Journal of Cleaner Production 124 (2016) 339–349

Contents lists available at ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

# Leadership competences of sustainable construction project managers

Amin Akhavan Tabassi*, Kamand M. Roufechaei, Mahyuddin Ramli, Abu Hassan Abu Bakar, Radzi Ismail, A. Hamid Kadir Pakir

*School of Housing, Building and Planning, Universiti Sains Malaysia (USM), 11800 Penang, Malaysia*

ARTICLE INFO

*Article history:*
Received 21 January 2014
Received in revised form
16 February 2016
Accepted 16 February 2016
Available online 2 March 2016

*Keywords:*
Leadership competence
Project manager
Transformational leadership
Sustainable building construction

ABSTRACT

The building industry has been acknowledged as being vital in stimulating societal change toward sustainable development in a global context. From a theoretical perspective, this study extends leadership competencies and transformational leadership qualities as hierarchical, reflective constructs, integrating ten associated components. The research analysis was completed using a sample population of 70 project managers in sustainable building projects. The model shows that leadership competencies, as well as the transformational leadership qualities of project managers as second-order reflective constructs experience a direct impact on the success criteria for sustainable buildings. In addition, the results indicate that the intellectual competence of project managers plays the most significant role in sustainable building achievements. In general, the present study extends some of the significant components from leadership assessment in the context of construction project managers in sustainable building projects and has generated a new model to facilitate the process of sustainability in the industry.



## 1. Introduction

Over the past decades local and international communities have recognized the construction industry, and particularly the building sector, as vital in encouraging societal change toward sustainable development in a global context (Maliene and Malys, 2009; Ofori, 2008; Tsai and Chang, 2012). Chapter 7 of the United Nations Earth Summit Agenda 21 (2009), the action blueprint for "promoting sustainable human settlement development" advocates the promotion of sustainable construction industry activities and working together to take action towards achieving sustainable human resource development and capacity-building for human settlement development. In this regard, construction leaders and/or project managers of sustainable projects by transforming subordinates as well as influencing them (Tabassi et al., 2012; Northouse, 2007; Purvanova and Bono, 2009), may achieve better sustainable performance. In sustainable construction development, a leader by his/her leadership style and the way of managing the project, as well as the subordinates can also transform the project toward sustainability and achieve better productivity.

From another viewpoint, the critical role of project manager in sustainable development inspired the Leadership in Energy & Environmental Design (LEED) Rating System to incorporate some of the project management improvement tools into the latest overhauling of the Rating System LEED v3. Following that, 50 points (5% of the total marks assigned to seven different assessment categories of Green Globes) allocate to project management and especially to those related with increasing functionality and flexibility of the construction teams (Kubba, 2010), which is mainly relevant to the leadership style of the leader.

On the other hand, leadership discipline shows emerging trends; the expectation is that the concept of leadership will evolve (Daft and Pirola-Merlo, 2009) with performance improvements for organizations. But there is a lack of enough research on leadership in sustainable development, particularly in the construction industry. As a result, the current study aims to contribute to the existing literature on evolution of the leadership theories such as those presented by Bass (1985), Bass and Avolio (1997) and Daft and Pirola-Merlo (2009), but by focussing on the role of leaders and their leadership style towards sustainable development.

Although there are many definitions and explanations for leadership, it "is one of the most observed and least understood phenomena on earth" (Burns, 1978). Accordingly, clarifying leadership is difficult largely because the nature of leadership itself is complicated (Tabassi and Bakar, 2010). Despite the multitudes of

* Corresponding author. Tel.: +60 174709240; fax: +60 46576523.
*E-mail addresses:* akhavan.ta@gmail.com (A.A. Tabassi), kamand84@gmail.com (K.M. Roufechaei), mahyudin@usm.my (M. Ramli), abhassan@usm.my (A.H.A. Bakar), radhi.ismail@gmail.com (R. Ismail), hamka1@usm.my (A.H.K. Pakir).

http://dx.doi.org/10.1016/j.jclepro.2016.02.076
0959-6526/

ways that leadership has been conceptualized, Tabassi and Bakar identified the key components associated with the leadership phenomena and defined it as a process whereby a leader with his intelligence and willpower has a bearing on a group of subordinates to be able them to develop their potentials so as to attain the organizational objectives within granted time, funding, and quality.

