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The effects of sustainable practices and managers' leadership competences on sustainability performance of construction firms

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ABSTRACT

Sustainable practices performed throughout the construction project cycle positively affect the environment, society, and economy – three dimensions of sustainability. Awareness of the importance of sustainable practices' implementation is currently greater than in the past. In this regard, leaders need to integrate sustainability into firm activities, making the business strategy's sustainable development part. However, the understanding of leadership and its linkage to sustainable construction are still limited, thus more work is required to establish the leaders' vital role in the implementation of sustainable practices. To our knowledge, the extant literature still lacks the empirical evidence to prove the relationships among sustainable practices, sustainability performance, and leadership competences of construction managers. Therefore, this study developed a survey questionnaire to collect data and used Structural Equation Modeling (SEM) to empirically investigate the relationships between sustainable practices (environmental, economic, and social) and sustainability performance and the moderating effect of construction managers' leadership competences on these relationships. The findings revealed that environmental, economic, and social practices have the positive influences on sustainability performance. Moreover, this study also discovered that leadership competences strengthen the environmental practices-sustainability performance relationship. However, we did not find the empirical evidence to support the moderating effect of leadership competences on the relationships between economic, social practices and sustainability performance. This study attempts to fill the certain gaps of the sustainable construction literature and provides researchers and construction managers with a deeper understanding of the roles of sustainable practices and construction managers' leadership competences in sustainable construction.

1. Introduction

The construction industry has always been criticized as environmentally unfriendly. Prior research emphasized that traditional construction methods have caused heavy pollution of the environment (Abidin et al., 2015), particularly the construction industry is one of the main sources of carbon emissions (Wu et al., 2012). Main construction players largely feel comfortable with economy-oriented practices of the traditional approach in which resources are abundant and easy to obtain, and eliminating used products is considered cheaper than proper waste management (Esa et al., 2017). This situation leads to a need to mitigate adverse environmental influences of construction projects by implementing environmental practices. Although there are many studies examining the linkage between sustainable practices (SPs) and sustainability performance of construction firms, most of them only focus on one dimension of SPs (environmental, economic, or social) or one pillar of sustainability performance, for instance, the relationships between environmental management practices and financial performance or economic performance (Chen et al., 2016; Yusof et al., 2016; Awang and Iranmanesh, 2017; Li et al., 2019). Meanwhile, some authors only investigate the connections between social practices and social performance or financial performance of construction firms (e.g. Huang and Lien, 2012; Bamgbade et al., 2017; Loosemore and Lim, 2017; Lu et al., 2018). It is recognized that there is still very little empirical evidence for the relationship between social practices and social sustainability. Furthermore, it can be seen that previous scholars gave a special priority to the implementation of environmental practices, underestimating the importance of economic and social practices. Chang et al. (2016) also affirmed that very little interest has been given to a comprehensive exploration of economic and social aspects associated with sustainability.

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However, Tan et al. (2011) argued since sustainable construction (SC) implies integrating environmental, economic, and social considerations into construction practices and business strategies; it is necessary to comprehensively examine the effects of all three SPs on sustainability performance of construction firms. Indeed, according to Seebode et al. (2012) the contribution of the construction industry to climate change and ecosystem degradation has requested a shift to marketing approaches and sustainable principles in addressing the construction projects' ecological load. The Triple Bottom Line approach takes financial performance, social performance, and environmental protection into consideration in executing projects (Elkington, 1994). This approach mentions that sustainability in construction can be attained by a combination of environmental, economic, and social performance in which the focus is not just for achieving financial benefits but also society and environment conservation. SPs have evolved over the years in the construction industry and their positive outcomes have led firms to abandon traditional construction methods (Bamgbade et al., 2017). Therefore, the first objective of this study is to investigate the effects of environmental, economic, and social practices on sustainability performance of construction firms since very limited research has been done to test such effects.

Research on leadership phenomena and sustainable building development can constructively affect sustainable projects, thus driving forward a long-term plan for higher performance. However, research investigating competencies of leadership and leaders' quality practices has been insufficient in sustainable projects, except for a few cases, e.g. transformational leadership qualities and project managers' leadership competencies strongly impact on sustainable buildings' success criteria (Tabassi et al., 2016); intra-organizational leadership role in UK construction firms is responsible for promoting SPs (Opoku et al., 2015b); effective leadership style of sustainability professionals is charged with the development of SC strategies (Opoku et al., 2015a); the delivery of sustainable projects needs to be encouraged by inspirational and committed leadership by a deep understanding of barriers to SC (Hwang and Ng, 2013); construction firms need intra-organizational leadership to provide the strategy, direction, and vision towards a sustainable future (Opoku et al., 2015b). Moreover, Opoku et al. (2015a) also admitted that leadership is an important factor in encouraging SPs in the construction industry. Leadership significantly impacts on firm activities including SPs, yet it is still not a main interest in the sustainability field as well as its adoption research in construction management (Opoku et al., 2015b). Some scholars (e.g. Quinn and Dalton, 2009; Egri and Herman, 2000) argued that understanding and study of leadership and its linkage to sustainability are still in infancy, thus more work is required to establish the leaders' vital role in the implementation of sustainable strategies. The construction leadership's understanding is still immature as compared to that of leadership in mainstream leadership research. The organizational leadership's significance and interest are rapidly increasing, this results from the organizations' need to continuously innovate in response to the changing business environment (Chan and Cooper, 2007). However, to our knowledge, despite the efforts of these studies the extant literature still lacks the empirical evidence to prove the role of construction managers in promoting SPs to achieve sustainability performance. Previous studies such as Opoku and Ahmed (2014) and Opoku et al. (2015b,a) mainly examine the role of construction managers in SC at the exploratory level, by confirmatory research our work further confirms the importance of construction managers towards SC.

Consequently, the two main objectives of this study are: to empirically investigate the relationships between SPs (environmental, economic, and social) and sustainability performance, and to investigate the moderating affect of construction managers' leadership competences on the SPs-sustainability performance relationship. Findings of our study attempt to fill the specific gaps in the existing SC literature and help researchers and construction firms better understand the positive effects of SPs and the role of construction managers towards sustainability in construction.

2. Literature review

2.1. Sustainable practices

A SP is any practice aiming at achieving or supporting a sustainable value. It was described by Hart (1996) as a group of practice attributes (what), executed by one or more agents (who) in a specific context (when and where), and driven by a sustainable value (why). Sustainable objectives may only be attained if practices are informed by knowledge (Khalfan et al., 2002), for example, which SPs to be executed, when and how to implement them. Increasing benefits of SPs have helped firms change their traditional construction culture. Negative effects of the construction industry on the ecosystem and climate called for a change towards sustainable approaches, aiming at addressing construction projects' ecological loads (Seebode et al., 2012). Geels (2011) emphasized that sustainability transition has been a major concentration in studies on sociotechnical systems and technological innovation. It is defined as a shift of sociotechnical systems towards sustainable alternatives. In order to make this transition, SPs should be disseminated in any industry. The strategic sustainability behavior's literature highlighted that many firms are willing in embracing new concepts (e.g. sustainability), actively transforming their business based on sustainable principles. Meanwhile, other firms are resistant to the organizational shift and maintain their current status. Lee and Ball (2003) explained that firms' strategic responsiveness to environmental problems depicts a continuum ranging from reactive compliance with legislation to proactive practices.

