A conceptual model of subcontractor development practices for LEED projects

Abstract

Purpose – This paper presents a conceptual model of effective subcontractor development practices to guide general contractors' development of a network of high-performing subcontractors (SCs) for Leadership in Energy and Environmental Design (LEED) projects.

Methodology - Drawing from supplier development theories and practices in the manufacturing sector, a mixed interpretivist and empirical methodology is adopted to examine the body of knowledge within literature for conceptual model development. A self-reporting survey questionnaire with a five-point Likert scale is used to assess 30 construction professionals' perceptions of the effectiveness of 37 SC development practices classified into five categories. Descriptive statistics, weighted means, and t-tests are used for data analysis.

Findings – SC pre-qualification, commitment, incentives, evaluation and feedback practices can be effective in generating high-performing SCs. Practices that require more direct involvement and linkages between GC and SC are perceived to be less effective.

Research Implications - Theoretical contributions include a framework to foster future research to advance knowledge and understanding to enhance the adoption and implementation of SC development practices in the construction sector.

Practical Implications – Implementation of ranked SC development practices can equip GCs with a network of high-performing SCs for improved competitive advantage and revenues.
.

Originality/value – The proposed conceptual model expands discussions on the modification of supplier development theories and practices currently utilized in the manufacturing sector towards their application in the construction sector. This research differs from previous research, which focused primarily on the manufacturing sector.

Keywords: supplier; development; practices; construction; subcontractor; contractor; LEED; conceptual model; manufacturing; program; adoption; implementation.

Introduction

In the advanced 21st century global business environment, effective supplier development practices for developing a network of high-performing suppliers is crucial for competitive advantage and success in both developing and developed countries to include South Africa, India, Germany, Switzerland, Australia, and U.S.A. (Sucky & Durst, 2013; Govindan et *al.*, 2010; Wagner, 2006; Bayne, 2010; Fernie & Thorpe, 2007). However, in contrast to the extensive adoption of supplier development practices in the manufacturing sector, the construction sector has been slow in adopting supplier development practices. Several challenges minimize the full integration of suppliers into the construction supply chain (Dainty, Millet, & Briscoe, 2001). Particularly, the extensive use of 'one-time' short term contracts cause construction supply chains to suffer from project uniqueness and non-repetition which hinders long-term cooperation and benefits from supply chain management (Tey, Yusof, Ismail, & Wai, n.d.; Papadopulos, Zamer, Gayialis, & Tatsiopoulos, 2016). Also, skepticism regarding the motives of supply chain management practices limit its implementation in the construction sector (Dainty et *al.*, 2001). Lastly, the heterogeneity of construction parties from different disciplines, organizations, and cultures further complicates supply chain management processes, which have extensive and interrelated tasks that have to be completed over a relatively short period of time (Tey et *al.*, n.d). Nevertheless, considering the heavy dependence of GCs on SCs during construction processes, the adoption of supplier development practices could improve SC performance, particularly for specialized construction projects with requirements beyond the traditional performance requirements - quality, schedule, and cost (Mokhlesian & Holmen, 2012, Ofori-Boadu et *al.*, 2012; Dainty et *al.*, 2001; Tey et *al.*, n.d.). SCs provide many key inputs for success and so GCs rely heavily on SC performance, particularly for specialized construction projects such as Leadership in Energy and Environmental Design (LEED) projects which have additional sustainability performance requirements beyond the traditional construction project requirements (Fagbenle et *al.*, 2018; Ofori-Boadu et *al.*, 2012; Bayraktar & Owens, 2010; Dainty et *al.*, 2001; Mokhlesian & Holmen, 2012).

In order to improve the environmental performance of buildings, LEED rating systems provide four building certification levels (namely, platinum, gold, silver and certified) that meet six credit categories viz: location and transport, sustainable sites, water efficiency, energy and atmosphere, materials and resources and indoor environmental quality (USGBC, n.d.). However, due to the evolving nature of the LEED process, SC risks result in delays, cost overruns and inability to obtain LEED certification (Ofori-Boadu et *al.*, 2016; Li et *al.*, 2011; and Anderson, 2012). This is because SCs do not understand LEED requirements and are unwilling to invest additional resources for success (Ofori-Boadu et *al.*, 2016). The delivery of capability of GCs is highly dependent on SC performance, particularly for projects with additional environmental performance requirements such as Leadership in Energy and Environmental Design (LEED) projects (Fagbenle et *al*., 2018; Ofori-Boadu et *al.*, 2012). LEED commercial rating systems include: building design and construction; interior design and construction; and operations and maintenance. Due to the evolving nature of the LEED certification process and the learning curve associated with LEED project delivery, SC risks result in delays, cost overruns and inability to obtain LEED certification (Ofori-Boadu et *al.*, 2016; Li et *al.*, 2011; and Anderson, 2012). Ofori-Boadu et *al.* (2016) noted that SCs are the primary source for both technical and managerial challenges associated with LEED projects because they did not understand LEED requirements and are unwilling to invest additional resources to ensure LEED project success. Nevertheless, with the global push for green built environments, successful GCs need a network of high-performing SCs to ensure LEED certification is achieved within pre-defined quality, budget, time, and environmental performance targets. Mokhlesian & Holmen (2012) emphasized that successful partner networks are important in business models for green construction as partners complement each other and provide expertise that will help minimize risks associated with evolving and complex nature of sustainable projects.

Hollobaugh (2011) and Ofori-Boadu et *al.*, (2016) noted that contractors should protect themselves and minimize SC risks on LEED projects through: additional prequalification requirements; extensive LEED project documentation; inclusion of LEED-specific clauses in SC agreements; implementation of LEED checklists and standard procedures; and LEED specific onsite training. SCs with a good working

understanding of the LEED certification standards and a plan for achieving these standards will be better prepared to meet LEED project needs and be more attractive to GCs engaged in the development of green buildings (Tijsseling, 2009). GCs need a network of competent SCs to compete effectively in the growing global sustainable construction market and contribute successfully to the environmental performance of sustainable buildings (Tufts, 2016; Li et *al.*, 2011). In order to remain competitive in global markets with increasingly complex requirements, buying organizations in the manufacturing industry have addressed similar challenges in the performance of their network of suppliers for specialized products and processes by developing and implementing supplier development programs (Hahn et *al.*, 1990; Amad et *al.*, 2008). Similar to buying organizations in the manufacturing sector, GCs need high-performing SCs to ensure performance requirements such as LEED certifications are achieved (Hollobaugh, 2011; Ofori-Boadu et *al.*, 2016; Tijsseling, 2009; Tufts, 2016; Li et *al.*, 2011).