In addition, managers are able to perform better if their management competence and personal characteristics fulfil the demands of the job position (Mumford et al., 2000; Müller and Turner, 2010; Avolio et al., 1999). However, there are accepted approaches to determine the characteristics and competence of leaders in different industries. For instance, the Leadership Development Questionnaire (LDQ) technique has been used by different researchers indifferent industries such as the British police (Hawkins and Dulewicz, 2007), the Royal Air force (Wren and Dulewicz, 2005), and in the engineering and construction industries, as well as the information and telecommunication industries by Müller and Turner (2010). Aside from LDQ, there are other theories to evaluate the leadership qualities of managers such as those presented by Bass (1985), Avolio et al. (1999), Daft and Pirola-Merlo (2009), etc. During almost all these studies a wide range of measurements were applied with regard to weighing and evaluating the correlations of leadership styles with performance indicators. However, there is still a lack of sufficient evidence in the leadership competence of project managers and success criteria in sustainable construction projects.

Nevertheless, strength in terms of sustainability, particularly in the construction industry of developing countries, is undoubtedly still not at an adequate level; and developing countries like Malaysia have only just commenced to deal with the challenges of sustainable development in the building industry. Accordingly, research on building sustainable development and leadership phenomena in the industry can have a constructive influence on sustainable project development and drive forward a future plan for effective performance in the construction sectors, especially in Malaysia. On the flip side, the majority of research in sustainable development in the industry accentuated on design concepts for sustainability (e.g. Tsai and Chang, 2012; Sieffert et al., 2014) and, therefore, not enough research has been performed on leadership competencies and quality practices of the leaders in sustainable development of building projects. As a result, a key significance contribution of the study that also distinguishes it from other publications in sustainable building construction is it centreing on leadership competences of those project managers engaged with green building projects. Accordingly, the research has been designed to build a model to study the most effective leadership competence in sustainable building construction in order to answer the following question:

Does the leadership style of the leaders affect the achievement in success criteria of the green building projects?

### 1.1. Sustainable building construction

Raised consciousness of the demand for sustainable development was mentioned in both national and global debates from the early 1970s (Passmore, 1974). After that, the promotion of sustainable development approaches has framed the vision and mission of almost all industries including the construction industry in terms of sustainable performance, which works for equilibrium among economic, social and environmental operations. With the Brundtland Commission report published in 1987 (Brundtland, 1987), frameworks for sustainable development have emerged globally, nationally and locally by organizations in every area in which human beings affect the environment (Roufechaei et al., 2014). Accordingly, sustainable building construction plays a major role in terms of the human impact on the natural environment and on the quality of life (Anink et al., 1996; Lu and Zhang, 2016). Several researchers have considered the building industry as a sector with an ability to satisfy high levels of human needs as well as sustainable development requirements (Anink et al., 1996; Maliene and Malys, 2009; Lu and Zhang, 2016). For instance, Anink et al. (1996) acknowledged that the building industry accounts for a considerable portion of the world's environmental wreckage, as buildings account for 17% of the world's fresh water withdrawals, 25% of the world's wood harvest, 40% of the world's materials and energy flows (World Energy Outlook, 2011), and approaching major path of employment and land usage. In connection to above, Lu and Zhang (2016) emphasised that ignorance of environment friendly construction works could result in significant issues to the nations. However, sustainable building as a holistic policy proactively considers the broader issue of the global environment together with local traditions. With the intention of dealing with the required services of buildings, such as heating and cooling, illumination, water and power controls, buildings crank out substantial amounts of Green House Gas (GHG) emissions, up to 30% of total GHG emissions annually (Chou and Yeh, 2015), and ozone-depleting gases during their life cycles, which has a tremendous effect on the environment (Melchert, 2007; World Energy Outlook, 2011). Furthermore, during the construction, operation and maintenance and end of life of construction projects, there are many types of pollution and undesirable effects on the environment. In particular, the industry drains more than 50% of extracted materials, generates 180 million tons of waste every year, and causes site related nuisances such as traffic, noise, etc. (World Energy Outlook, 2011). The U.S. Department of Energy (USDOE) appraises that buildings are the reason for 73.6% of total electricity costs and 40% of overall carbon emissions (USDOE, 2012 cited in Zhang et al., 2015b). Therefore, the management in this industry needs to take account of all conditions and sustainability attitudes within project design, construction, and maintenance. Accordingly, the building industry as a feature of sustainable development has composed its own “social”, economic, and “spatial” environment, in which a wide range of building forms can be found with different architectural and engineering shape and design. Nevertheless, one of the innovative goals today is to investigate sustainable alternatives for buildings from an economic, social-psychological and ecological point of view and to increase global experience and apply it in a creative manner so as to reach higher standards of economic and social welfare (Roufechaei et al., 2014). On top of that, building premises ought to be designed based on the conditions of that locality and meet with the established technical and hygiene requirements (Maliene and Malys, 2009). To achieve sustainable building construction, Nelms et al. (2005) concluded that the replacement of conventional construction methods and technologies with those that reduce the ecological, health, and environmental life cycle impact are also necessary to trigger the application of sustainable development concepts in the design, construction, and operation and maintenance of buildings. In addition, Lu and Zhang (2016) proposed that the construction industry should relocate from serving only green projects to “green/sustainable” organizations that straighten up with business sustainability that is going to interact with different stakeholders, corporate decision makers, project managers and alike.