Gadenne et al. (2009) defined the environmental practice of construction firms as regulatory compliance with environmental issues. Some examples of environmental practices are waste management, environmental involvement, and energy efficiency (Yusof et al., 2016); or environmental training programs, green procurement, and pollution abatement (Chen et al., 2016). Economic practice refers to considerations given to economic influences that a firm's operations have on stakeholders and community (Uddin et al., 2008). Quality management, supply chain management, and risk management are illustrations of economic practices (Chang et al., 2016). Social practice is the continuing commitment by business to behave ethically and to improve the life quality of workforce and their families, and the society (Watts and Holme, 2003). Social practices may include social commitment and social participation of construction firms (Huang and Lien, 2012). Opoku et al. (2015b) noted that practices all involve the whole project cycle (i.e. pre-construction, construction, and post-construction) and may encompass waste management, procurement, sustainable design, whole life costing, and utilization of materials and resources.

Table 1 shows representative studies on the relationship between SPs and sustainability performance in construction. It is seen that three practices have been widely studied by prior research in which environmental and social practices attract more attention from authors than economic practices. Barnes and Croker (2013) and Roberts and Kriese (2009) noted social and environmental dimensions often have the same level of dominance when adopted (see Table 1), e.g. Jiang and Wong (2016) revealed environmental protection and construction safety and quality are usually embedded together into construction processes. These

Table 1
Representative studies on the relationship between SPs and sustainability performance.

Authors	Sustainable practices			Sustainability performance		
	Environmental practices	Economic practices	Social practices	Environmental sustainability	Economic sustainability	Social sustainability
Tan et al. (2011)	✓		✓		✓	
Huang and Lien (2012)			✓		✓	✓
Newell and Lin Lee (2012)	✓		✓		✓	
Siew et al. (2013)			✓		✓	
Tan et al. (2015)	✓		✓		✓	
Ye et al. (2015)				✓	✓	✓
Abidin and Iranmanesh (2016)	✓					
Chang et al. (2016)	✓	✓	✓			
Chen et al. (2016)	✓				✓	
Wang et al. (2016)					✓	✓
Xiong et al. (2016)					✓	✓
Yusof et al. (2016)	✓					
Zhao et al. (2016)			✓			
Awang and Iranmanesh (2017)	✓			✓	✓	
Bamgbade et al. (2017)						✓
Loosemore and Lim (2017)			✓		✓	✓
Athapaththu and Karunasena (2018)	✓	✓	✓	✓	✓	✓
Bamgbade et al. (2018)				✓	✓	✓
Chang et al. (2018)	✓	✓	✓	✓	✓	✓
Lu et al. (2018)			✓		✓	
Li et al. (2019)	✓			✓	✓	✓

two dimensions of SPs may be interrelated or even accentuate each other in the construction context. Only some papers have focused on economic practices (e.g. Chang et al., 2016; Athapaththu and Karunasena, 2018; Chang et al., 2018), meaning that economic practices are the least dominant facet of SPs.

Many scholars such as Chang et al. (2016), Athapaththu and Karunasena (2018), and Chang et al. (2018) consider all the three practices in their works but these works fail to provide the evidence for the connection between SPs and sustainability performance. Meanwhile, the others (e.g. Ye et al., 2015; Wang et al., 2016; Xiong et al., 2016; Bamgbade et al., 2017) concentrate on some aspects of sustainability performance but we do not know the role of SPs in enhancing sustainability. Instead of considering practices, they only consider some factors driving sustainability of construction firms, for instance market competition, government support, market orientation, or product innovativeness. The works of Zhao et al. (2016) and Yusof et al. (2016) were unable to establish the links between some dimensions of SPs and sustainability. We conclude three SPs are seldom integrated together by previous authors. In other words, SPs have been mainly applied in isolation in construction. Since SC aims to comprehensively integrate economic, social, and environmental considerations into construction business strategy; overlooking any aspect of SPs is unable to achieve sustainable development. It is concluded past research has not considered the linkages between all the three SPs and sustainability performance. Hence, in this study we comprehensively examine the influences of environmental, economic, and social practices on sustainability of construction firms.

2.2. Leadership competences of construction managers

International and local communities in the last few decades have posited the construction industry has a crucial role in encouraging the society transformation towards sustainable development (Tsai and Chang, 2012; Ofori and Toor, 2008; Maliene and Malys, 2009). According to Agenda 21 (1992), the action blueprint in encouraging sustainable settlement needs to advocate the SC activities' promotion and working together towards the achievement of sustainable human resource development and capacity-building in developing human settlement (Tabassi et al., 2016). Related to this issue, construction managers (i.e. project managers, construction leaders) by influencing and transforming subordinates (Tabassi et al., 2012; Northouse, 2007; Purvanova and Bono, 2009), could improve sustainability performance. For SC, leaders by their leadership style and the way to manage projects and subordinates, could transform projects towards sustainability and higher productivity. The review of the leadership literature and theories over the last decades indicated that whilst leadership is widely investigated in the literature of organization management (Yukl, 2002; Müller and Turner, 2010), it is considered as a dynamic concept in developing communication channels towards others and in affecting the group to achieve goals (DuBrin, 2004).

Bass (1985), Yukl (2002), and Müller and Turner (2010) highlighted that leaders' ability in motivating followers and fostering cooperative goals strongly impacts on project performance. Yukl (2006) described leadership as an influence process which can originate from the firm's internal and external stakeholders. It is also regarded as a process of affecting the firm's vision and direction, appearing through the leaders–followers relationships (Taylor et al., 2011). Northouse (2007) posited that effective leaders could change their own style relied on needs of subordinates and work requirements, even in the middle of project. Furthermore, Northouse (2010) affirmed that leadership implies affecting individuals to abandon their selfish interests, contributing to the whole group's performance. Although there are many ways to conceptualize leadership, this study implies the definition of Tabassi and Bakar (2010) when leadership is defined as a process whereby leaders with willpower and intelligence have a bearing on subordinates, aiming at developing their potentials to achieve organizational objectives.