Buying organizations in the manufacturing sector have addressed similar challenges in the performance of their network of suppliers for specialized products and processes by developing and implementing supplier development practices for improved performance (Hahn et *al.*, 1990; Amad et *al.*, 2008). Buyer-supplier relationships, as inter-organizational or intra-organizational relationships, are formed to improve operational and environmental performance, as well as competitive advantage for both buyer and supplier in a dyadic exchange context (Autry & Golicic, 2010; Rashidi & Saen, 2018; Agan et *al.*, 2016). The relationship between the development of green suppliers and their performance is statistically significant, with green supplier development as a mediating relationship between green procurement and supplier performance. (Kumar & Rahman, 2016; Biome et *al.* 2014). Ofori-Boadu et *al.* (2016) recommended an industry-wide promotion of SC development programs to improve SC performance.

While few short-term supplier development practices have been implemented by large GCs, local governments, and non-profit organizations in the construction sector, long-term supplier development programs in small and medium-sized construction contracting organizations were not found in literature nor in practice (Papadopulos et *al.*, 2016; Dainty et *al.*, 2001; Ofori-Boadu et *al.*, 2012; Clark

Construction, 2018; Turner Construction, 2018; Choate, 2018; and HITT, 2018). In particular, the important role played by SCs in GC performance, necessitates that subcontractor development practices programs (SDPPs) are implemented in the construction sector. Although supplier development practices have been effective in improving supplier performance in the manufacturing industry, caution must proceed its adoption and implementation in the construction industry due to operational differences that exist between these sectors. Theories and research to guide supplier development in the construction sector are scanty, evolving and confusing (Tey et al., n.d.). Considering its potential benefits, research and industry commitment is needed to support its adoption and implementation (Dainty et *al.*, 2001). Papadopulos et *al.* (2016) emphasized that considering the lack of academic studies and the increased interest of large construction companies to improve supply chain, research into more structured approaches of subcontractor development is needed.

Consequently, drawing primarily from supplier development practices foundational theories in the manufacturing sector, the purpose of this paper is to present a conceptual model of subcontractor development practices programs (SDPPs), which has the potential to improve SC performance on LEED projects. Findings should expand supplier development practices theories and frameworks in the manufacturing sector to guide subcontractor development research and practice in the construction sector.

Literature Review

Research has mostly focused on the contribution of suppliers to the performance and success of buying organizations in the manufacturing sector (Glock et *al.*, 2017; Carr et *al.*, 2008; Corsten & Felde, 2005; Amad et *al.*, 2008; Nagati & Rebolledo, 2013; & Krause & Scannell, 2002). Supply chain research in the construction sector has focused on characteristics, problems, roles, relationships, knowledge, and human resource development (Papadopulos et *al.*, 2016; Dainty et *al.*, 2001; Tey et *al.*, n.d.). These researchers concur that compared to the construction sector, supplier and subcontractor development in the manufacturing sector is more systematized and involves more structured programs involving training, consulting, and feedback (Papadopulos et *al.*, 2016). This is important as suppliers provide specified

material and services to meet pre-defined objectives associated with quality, time, cost, safety and environmental performance. In recent times, suppliers are required to assume additional responsibilities and achieve more complex performance requirements (Amad et *al.*, 2008; Krause & Scannell, 2002). Without effective management, suppliers present risks to buying organizations that result in low performance, poor productivity, low customer satisfaction, strife, legal action, losses, delays, poor reputation, reduced business opportunities and smaller market shares. Many buying organizations report the need for supplier improvements in quality, cost, delivery, innovation and product design; moreover, they indicate that suppliers' future capabilities may not meet future expectations and needs of buying organizations without some form of intervention (Krause & Scannell, 2002). Consequently, proactive buying organizations have devised aggressive and continuing SuDPs (Amad et *al.*, 2008).

For supplier development practices success, Hahn et *al.* (1990) proposed frameworks as a purchasing function to secure competent supply sources that provide an uninterrupted flow of required materials at a reasonable cost and involves selection of competent suppliers and working with them to minimize deficiencies and upgrade capabilities. In the construction sector, vertical and horizontal flows of materials and information exist among buyers, contractors, and suppliers (Tey et *al.*, n.d). In order to remain competitive, buyer organizations are increasingly implementing supplier development practices because the quality and cost of a product or service offered is a function, not only of the capabilities of the firm, but also of the supplier network that is capable and provides the inputs to the enterprise. (Modi & Mabert, 2007; Amad et *al.*, 2008). Management improvements include training, resource sharing, capacity building, informal supplier evaluation, feedback of supplier evaluation results, raised performance expectation, formal supplier evaluation, supplier certification, supplier recognition and direct capital investment (Krause, 1995 in Amad et *al.*, 2008; Awasthi & Kannan, 2016). Well-designed supplier development practices are initiated by buying organizations and prioritize resolving challenges (Batson, 2002; Frahm 2003; Amad et *al.*, 2008). Hahn et *al.*, (1990) noted that SDPPs must be recognized by top management, implemented by a team or department and include performance evaluations. Glock et *al.* (2017) noted that supplier development consists of three main steps:

(1) Preparation: The buying organization evaluates whether supplier development measures will be valuable;

(2) Development: The buying organization selects suppliers, identifies attributes that require development, and makes decisions on appropriate supplier development measures;

(3) Monitoring: The buying organization continuously monitors the supplier development measures to ensure that expected outcomes are met.

Following Hahn et *al.*, (1990), subsequent supplier development strategies recommended by Krause et *al.* (2000) were in four categories: (1) Competitive pressure is applied by buying organizations when they are able and willing to switch to another supplier, when dissatisfied with their existing supplier (Dyer and Ouchi, 1993). Using market forces and competitive pressure, organizations utilize multiple supplier sources to provide materials or services so that the organization can distribute their business opportunities to the network of suppliers - with higher volumes of business allocated to the highest performing suppliers (Modi and Mabert, 2007). Service firms rely to a greater extent on competitive pressure of market forces to instigate supplier performance when compared to product-based firms (Krause & Scannell, 2002); (2) Incentives such as awards, sharing of cost savings, and consideration for future business are offered by the buying organization to encourage suppliers to improve their performance (Modi & Mabert, 2007*).* Product-based firms rely to a greater extent on assessment, incentives and direct involvement to instigate supplier performance when compared to service firms (Krause & Scannell, 2002). According to Amad et *al*., (2008), successful supplier development practices involve presenting awards to recognize and motivate best suppliers; (3) Direct Involvement allows the buying organization takes a proactive approach in guiding and developing suppliers through a very direct involvement such as investing in human resource development and making capital and equipment improvements in supplier operations (Modi & Mabert, 2007). Amad et *al.* (2008) noted that buying organizations with supplier development activities require substantial reliance on the suppliers. Minimal involvement from the buying organization with little intent of developing closer relationships with the suppliers generate severe challenges, which minimize sustainable performance improvements. Furthermore, with support from top

management, buying organizations develop internal supplier certification programs to minimize inspections and guarantee consistent performance (Amad et *al.*, 2008);

