"		Group "Southern"		Mann-Whitney *U-test*			
	M	R	M	R	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
C1	3.83	17	3.62	18	959.521	1059.521	−0.589	0.105
C2**	3.79	19	3.90	4	1124.356	2024.346	−1.592	0.035***
C3	3.90	8	3.82	8	1243.265	1043.460	−0.248	0.942
C4	3.90	8	3.79	10	1077.579	2070.579	−3.019	0.348
C5	3.65	26	3.56	26	947.905	1047.900	−2.075	0.999
C6*	3.25	31	3.23	30	1323.005	2323.099	−0.335	0.313
C7	4.25	2	3.92	2	1005.950	2105.007	−0.979	0.320
C8	3.38	27	3.85	7	998.093	3098.013	−2.379	0.113
C9	3.80	20	3.59	20	1000.059	2599.050	−2.584	0.218
C10**	4.19	5	3.52	28	1300.103	1990.152	−2.595	0.039***
C11	3.24	30	2.77	31	1211.098	1911.090	−2.248	0.793
C12	3.85	16	3.87	5	999.920	1091.947	−3.219	0.354
C13	3.37	29	3.49	29	1003.302	1773.002	−2.975	0.191
C14	4.34	1	3.94	1	1119.245	1829.220	−0.785	0.298
C15	3.90	8	3.86	6	1270.359	2270.355	−0.449	0.535
C16	3.69	22	3.57	24	949.321	1049.320	−2.379	0.654
C17	3.78	21	3.58	22	1144.856	1845.878	−3.589	0.369
C18	3.72	23	3.59	20	1213.295	2713.290	−2.692	0.357
C19	3.84	15	3.60	19	1012.479	1812.479	−1.748	0.259
C20	3.90	8	3.80	9	948.9/005	2889.005	−0.819	0.123
C21	3.84	18	3.63	16	1303.705	3303.704	−2.975	0.458
C22	3.92	7	3.88	3	1115.050	2015.010	−0.535	0.565
C23	3.66	25	3.57	24	994.053	3294.053	−0.279	0.890
C24	3.38	27	3.64	15	1004.159	2004.159	−4.379	0.900
C25**	4.21	4	3.65	14	1340.103	2390.111	−2.589	0.034***
C26**	3.97	6	3.56	26	1241.058	2541.754	−0.592	0.028***
C27**	4.22	3	3.63	17	941.927	271.928	−3.048	0.026***
C28	3.88	12	3.77	11	1217.102	2217.240	−2.419	0.273
C29	3.87	13	3.72	12	1219.745	3219.777	−1.075	0.212
C30	3.87	13	3.70	13	1170.659	3150.898	−0.535	0.325
C31	3.68	24	3.58	22	1001.278	2001.778	−1.979	0.431
Kendall's W[a]	0.303		0.273					
Chi-Square	313.12		350.02					
df	31		31					
Level of significance	0000		0000					

Note: M: Mean; R: Ranking; '*' Data with insignificant results of one-sample t-test ($p > 0.05$) (2-tailed); "**" The challenges which received the significant difference in their rankings ranked general contractors from Southern vs. Northern. "***" Data with significant results of Mann-Whitney *U-test*.

"*a*" Kendall's Coefficient of Concordance test on the challenges amongst the two respondent groups;

The mean values of relative importance/criticality of challenges in delivering GB projects given by experts from each of the two groups of Vietnam Southern vs. Northern were calculated (see Table 2). In addition, the statistical t-tests of the mean values against a test value (i.e. 3.5) were used to evaluate whether or not each challenge was significantly important at a significance level of 0.05 (also see Table 2). Accordingly, GCs from both two regions perceived that the challenge C6 was not statistically significant. In addition, there is a good consensus between GCs from these two regions on the Top Two most significant challenges across the country, including "lack of legal regulations and technical codes on GB" (C14) and "more difficult to early establish a competent, integrated, multidisciplinary GB project team" (C7) (see Table 2).

On the other hand, the challenges "lack of appropriate tools, equipment to conduct construction activities onsite ensuring the defined green performance" (C11), "more difficult to design a good plan on inspection of and acceptance for the construction tasks and the work items" (C6), and "require a larger finance for GB projects" (C13) were perceived as the three least critical challenges in executing green building projects by GCs from both Northern and Southern.