2.3. Sustainability performance

It can be seen from Table 1, three aspects of sustainability performance of construction firms have been investigated by past research. Yet, it is surprising that just a few works concentrate on all the three aspects, namely the works of Ye et al. (2015), Athapaththu and Karunasena (2018), Bamgbade et al. (2018), Chang et al. (2018), and Li et al. (2019). However, these studies do not provide the empirical evidence on how sustainability performance of construction firms can be enhanced by adopting SPs. As Elkington (1994) stated, Triple Bottom Line is a concept

which considers financial performance, social performance, and environmental protection in the project implementation. In other words, SC refers to integrating economic, social, and environmental considerations into construction business strategy. Moreover, it is defined as a creation and management of healthy built environment relied on ecological principles and resource efficiency. The construction industry needs to enhance its social contribution and particularly mitigate its adverse effects on the environment (Hill and Bowen, 1997). Therefore, sustainability performance in this study refers to environmental protection, economic prosperity, and social well-being — the three main objectives of SC as suggested by (Tan et al., 2011; Bamgbade et al., 2018).

3. Development of research hypotheses

3.1. The relationship between sustainable practices and sustainability performance

Practices implemented in the construction phase could negatively or positively impact on the environment, economy, and society — three dimensions of sustainability. In order to promote positive and mitigate negative affects, firms are required to adopt SPs in this phase (CII, 2009). The importance awareness of SPs implementation is currently better than in the past (Son et al., 2011). Firms adopting SPs to improve the resource efficiency and create a better workplace for staff and community, are more likely to enhance competitiveness, save more costs, and improve overall bottom line (Opoku et al., 2015b). Tan et al. (2011) confirmed that adopting SPs can lead to the firm sustainability performance improvement. As documented by Robinson et al. (2006), the SPs implementation contributes to competitive advantage, e.g. cost saving from reduced waste, enhanced human development, higher labor practice through mitigating risks related to dangerous and dirty construction sites, loyalty, improved market access, revenue gains from improved image, and repeated businesses. Adetunji et al. (2003) performed a survey in the UK construction industry and concluded that sustainability strategy can help firms in enhancing the business competitiveness and reputation. Hence, SC is really crucial for the firms' survival. Furthermore, Fergusson and Langford (2006) constructed a framework to explore the connections between competitive advantage, environmental strategy, and performance. Increasing environmental competencies show the opportunity for firms in gaining the competitive advantage, resulting in enhanced performance. Tan et al. (2011) evaluated sustainable development in construction and suggested a framework to assist firms in improving competitiveness by the implementation of SPs.

There was evidence to prove that firms often implementing SPs have better profits, improved productivity, enhanced employee and customer satisfaction, good safety and health, and mitigated environmental effect (SECBE, 2005). Many firms also apply sustainable building designs which consume minimum water and energy, prevent pollution, produce minimum waste, and preserve the local ecological biodiversity. These practices have resulted in the minimization of environmental influences of the built asset. Singh (2007) argued that promoting sustainability refers to the appropriate practices' adoption pertaining to materials choice, origin of used materials, used construction method, and waste-minimizing design. Materials' production, transport, and utilization negatively influence the environment (e.g. quality of air, soil, and water). Construction activities also consume a large amount of energy, generating more noise, dust, and waste. These environmental damages occur throughout the project cycle, hence it is urgent that SPs need to be executed from project planning to its demolition stage (Sev, 2009; Rohracher, 2001; Son et al., 2011; DTI, 2006). Chang et al. (2016) suggested that practices should be executed to comprehensively respond to sustainability. This was also confirmed by Geels (2010) who concluded that sustainability transition consists of multiple potential measures and practices. Basically, SPs may be divided into three categories: environmental practices, economic practices, and social practices (Chang et al., 2016), corresponding to three main objectives of SC, i.e. environmental, economic, and social sustainability. Regarding environmental practices, they can positively impact on outcomes of construction firm, e.g. economic and environmental performance. Yusof et al. (2016) affirmed adopting environmental practices namely waste management and energy efficiency can result in resource efficiency and improved waste management during project implementation, reduction of processes that are environmentally harmful (Shi et al., 2016; Shen and Tam, 2002). For economic practices, quality management needs to be adopted during the construction process including design, procurement, construction preparation, construction, and construction completion. Supply chain management should clearly identify criteria to assess and choose suppliers and incorporate sustainability principles into selection criteria (Chang et al., 2016). Such economic practices will make an important contribution to achieving sustainability in construction. In terms of social practices, Tan et al. (2011) noted construction firms show their social commitment to SC through better education and training of employees and health and safety management. Firms are also required to comply with legal frameworks, laws, and regulations towards SC (i.e. economic advancement, environmental and social responsibility). To conclude, the following three hypotheses are given.

H1: Environmental practices positively affect sustainability performance

H2: Economic practices positively affect sustainability performance

H3: Social practices positively affect sustainability performance

3.2. The moderating effect of construction managers' leadership competences

Shriberg (2002) outlined that a sustainability management system should integrate the firm environment and culture together in which ecological, social, and economic considerations have to be involved. Shriberg further identified that the connection between the organizational management system and sustainability requests complicated strategies for employee and operational management. Though the task of setting sustainable development's standards, especially in the construction industry, typically requests the participation of many communities (e.g. governmental, non-governmental, corporate, or scientific), the responsibility of promoting SC still strongly depends on leaders and managers (Shriberg, 2002; Ofori and Toor, 2008; Lam et al., 2011). A sustainable management model should be constructed to cope with the construction activities' adverse environmental impacts and to restore the environment. Therefore, environmentally intelligent and innovative directors and leaders can help in reducing project costs, ecological impacts, and wastes; and strengthening the firm's financial performance (Shriberg, 2002). Since ineffective sustainable management, especially in building planning and construction, leads to the unsuccessful investment in infrastructure as well as restrictions on the environmental cohesion (Chen et al., 2005); the most crucial aspect in implementing a sustainability agenda is to connect management decision-making to three sustainability dimensions (environmental, economic, and social) (Tabassi et al., 2016).

The construction industry plays a vital role to attain sustainable development objectives of the society, yet the shift towards

adopting SPs is a process which poses a challenge of leadership (Opoku et al., 2015b). Latham (1994) and Egan (1998) called on leaders in leading the mission for the industry change, and after that Opoku et al. (2015b) studied the intra-organizational leadership's role in UK construction firms responsible for promoting SPs. Quinn and Baltes (2007) stressed that firms are requested to basically alter the way of doing business from concentrating on the shareholders' short-term value to paying attention to their operations' environmental, social, and economic impacts. Hence, the construction industry is required to drive towards sustainability due to construction activities' adverse effects. Leaders play an important role since the industry performs its mission of attaining sustainability (Ofori and Toor, 2008). The firms' ability in pursuit of a sustainability agenda, irrespective of the maturity level, is believed to be affected by conviction and commitment of their leaders. Leaders need to communicate the sustainability importance and establish a culture which integrates sustainable principles into daily management decisions (Avery, 2005). There has been an urgent need in the construction industry in encouraging a positive culture. For this reason, the industry requests leaders with good ethical behaviors as well as positive values to change the project management's current conservative paradigm (Toor and Ofori, 2008). Firms really need leaders who can provide a collective vision, direction, and strategy towards a sustainable future. More important to note that leaders need to have both knowledge and ability to effectively guide their firm towards the sustainability achievement. Bossink (2007) realized that the leadership role in improving innovation and performance has been receiving more attention in the construction industry. Bresnen (1990) and Loosemore et al. (2003) admitted that the construction industry is one of the most complicated environments, thus a challenging context for leadership and managerial concerns has been deemed necessary (Fellows et al., 2002). In this sense, effective management and leadership practices have been especially important in sustainable projects where leaders' task is to cope with the implementation process and lead the project team throughout the construction phase (Druker and White, 1995).