The promotion of sustainable practice in building development has led in the advancement of numerous green strategies mainly with regard to enhancing environmental performance in the process of building construction (Zhang et al., 2011). The promotion of green strategies in housing development, for instance, has made a significant contribution to the implementation of sustainable development principles. Deb et al. (2000) proposed that “investing

in green housing can achieve not only high standards of environmental performance but also social performance, which can help build advantage to attract customers". Hence, sustainability in the context of building development is a complex, controversial, and challenging phenomena (Pakir et al., 2012). Definitions assigned to the sustainable building construction approach have gone through several interpretations with different practitioners (Maliene and Malys, 2009; Melchert, 2007; Zhang et al., 2011); however, ongoing interpretations stress that sustainable building construction should be cost-efficient throughout its life cycle, cosy, affordable to maintain and conform to the physical and bio-cultural aspects of the environment. In line with this, the new version of LEED set the following criteria as rating system for sustainable building measurement (Kubba, 2010):

- Sustainable sites (26 pts)
- Water efficiency (10 pts)
- Energy and atmosphere (35 pts)
- Materials and resources (14 pts)
- Indoor environmental quality (15 pts)
- Innovations in design (6 pts)
- Regional priority (4 pts)

### 1.2. Success criteria for sustainable building projects

The most critical aspect of sustainable building is the wide variety of suggestions attempting to fill the gap between the current situation and visions for the future (Shriberg, 2002). Since each country and region has its own climatic conditions and cultural patterns, a traditional settlement and building form or 'vernacular architecture' should be the basis for the solutions for each individual situation. Consequently, the success criteria for sustainable building construction may vary from country to country. But the concept that has been acknowledged as a general rule is that to minimize environmental damages, the construction industry has incorporated "green" among the key project management directions. For that reason, an increasing number of construction organizations have initiated determining issues around different aspects of sustainability as main essentials for improving the organization's performance and success (Zhang et al., 2015a). Accordingly, managers in the industry need to contemplate all associated variables to sustainable building construction, which are influenced by the conditions and cultural aspects of the region. For instance, protecting a building from sun and heat plays a significant role in areas which are hot during the summer time, while the issues in areas with a cold climate are quite different (Oktay, 2002). Buildings should also be contemplated in terms of the site conditions, project environment, and cultural aspects, as well as other features such as aesthetics, over shading, self-shading, vegetation and pollution in terms of sustainable development (Edwards, 2005).

In addition, sustainable buildings may be defined as 'energy efficient' or 'low carbon' buildings (Lovell, 2004). From this point of view, Seyfang (2010) stated clearly the technologies and designs which deliver lower zero carbon homes.