4.3. *Result of difference analysis between the two expert groups of Southern vs. Northern on their rankings*

As mentioned above, the U-test has been adopted to identify any significant differences between the two expert groups on their ranking of challenges. The analysis result in Table 2 showed that the five challenges: "Shortage of reliable green building materials, technologies, and equipment in the market" (C25), "lack of reliable suppliers of green products, materials, equipment in the market" (C26), "lack of appropriate tools/laboratories specific for assessing and measuring the green performance of construction products" (C10), "difficulty in selecting and managing subcontractors" (C27), and "difficult in comprehending the green specifications" (C2) have significant differences between the two expert groups. GCs in Northern perceived the challenges C25, C26, C27, and C10 as much more critical than GCs in Southern. In contrast, GCs in Southern considered the challenge C2 as much more critical than GCs in Northern. In detail, with C25, C26, C27 and C10, while the Northern GCs ranked them fourth, sixth, third, and fifth with high mean values of 4.21, 3.97, 4.22, and 4.19, respectively; the Southern GCs ranked C25, C26, C27 and C10 fourteenth, twenty-sixth, seventeenth, and twenty-eighth with a mean values of 3.65, 3.56, 3.63 and 3.52, respectively. Regarding the challenge C2, the Northern GCs only ranked it nineteenth with the mean value of 3.79 while the Southern GCs ranked it fourth with the mean value of 3.90.

For the remaining 20 challenges, significant differences were not discovered between the two groups. This is reasonable since the mean values and ranks were very close across the two groups for these challenges (see Table 2).

4.4. *Discussion*

a. Consensus between GCs from Northern and Southern in their ranking on challenges

First of all, the general contractors from both Southern and Northern together perceived that "lack of legal regulations and technical codes on GB" (C14) was the most critical challenge in delivering GB projects. This is really not surprising because until now, only a few codes on non-baked building materials and the National Technical Code on Energy Efficiency Buildings (namely QCVN 09:2017/BXD) were issued. However, they have been also criticized as to be not yet comprehensive, difficult to obey, and therefore not fully enforced in this country [32, 33]. This result is also agreed with previous studies. For example, the studies of [34, 35] explored that the system of legal documents on GB in Vietnam is not yet holistic. Nguyen et al. [3] empirically found that the lacking of technical codes to guide sustainable construction activities was one of the most influential barriers to adopting GB technologies in Vietnam. This finding is also consistent with other empirical studies, such as Tran et al. [36], Hwang and Tan [2], and Mohammadi and Birgonul [17]. This result implies that the Vietnamese government should speed up establishing a clear and comprehensive system of legal regulations and technical codes on GB based on the life cycle perspective of construction projects. Such regulations and codes should focus on all various aspects of green and sustainable criteria for both private and public construction projecgovernment ts. In general, different green building rating systems such as LOTUS, LEED define green criteria for green buildings including energy efficiency, water efficiency, sustainable materials and resources, health and comfort, site and environmental, and facility management and operation. Additionally, the government should also establish regulations of license of green building experts as well as incentive policies and regulations to build and operate laboratories for green efficiency assessment of construction materials or products. Especially, it is important to establish a holistic managerial system of the market of such green products. This system must define clearly processes, procedures of assessment, certification, and label of green products/equipment/materials. Besides, relative professional associations and local state agencies must pay much more attention on researching, developing and issuing technical standards/guidelines, cost estimated norms that are specific to local characteristics to more effectively help in delivering green building projects. Many standards/guidelines should be prioritized to establish, such as technical standards of local green construction materials; guidelines on assessing, testing, inspecting and acceptance of green efficiency of construction products, materials, and equipment, and tools; a guideline of standardized GB project delivering framework; a guideline of integrated design process (IDP), etc. Finally, the government needs to establish the benchmark of energy consumption for the main types of buildings, such as hospitals, offices, schools, and commercial buildings.

The second most critical challenge in delivering GB projects perceived by the GCs from both the two regions was “more difficult to early establish a competent, integrated, and multidisciplinary GB project team” (C7). This finding is very reasonable because the GB industry is arguably new and not yet developed across Vietnam [3, 34, 35]. Up to now, there have been only appropriate 430 certified or registered GB buildings in Vietnam; this reflects an unexpected fact that there exists a big shortage of skilled and experienced managers, engineers, consultant experts, and workers on GB and sustainable construction [3, 34, 35]. Delivering GB projects requires to early establish a project team to conduct multidisciplinary collaboration and coordination from the very early phases of such projects. A GB project team should consist of skilled and much experienced experts on green construction; it can include project managers, designers, structural engineers, field supervisors, field managers, subcontractors, and specialists of GB certification, even facility managers, and other members. These members must be equipped with good knowledge, skills, and experience on GB (Robichaud and Anantatmula [22]). As known, GB projects often require a higher level of GB competency of all project team members. The members must work closely together throughout phases of a GB project to get a clear and smooth understanding of the green goals defined, to effectively respond to unexpected changes as well as to plan and deliver the most suitable practices to achieve the project goals. It is extremely important to develop and maintain a more collaborative teamwork between a GC and its subcontractors, consultants, suppliers, and other stakeholders for executing GB practices onsite [9, 26]. Such stakeholders need to have a good capacity in terms of human, management, and technology to implement green construction practices. The studies of [25, 37] found out that lack of competent green construction units as well as lack of skilled labor were the critical barriers to delivering GB projects in the US, Malaysia, and China. It can be said that this also really brings out Vietnamese GCs considerable challenges in delivering GB projects at present [16, 17]. This finding implies that education and training efforts are very necessary to respond to the situation of lack of skillful and knowledge labor resources on green construction. Besides, the government should also take a pioneering role by investing and procuring public green building projects. With such projects, it should consider to invite international contractors, consultants, project managers those who are much experienced and skillful on GB to participate and collaborate with domestic units. Such projects will bring valuable practical chances to domestic construction enterprises to practice and improve their capacity for green construction. The more green public building projects, the more developed the market of green construction labor resources.