Sustainability requires firm leaders to take bold steps to go beyond efficiency to a better performance level. Sustainability is currently regarded as a strategy for the firm success and survival in the long term (McCann and Holt, 2010). Ofori and Toor (2008) argued that leaders need to embed sustainability into firm activities, making a sustainable development part of the firm strategy. Parkin (2000) emphasized the connection between SPs and leadership when asserting that leadership is an important part to achieve sustainability. Quinn and Dalton (2009) conducted a study using interviews with leaders from firms which executed SPs, and discovered that sustainability requests integrating environmental, social, and economic issues into the firm's vision, values, and operations. This integration really requires leaders to restructure their firm to incorporate sustainable values into the firm activities, aiming at reducing the construction process's harmful influences. Ofori and Toor (2008) argued that sustainable solutions also depend on leaders who can direct stakeholders' actions towards the pursuit of sustainability. This argument has resulted from a work regarding interviews with construction leaders in Singapore. Therefore, the leaders' next generation should learn how to integrate sustainability with their ability in facilitating others to pursue such vision. In order to implement a business strategy which integrates sustainability, leaders need to understand motivations of all stakeholders and collaborate with managers to disseminate the sustainability concept into the firm. Lueneburger and Goleman (2010) highlighted that leaders need to understand as well as overcome obstacles in adopting SC. Leaders should both give directions and cooperate with others to adapt to environment changes by modifications when needed (Ferdig, 2007). Quinn and Baltes (2007) asserted that leaders play a crucial role in offering awareness and training on sustainability issues for their firm. Based on the arguments above, we argue that construction managers' leadership competences act as a moderator in the linkage between SPs and sustainability. According to Baron and Kenny (1986) a moderator is as a third variable which impacts on the strength and/or direction of the independent-dependent variables relationship. The presence of a moderator may change the original relationship between dependent and independent variables (Sekaran and Bougie, 2013). Therefore, we hypothesize the following:

H4: Leadership competences of construction managers moderate the relationship between environmental practices and sustainability performance

H5: Leadership competences of construction managers moderate the relationship between economic practices and sustainability performance

H6: Leadership competences of construction managers moderate the relationship between social practices and sustainability performance

4. Questionnaire and data collection

The proposed hypotheses of the model illustrated in Fig. 1 are validated by the data collected in Vietnam. A survey questionnaire helps in collecting quantitative data in a standard way, hence it is internally coherent and consistent for the analytical techniques' utilization (Durdyev and Mbachu, 2011). The questionnaire is divided into three parts. The first introduces the purpose and objectives of this study, presents the definitions of SC and SPs, and what are leadership competences of construction managers and their roles in SC? In the second, the respondents are asked to indicate to what extent, they agree with the following statements: environmental, economic, and social practices positively affect sustainability; and construction managers' leadership competences can promote the implementation of SPs to improve sustainability. The third part is to collect the demographic background of the respondents (e.g. industry experience, project type). A Likert scale of five points is applied where answers in the questionnaire are ranged from 1 (strongly disagree) to 5 (strongly agree). The questionnaire is sent to a total of 229 respondents and 148 responses are returned. However, 11 responses are eliminated due to the problem of incomplete data. Ultimately, 137 completed responses are retained and analyzed to demonstrate 6 hypotheses of the research model. Regarding the respondents' demographic background, in terms of the industry experience, the result shows that 116 respondents have more than 5 years of the industry experience (accounting for 84.7%); more noticeably, there are 45 respondents with more than 10 years of experience, 26 respondents are from 11 to 15 years, 14 are from 16 to 20 years, and 5 have more than 20 years. Moreover, the respondents work for contractors with the roles: firm director, project manager, designer, project team member, and engineer.

As recommended by Pallant (2010), we examined non-response bias. This step is performed by classifying the respondents into two distinct groups. The first and second group include responses received within and after the first 30 days, respectively (referred to as early and late responses). Vink and Boomsma (2008) noted a thirty-day period is appropriate since response rate often sharply reduces after three to four weeks. Independent samples t-test is adopted to compare means of the two groups. Its aim is to check any discrepancy's form by the comparison of their means. The Levene test's value for the variances' equality should be higher than 0.05 (Pallant, 2010). The result shows that all significant values of the variance equality

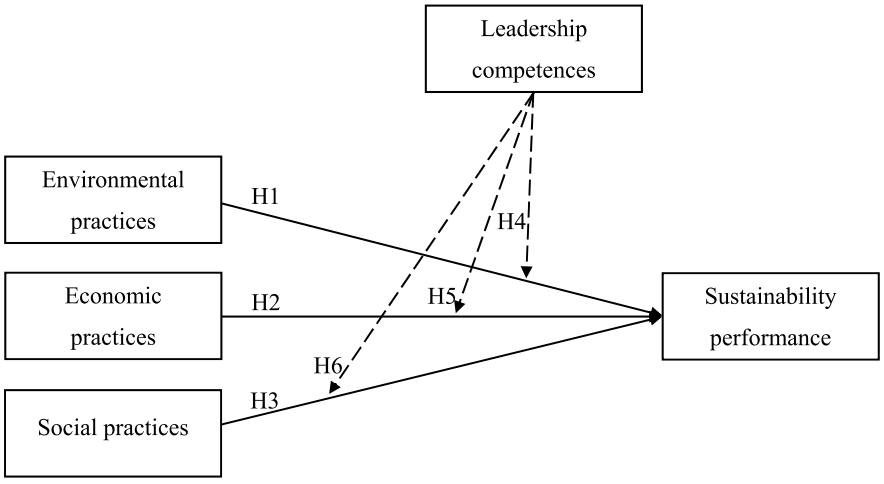

Fig. 1. The research model.

for each variable are higher than 0.05, meaning that there are no significant differences between early and late responses, hence our study is not impacted by non-response bias. Another problem is that self-reporting survey is employed by this study, thus Harman's one-factor test is employed to check common method variance (Podsakoff et al., 2003). The reason for this test is that if common method bias occurs, either just one factor emerges or one or more general factors will underlie and account for the variance (Podsakoff et al., 2003). The result reveals that common method variance is not a problem in our work and the relationships among the variables are unlikely to be inflated.