(4) Evaluation and Certification Systems allows supplier performance and client expectations to be communicated to suppliers through regular supplier evaluation and feedback (Modi & Mabert, 2007). It is critical that suppliers are aware that their performance is compared with a pre-defined standard to motivate them to improve their performance and receive associated rewards. Common performance measures that buying organizations utilize in the evaluation of suppliers include various aspects of cost, delivery, innovation, product service, quality, quality program, responsiveness, technology, administrative and customer service (Amad et *al*., 2008). Drawing from supplier development practices foundational principles by Krause et *al.* (2000), Glock et *al.* (2017), and others, a conceptual framework for subcontractor development practices programs (SDPPs) for the construction sector is proposed.

SDPP Conceptual Model

The SDPP conceptual model involves a three-stage process: (1) Preparation; (2) Development and implementation; and (3) Monitoring. They are in a sequential process flow from top to bottom and highlight the processes within the GC organization that ensure that feasibility and preparation is assessed, resources are made available for implementation, and the program is monitored for continuous improvement (Figure 1). This process model reflects the organizational change process in other models for quality management (Cheng & Heng, 2001). Drawing from supplier development practices literature for the manufacturing sector, Figure 1 shows that the five critical categories positioned within the last two phases of the three-phased process are:

Category 1 - Pre-qualification of SCs (PS)

The complexity and additional requirements for 21st century construction projects are beyond traditional performance requirements making it very critical for GCs to implement pre-qualification strategies for assessing the competence and preparedness of SCs prior to their engagement on a project (Tijsseling, 2009; Anderson, 2012). A successful program should begin with a proper selection process that will

ensure a fit between the SC and GC with selection consideration focusing on cost, technology, quality, investment in development and design, management and strategic plan and response time (Amad et *al*., 2008).

Fig. 1. A Conceptual Model for SDPP

Typical specific pre-qualification and selection requirements for LEED projects include SCs having a LEED-AP on staff; being a member of USGBC; demonstrating prior green or LEED project experience; having top executive committed to support the program; and demonstrating commitment to mentor other SCs (Hollobaugh, 2011; Ofori-Boadu et *al.*, 2016; Krause et *al*., 2000; Ofori-Boadu et *al*., 2012). Top management must identify critical pre-qualification requirements and provide resources to sustain the process to ensure that both the GC and the SC are successful (Amad et *al*., 2008).

Category 2 - Incentives to SCs (IS)

Incentives will motivate SCs to improve their performance with the expectation of receiving rewards. SC incentives include being on a preferred SC list, being rewarded with increased work volume for high performance, receiving awards at ceremonies, and sharing cost savings with GCs (Ofori-Boadu et *al*., 2012; Krause et *al*., 2000; and Modi & Mabert, 2007).

Category 3 - Direct Involvement of GCs (DG)

GCs can commit resources to develop strategies to strengthen specific SC competencies and resources. GCs have to be involved in SC development activities and performance in order to have an impact (Kraus & Ellram, 1997). Involvement includes contributions to SC finances; organizational development; GC visits to SC premises; lending of GC employee to SC for short periods; training and education of SC personnel; GC provision of training to SC; GC payment of SC employee test and training fees; and SC mentoring (Anderson, 2012; Ofori-Boadu et *al*., 2012; Krause et *al*., 2000; Kraus & Ellram, 1997; Modi & Mabert, 2007; & Hollobaugh, 2011). Close relationships between GCs and SCs communicate GC expectations and improves SC awareness (Amad et *al*., 2008). Trust and preferred SC status are key

antecedents of SC participation and have a positive influence on their operational performance (Nagati & Rebolledo, 2013)

Category 4 - Subcontractor Commitment (SCC)

SCC relational commitment is critical for the success of SDPPs. Relational commitment is defined as the existence of belief held by exchange partners that the ongoing relationship with another party is very important and demands their maximum input and effort (Morgan & Hunt, 1994). SC-specific activities are predictors of outcomes (Amad et *al*., 2008). Both GCs and SCs need good attitudes, commitment, and good communication to strengthen trust and information exchange (Amad et *al*., 2008). SC commitment is demonstrated through meeting attendance; technical information sharing; employee rewards; employee training; green building department; and mentoring of other SCs (Anderson, 2012; Ofori-Boadu et *al*., 2012; Ofori-Boadu et *al*., 2016; Krause et *al*., 2000; Modi & Mabert, 2007; Ofori-Boadu et *al*., 2016; & Hollobaugh, 2011).

Category 5 - Evaluation and Feedback to SC (SE)

Formal evaluation and feedback practices by GCs ensures that SCs understand their current performance and compare it with expected performance (Modi & Mabert, 2007). An evaluation system includes visits to SC premises, monitoring of SC performance to provide feedback, and corrective actions to restore poor performing SC and minimize SC switching costs (Amad et *al*., 2008). GCs can use formal evaluation systems and certification programs to motivate SCs to improve performance (Krause et *al*., 2000; Ofori-Boadu et *al*., 2012). Successful SCs will contribute to the subcontractor development program, while unsuccessful SCs will exit GCs network of suppliers due to continued low performance. Considering that formal and established long-term SDPPs are uncommon in the construction sector and the proposed conceptual model was derived mostly from literature on the manufacturing sector, the perceptions of construction professionals (CPs) are needed to validate the potential effectiveness of SDPPs towards future replication in the construction sector.