Agenda 21 of the United Nations Conference on Environment and Development (UNCED) encouraged nations with the support of international organizations to develop, apply and initiate the required methods for sustainable development. This includes developing quality-of-life indicators addressing, for instance, health, social wellbeing, environment and the economy (UN, 1992). Subsequently, a scheme for sustainable development was clearly articulated in the 7th Malaysian Plan. The plan outlined innovative procedures to enrich Malaysia's ability to develop sustainability. In the building industry in sustainable development practices, the Malaysian government through the Tenth Malaysian Plan (2011–2015) stresses simplifying the affordable housing delivery system, reinvigorating efforts to deliver high quality and environmentally sustainable building, and cultivating a healthy and sustainable building industry. Consequently, the Government with the aid of the Construction Industry Development Board (CIDB) has encouraged building providers to be certified, mainly for the recruitment of skilled and qualified labour and the enhancement of construction processes toward sustainable development. Consistent with the above, it needs to be considered that the Malaysian government has been encouraging the development of sustainable building since 2006 in the Ninth Malaysian Plan. In addition, the Government launched a new policy called the National Green Technology Policy in 2009. The policy has tried to lead the country towards energy efficiency and sustainable development, particularly in the building industry. The Government also provides some incentives for developers to strengthen green building practices in Malaysia. For instance, the planning approval for sustainable buildings is easier to obtain when compared to a conventional building (Alias et al., 2010).

On top of that, the Building Research Establishment Environmental Assessment Method (BREEAM) was set up in the United Kingdom in 1990 as the first environmental certification system. Following that, the sustainable qualification system was introduced in the United States by the U.S. Green Building Council (USGBC) in 1998, which was called LEED green building rating system that structured quite on the BREEAM rating system. The Green Globes rating system is also an adaptation of the Canadian version of BREEAM and was launched in the US by the Green Building Initiative in 2005. There are a number of different rating systems employed in nations around the world, such as GRIHA in India, CASBEE in Japan, BEAM in Hong Kong just to name a few, with its benefits and drawbacks relying on the method of qualification aimed for a particular building/construction project (Kubba, 2010). In Malaysia, the Malaysian Institute of Architects shaped a Sustainability Committee which was set up primarily to develop the Green Building Index (GBI) and the associated Panel for accreditation and qualification of green-rated buildings in August 2008. The GBI Building Rating tools evaluate the sustainable features of buildings based on six key criteria as shown in Table 1. Accordingly, these particular criteria are used as success criteria and are measured on 5 point Likert scales to assess project managers' level of achievement in their sustainable building projects.

The above criteria encourages developers and building owners to ponder the environmental quality of these buildings and associated inhabitants via enhanced site selection, provisions to gain access to public transportation, improved community services and connectivity, as well as advanced infrastructure.

### 1.3. Leadership

In the twenty-first century a higher premium is placed on effective leadership than ever before. Reviewing the leadership

**Table 1**
Key criteria for evaluating success sustainable building construction used for this study.

| Success criteria |
|---|
| Energy Efficiency (EE) |
| Indoor Environment Quality (EQ) |
| Sustainable Site Planning & Management (SM) |
| Materials and Resources (MR) |
| Water Efficiency (WE) |
| Innovation (IN) |

theories and literature of the past decades indicates that while leadership has been broadly studied in organization management literature (Müller and Turner, 2010; Yukl, 2002), it is still a dynamic concept for the development of communication channels toward others and influences the group for goal accomplishment (DuBrin, 2004). However, the broad concept of leadership can be summarized in three interrelated domains: personal characteristics of the leader, leadership style and situational theories (Fryer et al., 2004). In other words, leadership is a dynamic behaviour and a leader's role with regard to an ideal style varies with different circumstances and traits. Consequently, no ultimate leadership behaviour exists (Yukl, 2002) and the many ways that leadership has been conceptualized will influence the relationship among leaders and followers who intend real changes and outcomes that reflect their shared purposes (Daft and Pirola-Merlo, 2009). Therefore, dealing with rapid, complex, and often discontinuous change requires effective leadership. While the importance of leadership has long been recognized as a success factor for organizations, in regard to project context there have still not been enough empirical studies to support the association between leadership style and project success (Müller et al., 2012; Yang et al., 2014), particularly in the context of sustainable construction. However, overall project success consists of several dimensions that depend on the manager's leadership style (Bass, 1985; Chan and Chan, 2005) and competences (Boyatzis, 1982; Dulewicz and Higgs, 2005). Corresponding to the competence school of leadership, Dulewicz and Higgs (2005) performed a comprehensive review of current theories and determined fifteen leadership dimensions that can be grouped under two competences; intellectual (IQ) and managerial (MQ), and a personal characteristic measurement named emotional and social dimensions (EQ).