5. Measures

The constructs in this work are measured based on many studies in the extant literature. Environmental, economic, and social practices are measured based on the works of Chang et al. (2016), Chen et al. (2016), Yusof et al. (2016), Awang and Iranmanesh (2017), Loosemore and Lim (2017), and Chang et al. (2018) since these works cover a wide variety of SPs. Items of sustainability performance are measured by environmental protection, economic prosperity, and social well-being as recommended by Bamgbade et al. (2018) and Tan et al. (2011).

More specifically, environmental practices include environmental management, management of biodiversity impacts, green innovation and products, resources conservation (land, water, material, energy), construction waste management, efficient use of resources (land, water, material, energy), and pollution control (emission, light, noise). Economic practices encompass many measures namely: supply chain management, communication management, corporate governance, risk management, network building, innovation, and quality management. Social practices consist of items such as occupational health and safety, support community development, obey laws and regulations, caring for all employees, education and training, and industry development (Chang et al., 2016).

Dulewicz and Higgs (2005) conducted a theories' review and identified leadership facets which could be classified into two competences: managerial and intellectual, and emotional and social. In terms of managerial and intellectual competences, project depends on the leaders' effective leadership competencies. Furthermore, in order to assure the sustainable development's achievement, project managers in manufacturing, construction, and other project-based industries should inspire the project team's members to develop sustainable projects (Jones et al., 2017). Lu and Zhang (2016) argued that sustainability in construction mainly focuses on green projects instead of sustainable management in project implementation. Zhang (2015) emphasized the management importance in SC by indicating the management activities' effects on "environmental requirements", "high initial cost", and "green project's complicated processes". After all, Lu and Zhang (2016) and Zhang (2015) concluded leaders tend to be the key actor in driving SC. Therefore, corresponding to the leadership research importance on sustainable development, this study evaluates the effects of leaders' managerial and intellectual competencies on SC.

With the statements above, it could be seen that leadership behavior has a vital role to play to project productivity and effectiveness. Leaders can encourage the team members in building relationships, supporting one another, and seeking information to achieve objectives (Murphy and Ensher, 2008). Transformational leaders have the important mission in promoting the project effectiveness. They can affect the employee's constructive reaction and exhibit individualized consideration behavior, resulting in the higher performance of employees (McColl-Kennedy and Anderson, 2002). They can transform individuals to move beyond the current status with the aim of enhancing the ability to adapt and innovate in their team. Tabassi et al. (2014) posited transformational leadership has to be evaluated among project managers in SC. Many studies regarding transformational leadership (Daft and Pirola-Merlo, 2009; Northouse, 2007; Avolio et al., 1999; Bass and Avolio, 1997) mentioned various facets to measure the transformational leaders' quality. Daft and Pirola-Merlo (2009) constructed a questionnaire to evaluate the transformational leadership quality through two aspects: inspire followers to go beyond their own interest and develop followers into leaders. Broman et al. (2014) noted applying transformational leadership towards a sustainable society is really necessary for researchers and professionals to bring global, national, regional, and local changes on the journey towards sustainable development. To sum up, leadership competences of construction managers in our study are measured by three aspects including: intellectual competence (vision and imagination, strategic perspective, critical analysis and judgment) (Dulewicz and Higgs, 2005; Tabassi et al., 2016); transformational leadership (develops followers into leaders and inspire followers to go beyond their own interest) (Daft and Pirola-Merlo, 2009; Tabassi et al., 2016); and managerial competence (engaging communication, empowering, resource management, achieving, and developing) (Dulewicz and Higgs, 2005; Tabassi et al., 2016).

6. Analysis and results

PLS-SEM is a widely used method to simultaneously investigate the indirect and direct influences of many variables (Hair et al., 2011). This is a non-parametric method mainly applied as the research aim is to develop theory and explain variance, and it does not request the data's multivariate normality (Chin, 1998). According to Leguina (2015), its aim is to maximize the endogenous latent constructs' explained variance and minimize the unexplained variance. Because PLS is relied on a OLS regressions' series, it does not impose any restriction on the sample size as CB-SEM. The method selected will depend on objectives of research, model structure, and characteristics of data (Reinartz et al., 2009). Hair et al. (2013) recommended PLS-SEM is superior to CB-SEM for exploratory research. Hence, it is chosen for our study because the nature of this study is exploratory when the effects of SPs and leadership competences of construction managers on sustainability performance have not been previously investigated. Moreover, PLS-SEM is also chosen due to its ability in handling small sample size (Chin, 1998).

We used this method to test the relationships between the latent constructs (SPs, sustainability performance, and leadership competences) with the support of the software SmartPLS. Vinzi et al. (2010) noted that PLS-SEM is used to estimate a causal relationships' network relied on a theoretical model, linking two or more latent complicated constructs measured by many observed variables. It is considered appropriate since this study aims to anticipate the endogenous latent construct (sustainability performance) (Ringle et al., 2012). Moreover, this method is currently considered appropriate for multivariate analysis (Peng and Lai, 2012).

6.1. Measurement model

The measurement model includes the assessments of convergent and discriminant validity. In terms of convergent validity, the individual item reliability's assessment is done through examining loading of construct measures (Hair et al., 2014). Items with loading of 0.50 or higher are retained according to the rule of thumb by Chin (1998) and Barclay et al. (1995). Items of the constructs with loading greater than 0.5 in our study were retained. Additionally, the coefficient of composite reliability is adopted to assess the constructs' internal consistency. Hair et al. (2011) and Bagozzi and Yi (1988) noted this coefficient should be higher than 0.7. It is observed that coefficients of composite reliability of the latent constructs range from 0.822 to 0.870, indicating that all these coefficients were greater than the minimum acceptable level. The estimates of AVE were greater than 0.5 for the five constructs. Fornell and Larcker (1981) suggested the minimum value for AVE is 0.50, we conclude all constructs in the model have sufficient convergent validity (Table 2).

Moreover, the discriminant validity is affirmed by evaluating square root of AVE. Squared correlations (highlighted in bold, Table 3) are compared to correlations among latent constructs (Fornell and Larcker, 1981). Appropriately, off-diagonal coefficients should be lower than squared correlations. As given in Table 3, all correlations among constructs are lower than the squared root of AVE along the diagonal, thus suggesting the sufficient discriminant validity.

6.2. Structural model

The significance of path coefficients between constructs in the structural model was evaluated. In order to do this, a standard procedure of bootstrapping was adopted with 5000 bootstrap samples and 137 cases (Henseler et al., 2009). All path coefficients of the research model are presented in Table 4. After determining path coefficients, coefficient of determination (R^2), predictive relevance (Q^2), and effect size (f^2) of the research model are also assessed. The coefficient of determination (R^2) of sustainability performance is 0.413, meaning that the research model with three exogenous constructs (environmental, economic, and social practices) explained 41.3% of the sustainability performance variance. As documented by Henseler et al. (2009) and Hair et al. (2011), acceptable R^2 for the endogenous construct is classified as 0.75, 0.50, and 0.25 for substantial, moderate, and weak respectively. Hence, it is concluded that the model's predictive accuracy is assured with R^2 of 0.413.