Methodology

This research adopts a mixed interpretivist and empirical methodology, which involved an initial examination of existing literature on supplier development theories and practices towards the development of a survey with the five SDPP categories in the proposed conceptual model (Figure 1). The self-reporting survey questionnaire explored construction professionals' (CPs) perceptions of the potential effectiveness of the 37 subcontractor development practices. Section 1 of the survey requested the background of the CPs and their organizations. The first part of Section 2 required CPs to use a five-point Likert scale to rate the level of effectiveness of 37 practices. The second part of Section 2 had open-ended questions where CPs provided expert opinions on technical and managerial challenges, management strategies, and whether SCs needed to pay participation fees. The structured and unstructured sections of the survey allowed the collection of data that permit generalization as well as provide rich meanings that enhance understanding of perceptions and experiences of construction professionals (de Vaus, 2014). A purposive non-random sampling method targeted construction professionals (CPs) with sustainable construction development experiences, and had some levels of affiliation with the construction program in an institution located in the southeastern region of the United States. Purposive sampling permitted the robust selection of information-rich cases related to the phenomena of interest and its inherent bias contributed to its efficiency as the reliability and competence of the informant was assured (Tongco, 2007; Palinkas, Horwitz, Green, Wisdom, Duan, & Hoagwood, 2015, 533). Out of 50 surveys that were emailed to the CPs, 30 surveys were returned resulting in a response rate of 60%. The non-respondents were mostly subcontractors from smaller organizations.

Sixty-one percent (61%) of the CPs were from organizations with annual revenues exceeding $500 million, and 14% had annual organizational revenues ranging between $100 million and $500 million. Seventy-nine percent worked in organizations that had been established for over 31 years with over 51 employees. Eighty-two worked with GCs and 54% had completed over 21 LEED projects. Fifty-seven percent had a Bachelor's degree and 29% had a master's degree. Forty-three percent of CPs were LEED-Accredited professionals (LEED-APs). The CPs had a variety of position titles to include: Project Engineer (29%); Project, Construction, Contract, or Operations Manager (39%); Estimator (7%);

Sustainability or BIM Coordinator (7%); and President or Vice-President (18%). This variation allowed a variety of perspectives to be included in the research study results. The mean working experience and completed LEED projects of all of the CPs was 14.64 years and 5.43 LEED projects. Data analysis involved the use of weighted means and standard deviations to rank SC development practices. Using the five effectiveness ranks listed in Table 1, practices were ranked based on their means and standard deviations.

Table 1. SDPP Effectiveness Ranks

Practices with the highest means and lowest standard deviations received the highest effectiveness ranks, while practices with lowest means and highest standard deviations received the lowest effectiveness ranks.

T-tests were used for testing for statistically significant differences existing between the perceptions of GCs and SCs. Although the sample size is small, t-tests can be used for extremely small sizes and as low as two (deWinter, 2013; Student, 1908). In this research project, where the focus is on a specialized group of CPs with personal and organizational experience in LEED projects, this sample size is adequate. However, findings should be interpreted with caution due to the small sample size and the focus on LEED projects.

Findings

Effectiveness of SDPPs

The overall weighted mean for the five SDPP categories was 3.38 with SE receiving the highest rating ($\bar{X}$= 3.68) and DG receiving the lowest rating ($\bar{X}$=2.97). Weighted means for SCC, IS, and PS were 3.48, 3.40, and 3.38 respectively. With the overall mean weighted rating ($\bar{X}$=3.38) of the five SDPP categories exceeding 3.00, CPs agreed that the SDPPs would be somewhat effective in improving SC performance. While the first four categories (Subcontractor Evaluation, Subcontractor Commitment, Incentives to Subcontractor, and Prequalification of Subcontractors) had means between 3.68 and 3.38, a gap existed

between the mean of the fourth category (Prequalification of Subcontractors) and the mean of the fifth category (Direct Involvement of GCs). This statistically significant difference ($p < 0.01$) indicated that there was agreement among both GCs and SCs that GC direct involvement in SC organization should be limited in SDPPs.

Subcontractor Evaluation (SE) Category: SE was the most effective category as 100% of its practices received a mean rating exceeding 3.0, and a standard deviation of 1.00 or less (Table 2). High ratings were because SE provides the greatest opportunity for the GC to evaluate SC performance and provide feedback for SC improvement. This provides SC the opportunity to improve, while allowing GCs the opportunity to assess the returns on their investment and make a decision regarding SC retention or elimination. Various forms of practices in the SE category are currently used on traditional construction projects, and so CPs were familiar with these practices and had confidence in the effectiveness of these practices because past positive results in research and practice are well-documented. With the highest mean ($\bar{X}$= 4.07) and lowest standard deviation of 0.80, the most effective practice in the SE category was related to the GCs providing feedback to SCs regarding their performance on construction projects. Formal and standard procedures to compare the current performance of SCs with their expected performance should be included in formal contracts between GCs and SCs, so that GCs clearly communicate expectations to SCs. This ensures that SCs better understand performance requirements and have adequate time to prepare to meet or exceed these requirements. GCs should communicate detailed evaluation results to SCs to ensure that SCs are aware of strengths and weaknesses and have the opportunity to improve on weaknesses. Frequent feedback will provide SCs with timely guidance to reduce the gap between their current performance and their expected performance.

Table 2. Ranking of SC Development Practices

With the lowest mean and highest standard deviation, GCs providing SCs with feedback on all other competing SCs received the lowest ratings. This is because competitive advantage may be lost if SCs feedback is shared with all other SCs. Furthermore, there could be issues associated with privacy and

362 confidentiality. Nevertheless, the sharing of SC evaluation and feedback with all competing SCs could
363 facilitate peer learning and minimize challenges associated with long learning cycles. SCs could learn
364 from best practices and avoid mistakes made by other SCs.
365 *Subcontractor Commitment (SCC) Category*: With a mean of 3.48, SCC received the second highest
366 rankings (Table 2). The most effective practice was related to the training and education of SC
367 employees. Eighty-six percent of the CPs believed that SCC practices would be 'always effective' or
368 'mostly effective'. Practices including SCs meeting attendance, goal statements, proprietary information
369 sharing, employee rewards, GC premise visits, and separate systems for tracking LEED costs received
370 mean ratings exceeding 3.0. The practices with the lowest ratings were for SCs establishing a separate
371 LEED department and mentoring other SCs. These were low because CPs believed that that few SCs
372 generated enough LEED project revenues to merit a separate LEED department. These practices place
373 demands to ensure the full commitment of SCs. Training and education on the specific performance
374 requirements related to the specific expertise or scope of work of the SC is critical for SC employees to
375 improve performance. While, there are many external education and training programs, in-house training
376 is also recommended. In-house training allows the more experienced SC employees to transfer relevant
377 SC expertise knowledge and skills to the less experienced employees within the SC organization. The
378 practice with the second highest mean and the second lowest standard deviation is related to SCs sharing
379 all LEED related challenges with the GCs in a timely manner. Solutions to any project challenges are
380 most effective when the challenges are identified early and solutions are developed and implemented in a
381 timely manner to address specific challenges. Since SCs are the most knowledgeable of the processes
382 associated with their expertise, they are most likely to identify challenges before GCs. It is critical that
383 challenges are communicated early to the GC to ensure timely correction. Practices related to SCs having
384 their own department and mentoring other SCs received the lowest ratings with standard deviations
385 greater than 1. Eleven percent of respondents believed that these practices would never be effective. This
386 is because these two practices will require SCs to commit additional time, budgets, and effort - and the
387 return on their investment may not be worthwhile. Since these two practices are currently not common