b. Difference between GCs from Northern vs. Southern in their ranking on challenges

There is a statistically significant difference between GCs from Northern vs. Southern in ranking the five challenges in executing GB projects. GCs in Northern perceived the challenges which relate to the availability and reliability of green building materials, technologies, and equipment as well as the suppliers of these things in the market to be much more critical than what GCs in Southern perceived. Additionally, the Northern GCs also perceived the challenge related to the shortage of competent subcontractors to conduct green construction activities to be much more critical than what GCs in Southern perceived. These findings can be explained because of the fact that the GB industry in Northern is not yet developed as much as in Southern; and this development is also uneven among the provinces in this region. The number of GBs in this region is only 129 buildings, accounting for less than 30% of the total number of GBs nationwide and they are very thinly distributed in twelve provinces. As the GB industry has not yet been developed, the demand for green building technologies, products, materials is low; and so that the market of green buildings products is not available and reliable. And since the number of GBs built are small, the practical chance to execute green construction activities on site is relatively rare. This makes the industry lacks experienced construction units including subcontractors, consultants, and green certification experts. These findings imply that in order to speed up the development of the GB industry in Northern, it is necessary to pay special attention to establishing suitable incentives, policies to effectively promote the market of green products, material, equipment, and other green technologies. Equal importantly, the local governments in this region need to promote the scientific research activities on design and manufacturing new green products/materials/equipment which must be more suitable to local weather, economic, and cultural conditions as well as using maximumly advantages of local raw resources. Besides, the local governments in Northern provinces also need to establish their own policies to promote greenness and sustainability of the state-budget building projects. Such these projects will play an important role as a starting motor in pulling the local GB industry moving toward more green and sustainable; and they also serve as places to providing more chances for the local construction enterprises to practice green construction activities. As a result, the green construction capacity of the whole local construction industry will be improved, especially general contractors, subcontractors, designers, and consultants.

Additionally, the Southern GCs perceived that they are facing more difficulty to comprehend the green specifications during the delivering process of GB projects. As mentioned, a large number of the GBs (accounted for appropriate 65%) is based in Southern; this fact implies that the GCs in this region seem to have more opportunity to participate in delivering GB projects. However, it is necessary to notice that the GBs built are of many different types of buildings, including industrial factories, commercial buildings, schools, offices, resident apartments, villas, single resident houses... This fact seems to set the Southern GCs reluctantly to work with many different green technologies/products/materials. This experience may make the GCs seem to feel not familiar and face more difficult to comprehend the green specifications. This finding indicates that it is important to develop a comprehensive system of technical guidelines and standards of green building technologies.

5. Conclusions

In order to promote the development of GBs widespread in each region as well as the whole nation, this study focused mainly on investigating differences between the Southern versus Northern GCs' perception of challenges in executing GB projects. The present study contributes to the development of the GB literature by focusing on the perspective of GCs in smaller regions rather than GCs in a whole country. The study found out that there exists a consensus as well as a significant difference among GCs from Northern vs. Southern in their ranking on the total of 31 challenges in executing GB projects. As a result, the study proposed many solutions specific for each of these regions to promote the development of local GB industry.

Since the study was designed based on the broad literature and GCs from many provinces of each region were engaged, the study's findings may be generalizable. The findings can be beneficial not only for the central government but also for the local governments, industrial practitioners and project stakeholders to gain a better understanding of the major challenges in executing GB projects at local or regional level. They are valuable knowledge to help policy makers and practitioners to adopt suitable and effective measures to encourage the development of the GB industry across the country.

Although the objectives of this study were achieved, there are some limitations drawn, such as the sample size was relatively small, samples used only from the Northern and Southern but not yet including the Central. The further research work should make more effort to fill up these limitations.

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