The next step is to estimate the effect size. This is obtained through recording the change of R^2 as each exogenous construct is eliminated from the model to evaluate the omitted construct's substantive effect on the endogenous construct (Chin, 1998). The guideline to assess the effect size f^2 was proposed by Cohen (1988) where 0.35, 0.15, and 0.02 are for large, medium, and small impacts respectively. The result shows that the effect size is 0.068 for environmental practices, 0.049 for economic practices, and 0.022 for social practices. Thus, the effect size can be regarded as relatively medium for environmental and social practices; and small for social practices. Last, the Stone–Geisser test of predictive relevance for the research model is adopted with blind-folding procedure (Geisser, 1974; Stone, 1974). A cross-validated redundancy is applied to measure the model's predictive relevance (Q^2) (Chin, 2010; Hair et al., 2013; Ringle et al., 2012). In PLS-SEM, if Q^2 is higher than zero, the predictive relevance for a particular construct is confirmed. Q^2 value of our model is 0.218 for the endogenous construct (sustainability performance), thus ensuring the model's predictive relevance.

Pertaining to hypothesis 1, it is predicted that environmental practices have a positive influence on sustainability performance. Indeed, Table 4 shows that environmental practices positively affect sustainability performance with $\beta = 0.255$ and $p < 0.01$, hence hypothesis 1 is supported. Moreover, the finding also shows the empirical support for hypothesis 2 which predicted that economic practices are significantly associated with sustainability performance ($\beta = 0.301$, $p < 0.01$). In assessing the direct influence of social practices on sustainability performance (hypothesis 3), the result concludes that social practices show the significant positive relationship with sustainability performance ($\beta = 0.170$, $p < 0.05$), thus hypothesis 3 is also supported.

6.3. Moderation analysis

In order to test hypotheses 4, 5, and 6, we considered the effects of construction managers' leadership competences on the relationships between three practices (environmental, economic, and social) and sustainability performance. The moderating effect can be analyzed by considering the interaction terms' impact of leadership competences and three aspects of SPs on sustainability performance (Chin et al., 2003). Baron and Kenny (1986) noted that hypotheses of moderating effect are supported if path coefficient between dependent variable and interaction term is statistically significant. The result in Table 4 reveals that the moderating effect of leadership competences is only significant to the environmental practices-sustainability performance relationship ($\beta = 0.158$, $p < 0.05$), thus offering support for hypotheses 4. However, the moderating effect of leadership competences is not significant to the economic practices-sustainability performance relationship ($\beta = -0.149$, $p > 0.05$) as well as to the social practices-sustainability performance relationship ($\beta = -0.022$, $p > 0.05$), hence hypotheses 5 and 6 are not supported.

We also assessed the moderating effect's strength of leadership competences on the linkage between sustainability performance and SPs, using the effect size as recommended by

Table 2
The result of measurement model.

Construct	Item	Loading	Composite reliability (CR)	Average variance extracted (AVE)
Environmental practices	Resources conservation	0.781	0.870	0.572
	Green innovation and products	0.765		
	Waste management	0.791		
	Pollution control	0.729		
	Efficient use of resources	0.713		
Economic practices	Risk management	0.728	0.843	0.573
	Communication management	0.740		
	Supply chain management	0.816		
	Quality management	0.741		
Social practices	Education and training	0.782	0.822	0.607
	Ensuring occupational health and safety	0.796		
	Obeying laws and regulations	0.759		
Leadership competences	Vision and imagination	0.693	0.837	0.514
	Engaging communication	0.775		
	Critical analysis and judgment	0.809		
	Inspire followers to go beyond their own interest	0.788		
	Empowering	0.788		
Sustainability performance	Social well-being	0.782	0.838	0.633
	Economic prosperity	0.759		
	Environmental protection	0.796		

Table 3
The discriminant validity assessment.

	Environmental practices	Economic practices	Social practices	Leadership competences	Sustainability performance
Environmental practices	**0.757**				
Economic practices	0.536	**0.757**			
Social practices	0.321	0.400	**0.779**		
Leadership competences	0.528	0.462	0.314	**0.717**	
Sustainability performance	0.504	0.479	0.367	0.530	**0.796**

Table 4
The result of structural model.

Hypothesis	Relationship	Path coefficient	Significance	Result
H1	Environmental practices → Sustainability performance	0.255	$p < 0.01$	Supported
H2	Economic practices → Sustainability performance	0.301	$p < 0.01$	Supported
H3	Social practices → Sustainability performance	0.170	$p < 0.05$	Supported
H4	Environmental practices*Leadership competences	0.158	$p < 0.05$	Supported
H5	Economic practices*Leadership competences	−0.149	$p > 0.05$	Not supported
H6	Social practices*Leadership competences	−0.022	$p > 0.05$	Not supported

Note: Dependent variable: Sustainability performance

Cohen (1988). The amount of the variance explained (R^2) of the original model was compared to that of the full model (including the moderating effect of leadership competences). The guideline for assessing effect size value f^2 given by Cohen (1988) is 0.02, 0.15 and 0.35 for small, medium and large impacts respectively. The results indicated that the value of effect size f^2 is 0.03, showing the small size of effect. It should be noted that a small effect size does not make the interaction effect insignificant (Bamgbade et al., 2018). Chin et al. (2003) affirmed if beta value is statistically significant, the small size of effect is still taken into consideration.

7. Discussion

The first significant contribution of this study is to comprehensively examine the linkages between three SPs and sustainability performance of construction firms. The purpose of SC is to consider the impact of construction activities on the environment, economy, and society; yet three SPs are rarely integrated together by prior research (Table 1). Overlooking any dimension of SPs will lead to failure to achieve SC. The works of Chang et al. (2018) and Athapaththu and Karunasena (2018) only study the effects of three SPs on sustainability at the conceptual or exploratory level while the others (e.g. Abidin and Iranmanesh, 2016; Chang et al., 2016; Yusof et al., 2016; Zhao et al., 2016) cannot provide empirical evidence for the SPs-sustainability relationship. For this reason, with confirmatory research our work investigates the influences of social, economic, and environmental practices on construction firms' sustainability performance. Consistent with hypotheses 1, 2, and 3 of the research model, the result indicated that statistically significant relationships exist between environmental, economic, social practices and sustainability performance. This implies that if construction firms focus more on the implementation of SPs, their sustainability performance will increasingly be improved. Contractors always play a vital role to promote sustainable development in the construction industry context by assuming the responsibility to reduce the construction process's adverse influences on the society and environment and enhance the economic contribution (Tan et al., 2011). Shen and Tam (2002) noted that contractors can enhance environmental sustainability through the implementation of responsible practices throughout the project implementation. According to Hakkinen and Belloni (2011), increasing awareness of environmental practices' importance of construction firms plays a very important role in the true implementation of environmental practices. For instance, some firms may adopt environmental practices even though they do not know profits will be higher or lower because they are required to do this by regulation (Mora, 2007). On

the contrary, others are willing to adopt environmental practices but faced with constraints which lead to resistance to adopting those practices (Rodriguez et al., 2011; Zainul Abidin et al., 2013). Hence, firms are more likely to maintain the current way of doing business because they may not accept low performance and sacrifice convenience. Such constraints could discourage firms from implementing environmental practices. For this reason, this implementation requires construction firms to revisit their services and products, which entails a collaboration between various departments and units (Hillestad et al., 2010).