practice in the construction industry, the CPs were unsure of their effectiveness in improving SC performance. Furthermore, due to the competitive nature of the construction business and resource limitations, high-performing SCs struggle with the idea of mentoring low-performing SCs who are most likely to be their potential competitors on future projects. Although the benefits of mentoring are well-documented, CPs indicated that mentoring would reduce the competitive advantage of the high-performing SCs over the low-performing SCs; and, hence high performing SCs may not be as willing to mentor low-performing SCs. Consequently, it will be beneficial for GCs to offer some form of incentives to encourage high-performing SCs to mentor low-performing SCs.

Incentives to Subcontractor (IS) Category: With the mean rating of 3.40, this was the third most effective category and showed that incentives can motivate SCs towards high performance (Table 2). The practice with the highest mean, lowest standard deviation, and with no respondents selecting 'never effective' was to reward SCs with increased volume of work. This will provide opportunities for SCs to generate more revenues and profits. Ceremonial awards to recognize high performing SCs received the lowest ranking, with 18% of respondents indicating that it is never effective. With their short-term projections, GCs were not prepared to invest into ceremonial awards and many CPs placed little value on these awards.

Prequalification of Subcontractor (PS) Category: With its mean rating of 3.38, PS was the fourth most effective category. Its most effective practices included ensuring that SCs have experts on staff, demonstrate prior experience, and SC top management demonstrate commitment to SDPPs. Through SDPPs, a long list of SCs for sourcing can be prepared and after initial evaluations, SDPP SCs will be selected through a well-defined and fair pre-qualification process (Rashidi & Saen, 2018). In order to be successful, the GC should go beyond traditional relationships with SCs to demonstrate high levels of commitment that will ensure that the SDP is beneficial to both the GC and SC. SC demonstration of prior experience and the commitment of top management to SDPPs received the two highest rankings. It is important that during the pre-qualification of SCs for LEED projects, it is determined that SCs are both willing and able to complete projects successfully. A formal SDPP application process will allow GCs to detail specific criteria and fairly compare SCs for a more effective selection process. As assessment of the

414 commitment of SC leadership to performance requirements can predict the extent to which SC can meet
415 or exceed project requirements. The least effective practice was related to SCs mentoring other SCs. In
416 agreement with the low mean rating provided to mentoring in the SCC category, a low mean rating was
417 obtained for SCs mentoring other SCs in this category as well. Eleven percent (11%) of CPs believed this
418 would never be effective, while only 7% of respondents believed that this practice would always be
419 effective. Challenges associated with competitive advantage, resource availability, resource sharing, and
420 trust are the reasons for these low ratings for peer SC mentoring.

421 *Direct Involvement of GC Category*: With the lowest mean of 2.97, the DG category was ranked as
422 having the least effective practices (Table 2). The DG practice with the highest mean ($\bar{X}$ = 3.79) was
423 related to GCs providing SCs with education and training. Many of the practices in this category received
424 mean ratings lower than 3.0 with up to 39% of CPs indicating that GC investments in SC organization
425 would never be effective. Direct involvement of GCs received the lowest ratings because of the high costs
426 and closer collaborative efforts required for direct GC involvement in SDPPs. SCs are not comfortable
427 with GC knowing too many details about their establishment, as it becomes easier for GCs to identify
428 weaknesses within the SC organization. Also, GCs are not so willing to invest finance, time and effort
429 into improving the performance of SC because they simply do not have the funds and resources.
430 Furthermore, GCs find it difficult to assess the profitability of such an investment due to lack of trust and
431 uncertainties regarding SC long-term commitment to the SDPP (Batson, 2002; Frahm 2003; Amad et *al.*,
432 2008). Lastly, while common in the manufacturing sector, most of the DG practices are currently not
433 actively implemented in the construction sector. Consequently, these practices are highly unfamiliar to
434 both GCs and SCs, and there is little evidence to validate application and effectiveness in the construction
435 sector. CP may be unwilling to adopt and implement these practice without additional evidence and
436 frameworks to guide the adoption and implementation. Additional research to validate the practical
437 application and benefits of direct involvement to GCs in SC organization towards improved SC
438 performance could gain the attention and perhaps, increase the adoption and diffusion of these practices.

Nevertheless, although the ratings were low, potential benefits cannot be underestimated. GC provision of education and training to SCs would be beneficial as GCs could promote their internal processes to ensure their effective control of SCs performance on construction projects. Training and education would ensure that the SC is familiar and able to contribute effectively to the processes implemented by GCs. Customized plans by GCs to improve SCs performance received higher ratings compared to generic plans. This is because generic plans are inherently unable to adequately address the unique challenges and conditions that are persistent in different SC organizations. By customizing the plans, GCs can develop strategies that will be most effective in specific SC circumstances and these would better improve SC performance.

Practices associated with GCs lending their employees to SCs for a short period; allowing SC employee to join GC staff temporarily for mentoring; and GC investing in SC operations received low mean ratings. This is because CPs are largely uncomfortable with sharing resources because these practices are unfamiliar, uncommon, and costly. Trust issues between SCs and GCs and skepticism regarding motives could hinder the sharing of resources (Dainty et al., 2001). Nagati and Rebolledo (2013) suggested that trust is a key antecedent of the participation of suppliers in supplier development practices and have a positive impact on their operational performance. Both SCs and GCs will be more willing to commit to a long-term SDPP, if they are convinced that it will contribute to a common purpose.

Independent sample t-test results revealed that statistically significant differences exist between GC and SC perceptions in SDPP categories PS ($p=0.001$), SCC ($p=0.006$), and ES ($p=0.000$). Compared to SCs, GCs provided higher ratings because these practices were more familiar, well-documented, placed more responsibilities on SCs, and could improve SC performance. SCs provided lower ratings because these practices required them to commit more time, resources and effort to projects.