Construction firms that often adopt SPs, e.g. good corporate governance of social and environmental issues, will be able to enhance shareholders value and protect their reputation (SCTG, 2002). In line with the literature, our results provided the empirical evidence that firms usually executing SPs, are more like to improve sustainability (Opoku et al., 2015b; Tan et al., 2011; Robinson et al., 2006; Singh, 2007; Sev, 2009; Son et al., 2011; Rohracher, 2001). Indeed, since the construction industry greatly impacts on the environment, improving environmental performance in construction business is recognized as a main contributor in maintaining the firm competitiveness (Shen and Zhang, 2002). The main focus is given to attempts to reduce generation of wastes and improve techniques for minimizing construction activities' harmful effects on the environment. In addition to the environmental preservation, cultural as well as social equity concerns are also encouraged in conducting construction business, e.g. CSR is increasingly applied to represent a firm's economic, social, and environmental performance (Myers, 2005). The effect of CSR on many aspects of construction firm performance has been documented by several authors, e.g. Pivo and Group (2008), Liu et al. (2011), Huang and Lien (2012). They concluded that CSR can impact on firm's social performance such as corporate image. Loosemore and Lim (2017) revealed the relational effect of CSR on host communities who could object to projects being implemented and on building engagement and loyalty of customers and employees. Thus, implementing CSR to improve social performance has become a norm in the construction industry. Additionally, CSR is also found to enhance firm's financial performance (Newell and Lin Lee, 2012). In some situations, the reciprocal relationship between environmental responsibility and financial performance has been affirmed (Xiong et al., 2016).

Our second important contribution is to examine the moderating effect of leadership competences of construction managers on the SPs-sustainability performance relationship. Although organizational leadership role in SC has been emphasized by many authors such as Opoku and Ahmed (2014) and Opoku et al. (2015b,a), the role of leaders is mainly studied at the exploratory level. By confirmatory research, we further confirm the importance of construction managers in promoting SPs to improve the firm sustainability performance. This study's results reached a conclusion, leadership competences of construction managers can further enhance sustainability performance. However, they do not enhance the SPs-sustainability performance relationship at all. Concerning hypothesis 4, it was anticipated that leadership competences would moderate the environmental practices-sustainability performance relationship, meaning that such relationship will be positively stronger, particularly in the situation environmental practices receive more support from construction managers. As hypothesized, the finding discovered that there is a significant interaction effect between environmental practices and leadership competences. For hypotheses 5 and 6, they were expected that leadership competences would strengthen the relationships between economic, social practices and sustainability performance. Contrary to our expectation, the analysis indicated that there are no moderating effects of leadership competences on these two relationships. We did not find the empirical evidence to support these two hypotheses. One possible explanation for this may be that currently, managers mainly focus on the implementation of green projects which are designed and built in the way they consume less resources and energy than conventional projects. Green projects aim to mitigate negative influences of construction activities on the environment (Yudelson, 2008). Hwang and Ng (2013) concluded that leadership is one of the project managers' essential skills in green projects and important to these projects' success. Indeed, the change of global climate caused by greenhouse gases (GHG) emissions (Huang et al., 2015) has been the most serious environmental problem in the last years for the human development (Zuo et al., 2013; Wu et al., 2014a). In this situation, Zuo et al. (2015) and Wu et al. (2014b) affirmed the construction industry has contributed to a dramatic increase of GHG emissions. World Green Building Council (WorldGBC, 2013) revealed buildings generate one-third of GHG emissions at the global level, hence resulting in a need across the world for green construction. However, green construction is only a subset of SC and is a stepping stone to sustainable development. Despite having many definitions, a green project essentially means a project which is resource and energy efficient and has minimal disruptions to the environment (Hwang and Tan, 2012). Meanwhile, SC comprehensively concentrates on economic, ecological, and social considerations of a project in its community context (Kibert, 2008). As mentioned by our findings, the empirical evidence has been found in demonstrating the role of construction managers in the environmental practices-sustainability performance relationship, but there is no evidence to support that leadership competences of construction managers moderate the relationships between economic, social practices and sustainability performance. We argue the reason may be that construction managers are still focusing on the development of green projects aimed at mitigating construction activities' effects on the environment (Yudelson, 2008).

8. Theoretical and practical contributions

Regarding the theoretical contribution, our work is one of first attempts in the SC field to comprehensively examine the effects of SPs on sustainability performance of construction firms. Such effects on SC have not yet received more attention from prior research. Our study has extended the studies of Chen et al. (2016), Awang and Iranmanesh (2017), Yusof et al. (2016) which only investigate the impact of environmental practices on environmental and financial performance. Furthermore, although some scholars posited that leadership competencies of construction managers strongly impact on sustainable buildings' success criteria (Tabassi et al., 2016), intra-organizational leaders are responsible for implementing SPs (Opoku et al., 2015b), and leadership style of sustainability professionals is charged with development strategies of SC (Opoku et al., 2015a); the literature has not yet been able to provide empirical evidence about the role of construction managers in promoting SC. Therefore, we also supplement the present literature by offering the empirical evidence for this relationship. With the integration of the constructs into a hypothesized model, we have provided the empirical evidence to demonstrate the roles of both SPs and leadership competences in improving sustainability performance. Moreover, most research regarding SPs in construction often tests the linkage between SPs and sustainability performance, so we have added to this developing theoretical base through examining the role of construction managers in promoting SPs. Most importantly, in the SC literature organizational leadership role has been mainly studied at the exploratory level (e.g. Opoku et al., 2015b,a); by confirmatory research, this study demonstrated the

importance of leadership competences of construction managers to achieve sustainability performance. Indeed, our work indicates that attention should not just be directed to SPs but also the role of construction managers. Our findings are expected to broaden the understanding of SPs and construction managers' leadership competences through measurement items rigorously tested. The clear definition of these constructs may assist researchers and practitioners in designing an effective environment for adopting SPs to achieve higher sustainability performance. This work also made a crucial methodological contribution to the SC research by using PLS model to evaluate the psychometric property of the constructs with the aid of discriminant and convergent validities. In evaluating these psychometric properties, item reliability, composite reliability, and AVE of each construct are identified (Bamgbade et al., 2017).

For the practical contribution, it is recommended that the significance and benefits of SPs need to be firstly recognized by governments (i.e. improved awareness and knowledge of sustainability) to encourage stakeholders in investing more efforts in SC (Durdyev et al., 2018). Chong et al. (2009) admitted that knowledge of SC is fragmented in the construction industry and stakeholders have no platforms to integrate their knowledge, as a consequence, many cannot access to critical value-adding sustainability information (Wetherill et al., 2007). In this case, the construction industry needs to spend more efforts on improving the knowledge of sustainability issues and attracting many groups of professionals. Further, the industry should make sustainability more relevant and necessary to their firms and professionals, as well as provide platforms for professionals in order to communicate and share sustainability-related ideas. Additionally, effective and clear legislative process of governments is really important for the recognition building which significantly pushes the enforcement of SPs. Such an enforcement in combination with economic incentives and emphasis on workforce improvement will result in the effective implementation of sustainable initiatives, sustainable economic development and efficient resources use (Durdyev et al., 2018). Our findings are also useful for construction actors and policy makers. The positive effects of SPs on SC can offer an interesting approach for construction managers to sustainably perform construction activities. A direction for designing strategic policy can be provided to motivate firms to realize their impacts on the environment (Yusof et al., 2016).

This study's findings could help construction managers in many important ways. It is concluded that SPs have the positive effects on firm sustainability performance by the support of empirical evidence. Hence, it is really important for construction managers to strongly promote environmental, economic, and social practices in their business strategy. However, with sustainability awareness, this promotion needs to match the sustainability policy of firms which is a commitment statement from top management about objectives to be attained. This commitment implies the protection of environment as well as the enhancement of social responsibility. This policy needs to be designated to comply with relevant legislation and principles of sustainability. More noticeably, such a policy has to be unique to a particular firm through considering its characteristics and background. The policy should be clearly communicated to the firm employees and also available to the public. The policy has to point out the desired sustainability level and give guidelines to establish specific policies of projects (Tan et al., 2011). Furthermore, in order to comply with sustainability policy, firms first should identify clear SPs and strategies to achieve their sustainability objectives. SPs have to be designed to work and hence, improving firm sustainability. By implementing those practices, firms can attain the competitive advantage through integrating the long-term profitability with attempts of achieving sustainable development, for instance enhancing social and environmental responsibility (Stead and Stead, 1992). Stead and Stead (1995) stressed that construction managers should pursue the SPs implementation relied on their respective situations' analysis. For this reason, firms should develop SPs based on their own background in order to increase competitive advantage.

9. Conclusion, limitations and future research

This study empirically investigated the connections between environmental, economic, social practices and sustainability performance, as well as the moderating effect of construction managers' leadership competences on these relationships. To our knowledge, there has been very limited empirical research in the SC literature focusing on the relationships among SPs, leadership competences, and sustainability performance. Consequently, our study has attempted to fill this existing gap of knowledge. Based on the findings, this study established the linkages between SPs and sustainability performance as well as provided the empirical validation about the leadership competences' role in improving sustainability performance. More specifically, environmental, economic, and social practices positively impact on sustainability performance while leadership competences strengthen the environmental practices-sustainability performance relationship. However, the empirical evidence is not found to support the moderating effect of leadership competences on the relationships between economic, social practices and sustainability performance.

Despite the efforts of this study, several its limitations need to be considered before the findings can be generalized. First, our hypotheses are tested by the data gathered from questionnaire survey which just offers a cross-sectional study, hence reducing the ability in implying the causal links among the constructs. This does not allow us to test the effects of long-term investments in SPs and leadership competences of construction managers. The observations of sustainability performance's dynamic changes during adopting SPs are beyond the scope of our work. Thus, future research may concentrate on longitudinal study which can capture the effects of time-based investments into SPs and leadership competences, and their effects on sustainability performance. Second, though this work considered leadership competences as a moderator, there may be other drivers or contextual conditions moderating the SPs-sustainability performance linkage, e.g. organizational culture, government support. Further research could take such moderators into account to better understand the contextual conditions under which SPs become effective. Third, this study's data were gathered from the Vietnam construction industry, thus the findings may not be transferred to other countries. More work is required to prove how precise this study's findings are in other countries, e.g. since our work predicted that construction managers' leadership competences moderate the relationships between all three SPs and sustainability performance, we did not find the evidence for the fit between economic, social practices and leadership competences. Our research model needs to be validated in different countries to offer opportunities for the comparison of findings. Last, the constructs' variables which are significant in this study's hypothesized model need to be further inquired in future work because the construction industry of each country has its own background and characteristics. Some scholars such as Bamgbade et al. (2017) argued firm size may impact on sustainability performance of construction firms. Large firms often have better financial capability and resources in addressing customer issues. Moreover, firm performance may also be affected by its age (Anderson and Eshima, 2013). The failure possibility of firms

decreases with its age and well-established firms are always capable of maintaining their performance (Barney, 1991). Therefore, further studies may consider firm size and age as control variables affecting sustainability performance.

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Appendix. Questionnaire

Items measuring environmental practices, economic practices, social practices, leadership competences, and sustainability performance use a five-point Likert scale (strongly disagree (1), disagree (2), neutral (3), agree (4), strongly agree (5)) to indicate to what extent do you agree with the statements: (1) SPs positively affect sustainability performance, and (2) leadership competences of managers strengthen SPs and then improve sustainability performance of construction firms.

Construct	Items	References
Environmental practices	Environmental management Green innovation and products Resources conservation Waste management Efficient use of resources Management of biodiversity Pollution control	Chang et al. (2016), Chen et al. (2016), Yusof et al. (2016), Awang and Iranmanesh (2017), Chang et al. (2018)
Economic practices	Corporate governance Supply chain management Innovation Network building Quality management Communication management Risk management	Chang et al. (2016), Loosemore and Lim (2017), Chang et al. (2018)
Social practices	Ensuring occupational health and safety Obeying laws and regulations Education and training Active participation in government research projects and industry conferences Supporting community development Caring for all employees	Chang et al. (2016), Loosemore and Lim (2017), Chang et al. (2018)
Leadership competences	Vision and imagination Strategic perspective Critical analysis and judgment	Dulewicz and Higgs (2005), Tabassi et al. (2016)
	Develop followers into leaders Inspire followers to go beyond their own interest	Daft and Pirola-Merlo (2009), Tabassi et al. (2016)
	Engaging communication Empowering Resource management Achieving Developing	Dulewicz and Higgs (2005), Tabassi et al. (2016)
Sustainability performance	Environmental protection Economic prosperity Social well-being	Tan et al. (2011) and Bamgbade et al. (2018)

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