SC payment for Participation in SDPPs

Sixty-one percent of the CPs indicated that SCs do not have to pay for SDPP participation. Forty-four percent of related comments indicated this is because SDPPs are the responsibility of GCs. Thirty-eight

464 percent indicated that payment would be a disincentive to SCs, while 19% stated that the fee should be
465 passed on to the owner. One hundred percent of the SCs stated that SCs did not have to pay for SDPP
466 participation, and this is because they did not want to incur any additional costs. This is especially so
467 because there is very little evidence to justify the benefits of SDPPs to the SCs in the construction sector.
468 One CP noted that if the correlation between SDPPs and increased volume of work and profitability is
469 established, then SCs will be willing to pay for participation, if necessary. Thirty-nine percent indicated
470 that SCs should pay for participation. Sixty percent of the comments implied it was because it would
471 benefit the SC, while 40% alluded that it would increase SC commitment.
472
473
474
475 **Practical Implications**
476 From a management perspective, the practical implementation of well-designed SDPPs by GCs could
477 improve SC performance on construction projects. Drawing from table 2, figure 2 presents practices
478 ranked according to their level of effectiveness. Considering budget, time, and resource limitations, GCs
479 can initially allocate their limited resources to the more highly ranked SDPP practices (R1-R3) shown in
480 figure 2, as they initiate SDPPs in their organizations. Through effective SC pre-qualification,
481 commitment, incentives, evaluation and feedback, GCs can equip SCs with the competencies and
482 resources that support performance improvements. These practices focus on shaping SCs with minimal
483 mentoring and resource sharing between GCs and SCs.
484 **Fig. 2.** Ranked subcontractor development practices
485 The lower ranked practices that are considered by CPs to have lower levels of effectiveness (R4 & R5 in
486 figure 2) were mostly associated with increased direct involvement between GC and SC organizations.
487 These are considered less favorable by CPs due to unfamiliarity, varying roles, limited resources,

conflicting interests, trust issues, and resource-sharing situations that are uncomfortable to both GCs and SCs. GCs are unwilling to invest adequate time, budgets, effort and other resources into the development of the SC organization. SCs are unwilling to expose various details of their organization to GCs, particularly their weaknesses. Nevertheless, these lower ranked practices should not be dismissed easily. Rather, strategies for building trust and improving collaboration among GCs and SCs should be explored further. Lean Construction, particularly The Last Planner System, is credited for the promotion of effective project-based trust and collaboration building strategies to include enhanced data sharing and strong personal/peer relations among key construction team members for improved supply, workflow, quality, productivity, safety, and customer satisfaction (Lean Construction Institute, 2019; Lean Construction Institute, 2015; McGraw Hill, 2013). Project-based partnering concepts have also been promoted to increase partners' focus on building trust and developing non-adversarial relationships to reduce risks in construction project management; however, discrepancies have been found to exist between theory and practice. Integrated organization-wide trust building should focus on relationships between the trustor (SC) and trustee (GC) with particularly emphasis on strategies that enhance characteristic trust building, rational trust building, and institutional trust building as proposed for supply chain partner relationships (Laeequddin, Sahay, Sahay, & Waheed, 2012; Mayer, Davis, & Schoorman, 1995; Doney & Cannon, 1997). Over time, improved confidence in partner (characteristics, behavior, competence, reliability, technology, and institutional systems) is likely minimize risk perceptions and improve trust and collaboration between GC and SC.

Both GCs and SCs must be commit critical resources to SDPPs during the preparation, development and monitoring of the SDPP. GCs have to implement strategies to convince SCs that SDPPs will be mutually beneficial. SDPP effectiveness will be enhanced, if both GCs and SCs link their SDPPs with their overall corporate performance improvement strategy. This is likely to lead to improved SDPP effectiveness and improved SC performance. With little known about the effectiveness of these practices, CPs showed some restraint in expecting significant results from unfamiliar practices such as GC investing in SC operations.

513 Additional research will provide increased knowledge, understanding, and evidence to justify adoption
514 and practice in the construction sector. Documented SDPP successes from real-life case studies are likely
515 to reduce the negative attitudes towards resources sharing and mentoring among construction
516 professionals; particularly, if findings demonstrate positive SDPP impacts. Organization wide adoption
517 could equip GCs with a strong network of high-performing SCs. Consequently, GCs would have
518 performance capabilities exceeding that of their competitors, and these would lead to improvements in
519 GC competitiveness, market share, revenues, and profits.

520 **Theoretical Implications**

521 Despite the fact that supplier development theories and practices have improved supplier performance in
522 the manufacturing sector, they have not been adopted and implemented in the construction sector due to
523 the lack of knowledge, understanding, and evidence to justify their feasibility or effectiveness. Very little
524 research was found on SC development practices in the construction sector, although GCs depend largely
525 on SCs for success. Consequently, construction sector decision makers are less likely to adopt SDPPs,
526 despite the potential to improve SC performance. The proposed SDPP framework provides theoretical
527 foundations to support future research that would guide and advance the modification of existing supplier
528 development theories and practices in the manufacturing sector, so that it can be easily adopted in the
529 construction sector. The proposed practices are by no means exhaustive and Amad et *al*., (2008) and
530 Frahm (2003) concurred that there can be numerous deficiencies and challenges in SDPPs. Future
531 research should assess the effectiveness of SDPP case studies for different types of construction projects
532 and project delivery systems to advance the ease of adoption and diffusion of SDPPs across the
533 construction industry. Effective SDPP best practices research should consider the unique conditions of
534 GC and SC organizations towards developing customized SDPPs tailored to improve specific SC
535 performance. In the long term, effective SDPPs could improve the overall performance of GCs network
536 of SCs for improved competitive advantage and revenues.
537

Conclusion

The need for a strong network of high performing SCs is critical for GCs to remain competitive in the today's construction industry. Drawing from supplier development program theories in the manufacturing sector, the findings indicated that the conceptual model for a well-designed, three-phased SDPP comprising of five SDPP categories of 'ranked' effective SC development practices could improve SC performance. Theoretical contributions expand supplier development theories and foster future research that extends beyond the manufacturing sector into the construction sector.

SC pre-qualification, commitment, incentives, and evaluation practices are perceived to have the highest potential to be effective because they are familiar, well-documented, well-tested, and affordable to both GCs and SCs. More direct involvement and linkages between GCs and SCs are perceived to have the least potential to be effective due to challenges associated with trust, unfamiliarity, costs, resources, and resource-sharing between GCs and SCs. Due to the role differences and conflicts of interests, significant differences exist between SC and GC perspectives on SDPP practices. Future research studies should assess the effectiveness of real-life SDPP case studies for different construction projects and delivery systems, to assess their effectiveness in improving SC performance. Furthermore, the tailoring of SDPPs to meet specific cultural, industry and organizational environments should enhance effectiveness and performance improvement efforts of GCs and SCs.

Long-term vis-à-vis short-term commitments to SDPPs will enhance success and impact on SC performance. In the long-term, practical and consistent application of the SDPP could improve GC performance, productivity, profits, competitiveness and market share in the global construction industry.

References

Agan, Y., Kuzey, C., Acar, M. F., and Acikgoz, A. (2016), "The relationships between corporate social responsibility, environmental supplier development and firm performance." *Journal of Cleaner Production,* Vol. 112, pp. 1872 – 1881.

Amad, L. C., Hamid, A. B. A., Salleh, N. M., & Choy, C. S. (2008), "Adapting buyer-supplier relationship practices in the local industry." *Asian Academy of Management Journal,* Vol. 13 No. 2, pp. 17 – 32.

Anderson, J. W. (2012), "Be certain that subcontractors are 'on board' with LEED requirements", *SPOTTS FAIN,* available at: https://www.spottsfain.com/publications-archive/be-certain-that-subcontractors-on-board-leed-requirements (accessed 4 December 2018)

Autry, C.W., and Golicic, S. L. (2010), "Evaluating buyer-supplier relations-performance spirals: a longitudinal study. *Journal of Operations and Management,* Vol. 28, pp. 87 – 100.

Awasthi, A. & Kannan, G. (2016), "Green supplier development program selections using NGT and VIKOR under fuzzy environment", *Computing and Industrial Engineering,* Vol. 91, pp. 100 – 108.

Batson, R. (2002), "Getting started in a supplier improvement initiative", *Proceedings of the 56th Annual Quality Congress,* Denver, from ABI/INFORM Global.

599 Bayraktar, M. E. and Owens, C. R. (2010), "LEED Implementation guide for construction
600 practitioners." *Journal of Architectural Engineering,* Vol. 16 No. 3, pp. 85 – 93.
601 Biome, C., Hollos, D., and Paulraj, A. (2014), "Green procurement and green supplier development:
602 antecedents and effects on supplier performance", *International Journal of Production Research,* Vol. 52,
603 pp. 32 – 49.
604 Bayne, L. (2010), "Supplier Development Practices", Dissertation for University of Capetown, available
605 at: https://open.uct.ac.za/handle/11427/10106 (accessed 6 June 2019)
606 Carr, A. S., Kaynak, H., Hartley, J. L., and Ross, A. (2008), "Supplier dependence: Impact on supplier's
607 participation and performance." *International Journal of Operations & Production Management,* Vol. 28
608 No. 9, pp. 899 – 916.
609 Cheng, E. W. l. & Heng, L. (2001), "Development of a conceptual model of construction partnering",
610 *Engineeirng, Construction and Architectural Management,* Vol. 8 No. 4, pp. 292 – 303.
611 Choate Construction (2018). "LEED EXPERIENCE", available at:
612 http://www.choateco.com/sustainability/leed-experience/ (accessed 29 December 29 2018)
613 Clark Construction (2018), :"Subcontractors", available at:
614 https://www.clarkconstruction.com/subcontractors (accessed 29 December 2018).
615 Corsten, D. and Felde, J. (2005), "Exploring the performance effects of key supplier collaboration: An
616 empirical analysis into Swiss buyer-supplier relationships*", International Journal of Physical*
617 *Distribution & Logistics Management,* Vol. 35 No. 6, pp. 445 – 461.
618 Dainty, A., Millet, S. J., and Briscoe, G. H. (2001). "New perspectives on construction supply chain
619 integration", Supply Chain Management, Vol. 6 No. 4, 163 – 173.
620 De Vaus, D. (2014), "Surveys in social research", New York, NY: Routeledge.
621 deWinter, J. C. F. (2013), "Using the student's t-test with extremely small sizes", *Practical, Assessment,*
622 *Research, & Evaluation,* Vol. 18 No. 10, pp. 1 – 12.
623 Doney, P.M. and Cannon, J.P. (1997), "An examination of the nature of trust in buyer-seller
624 relationships", *Journal of Marketing,* Vol. 61 (April), pp. 35-51.
625 Dyer, J. H. and Ouchi, W. G. (1993), "Japanese-style partnerships: Giving companies a competitive
626 edge", *Sloan Management Review,* Vol. 35 No. 1, pp. 51 – 63.
627 Fagbenle, O., I., Joshua, O, Adedeji, A., Ojelabi, R., Fagbenle, O., Fagbenle, A., and Akomolafe, M.
628 (2018), "A framework for enhancing contractor-subcontractor relationships in construction projects in
629 Nigeria", *Construction Research Conference,* New Orleans, U.S.A.
630 Fernie, A. and Thorpe, A. (2007), "Exploring change in construction: Supply change management".
631 Engineering, Construction and Architectural Management, Vol. 14 No. 4, pp. 319 – 333.

632 Frahm, S. (2003). “Supplier development: A survey of risks and benefits”, available at:
633 https://scm.ncsu.edu/scm-articles/article/supplier-development- a-survey- of-risks-and-benefits
634 (accessed 28 December 2018)
635 Govindan, K., Kannan, D., and Haq, A. N. (2010), “Analyzing supplier development criteria for an
636 automobile industry”, *Industrial Management and Data Systems*, Vol. 110 No. 1, pp. 43 – 62.
637 Glock, C. H., Grosse, E. H., and Ries, J. M. (2017), “Decision support models for supplier development:
638 Systematic literature review and research agenda”, *International Journal of Production Economics*, Vol.
639 193, pp. 798 – 812.
640 Hahn, C. K., Watts, C. A., and Kim, K. Y. (1990), “The supplier development program: A conceptual
641 model”, *Journal of Purchasing and Materials Management*, Vol. 26 No. 2, pp. 2 – 6.
642 HITT (2018). “Building a sustainable future”, available at: https://hitt.com/sustainable-construction
643 (accessed 20 December 2018)
644 Hollobaugh, L. (2011), “Commentary: Four tips for managing subcontractor risks on sustainable
645 projects”, *Engineering News and Record*, available at: https://www.enr.com/articles/21566-commentary-
646 four-tips-for-managing-subcontractor- risks- on-sustainable-projects?page=1 (accessed 15 December
647 2018)
648 Hosseini, A., Windimu, P., Klakegg, O. J., Anderson, B., and Laedre, O. (2018), “Project partnering in
649 the construction industry: Theory vs. Practice”, The Engineering Project Organization Journal, Vol. 8, pp.
650 1 – 24.
651 Kraus, D. R. and Ellram, L. M. (1997), “Success factors in supplier development”, *International Journal*
652 *of Physical Distribution & Logistics Management*, Vol. 27 No. 1, pp. 39 – 52.
653 Krause, D. R. (1995), “Inter-organizational cooperation in supplier development: Influencing factor”,
654 Unpublished dissertation, Arizona State University.
655 Krause, D. R. and Scannell, T. V. (2002), “Supplier development practices: Product and service- based
656 industry comparisons”, *Journal of Supply Chain Management*, Vol. 38 No. 2, pp. 13 – 21.
657 Krause, D. R., Scanell, T. V., and Calantone, R. J. (2000), “A structural analysis of the effectiveness of
658 buying firms’ strategies to improve supplier performance”, *Decision Sciences*, Vol. 31 No. 1, pp. 33 – 55.
659 Kumar, D. and Rahman, Z. (2016), “Buyer supplier relationship and supply chain sustainability:
660 empirical study of Indian automobile industry”, *Journal of Cleaner Production*, Vol. 131, pp. 836 – 848.
661 Laeequddin, M., Sahay, B. S., Sahay, V., and Waheed, K. A. (2012),"Trust building in supply chain
662 partners relationship: an integrated conceptual model", *Journal of Management Development*, Vol. 31 Iss.
663 6, pp. 550 – 564.

Lean Construction Institute (2019), "Lean Construction Defined", available at https://www.leanconstruction.org/wp-content/uploads/2019/06/LeanConstructionDefined.pdf (accessed on 14 June, 2020).

Lean Construction Institute (2015), "Last Planner System: Business process standard and guidelines", available at https://www.leanconstruction.org/media/docs/chapterpdf/israel/Last_Planner_System_Business_Process_Standard_and_Guidelines.pdf (accessed on 14 June 2020).

Li, Y. Y., Chen, P.-H., Chew, D. A. S., Teo, C. C., and Ding, R. G. (2011), "Critical project management factors for AEC firms for delivering green building projects in Singapore", *Journal of Construction Engineering and Management*, Vol. 137 No. 12, pp. 1153 – 1163.

Mayer, R.C., Davis, J.H. and Schoorman, F.D. (1995), "An integrative model of organizational trust", *Academy of Management Review*, Vol. 20 No. 3, pp. 709-34.

McGraw Hill (2013), "Lean Construction: Leveraging collaboration and advanced practices to increase project efficiency", available at https://www.leanconstruction.org/media/docs/Lean_Construction_SMR_2013.pdf (accessed on 14 June 2020).

Modi, S. B. and Mabert, V. A. (2007), "Supplier development: Improving supplier performance through knowledge transfer", *Journal of Operations Management*, Vol. 25, pp. 42 – 64.

Mokhlesian, S. & Holmen, M. (2012), "Business model changes and green construction processes", *Construction Management and Economics, Vol, 30* No. 9, 761 – 775.

Morgan, R. M. and Hunt, S. D. (1994), "The commitment-trust theory of relationship marketing", *Journal of Marketing*, Vol. 58, pp. 20 – 38.

Nagati, H. and Rebolledo, C. (2013), Supplier development efforts: The suppliers' point of view", *Industrial Marketing Management*, Vol. 42, pp. 180 – 188.

Ofori-Boadu, A. N., Addo, L. and Adebakin, M. (2016), "An integrated approach for addressing LEED project challenges." *IOSR – Journal of Business and Management*, Vol. 18 No. 9, pp. 91 – 98.

Ofori-Boadu, A. N., Shofoluwe, M., Adebakin, M. & Waller, L. (2016), "A framework for the comprehensive management of LEED project documents: Lessons from construction professionals." *Proceedings of the 2016 International Conference on Technology Management (ICTM)*, pp. 181 - 190.

Ofori-Boadu, A. N., Owusu-Manu, D-G, Edwards, D., & Holt, G. (2012), "Exploration of management practices for LEED project: Lessons from successful green building contractors", *Structural Survey*, Vol. 30 No. 2, pp. 145 – 162.

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research. *Administration and policy in mental health*, *42*(5), 533–544. doi:10.1007/s10488-013-0528-y

Papadopulos, G., Zamer, N., Gayialis, S. P., & Tatsiopoulos, I. P. (2016), "Supply chain improvement in the construction industry", Universal Journal of Management, Vol. 4 No. 10, pp. 528 – 534.

Rashidi, K. and Saen, R. F. (2018), "Incorporating dynamic concept into gradual efficiency: Improving supplier in sustainable supplier development", *Journal of Cleaner Production,* Vol. 202, pp. 226 – 243.

Student (1908), "The probable error of a mean", *Biometrika,* Vol. 6 No. 1, pp. 1 – 25.

Sucky, Durst, (2013), "Supplier development: Current status of empirical research", *International Journal of Procurement Management,* Vol. 6 No. 1, pp. 91 – 127.

Tey, K. H., Yusof, A. M., Ismail, S., Wai, S. H. (n.d.), "New perspectives on evolutionary supply chain management in construction", available at http://www.ipedr.com/vol45/024-ICMTS2012-M00024.pdf (accessed on 10 October 2019)

Tijsseling, C. (2009). "Subcontractors should take the LEED." *Association of Construction and Development.* available at: http://www.associationofconstructionanddevelopment.org/articles/view.php?article_id=1_0502 (accessed on 28 December 2018).

Tongco, M.D.C. (2007), "Purposive sampling as a tool for information selection", *Ethnobotany Research and Applications, Vol. 15,* 147 – 158.

Tufts, R. (2016), "LEED by the numbers: 16 years of steady growth", *U.S. Green Building Council (USGBC) articles, available at:*https://www.usgbc.org/articles/leed-numbers-16-years-steady-growth (accessed December 28, 2018)

Turner Construction (2018), "Turner School of Construction Management", available http://www.turnerconstruction.com/office-network/somerset/community-involvement/turner-school-of-construction-management (accessed on December 29, 2018).

U.S. Green Building Council (n.d.), "LEED v4: impact category and point allocation development process", available at: http://www.usgbc.org/sites/default/files/LEED%20v4%20Impact%20Category%20and%20Point%20Allocation%20Process_Overview_0.pdf (accessed 8 January, 2019).

Villanueva-Ponce, R., Avelar-Sosa, L., Alvarado-Iniesta, A., and Cruz-Sanchez, V. G. (2015), "The green supplier selection as a key element in a supply chain: A review of case studies", *DYNA* Vol. 82 No. 194, pp. 36 – 45.

Wagner, S. M. (2006), "Supplier development practices: an exploratory study", *European Journal of Marketing,* Vol. 40 No. 5/6, pp. 554-571.