According to Jones et al. (2015), projects' executive leadership plays an important role on sustainability within which the success of sustainable projects rests on effective leadership competencies of the leaders. Moreover, Jones and colleagues stressed that to be able to ensure the achievement of sustainable development project managers within construction, manufacturing, and other project based industries need to inspire team members to mature sustainable projects within the daily process of satisfying client and project requirements. In addition, the recent call for papers for a special volume of the Journal of Cleaner Production put a great deal of emphasis on cohesive and practical leadership behaviour and actions across different disciplines, businesses, industries and countries to put together enhanced alternatives for sustainability (Broman et al., 2014). Lu and Zhang (2016) also reviewed different sustainability rating systems around the globe and concluded that the sustainability in the construction industry is highly focused on the green projects, such as the quantities, sizes, and values of final products of environmentally friendly projects, rather than on sustainable management in the process of doing the projects. On top of that, Zhang (2015) expressed on the importance of management in a sustainable construction industry by pointing at the effects of management activities on “high initial cost”, “high environmental requirements”, and “complex processes of green projects”. Nevertheless, sustainability at the corporate and organizational level is much ignored. The rational of this insolvent exposure is worth further research from both academia and the industry. After all, leaders in the organizations tend to be the key driving actors in order to promote the sustainability in the industry (Lu and Zhang, 2016; Zhang, 2015). Consequently, in line with the importance of leadership research on sustainable development the current study targeted to assess the influences of intellectual and managerial competencies of the leader on success of a sustainable building project. Therefore:

*Hypothesis 1: Leader intellectual competence is positively related to the success criteria of the projects.*

*Hypothesis 2: Leader managerial competence is positively related to the success criteria of the projects.*

Based on the above statements, it may be determined that leadership behaviour plays a continuously important role in project effectiveness and productivity. Leaders help the team breach boundaries to build relationships and support one another, scouting for the necessary information to accomplish objectives and achieve success (Murphy and Ensher, 2008). In particular, some scholars have specified the features of the leadership style that affect performance (Ayoko and Callan, 2010; McColl-Kennedy and Anderson, 2002; Murphy and Ensher, 2008). In this regard, a transformational leader has been found to promote project effectiveness. Transformational leaders are those who exhibit individualised consideration behaviour and are able to influence the employee's constructive reaction, which accordingly results in high employee performance (McColl-Kennedy and Anderson, 2002). Transformational leaders aim to transform individuals so that go beyond the status quo with the purpose of improving the ability to innovate and adapt in the team environment (Tabassi et al., 2014). On the grounds that the main focus of the study is centred on sustainable development and hence one of the variables of sustainability is social concerns, therefore, transformational leadership as a humanistic way to manage the subordinates (Tabassi et al., 2014) has been regarded to be assessed among the project managers in sustainable building projects.

Numerous studies dealing with transformational leadership (Avolio et al., 1999; Bass and Avolio, 1997; Daft and Pirola-Merlo, 2009; Northouse, 2007), have addressed different aspects of measuring the quality of transformational leaders. In this regard, Daft and Pirola-Merlo (2009) developed a questionnaire to assess the quality of transformational leadership in two dimensions; “develop followers into leaders” and “inspire followers to go beyond their own interest”. Aside from that, Broman et al. (2014) stressed on application of transformational leadership towards sustainable societies as a research area that essential for professionals and researchers to come up with the necessary local, regional, national and global changes on the way to sustainable growth. Therefore:

*Hypothesis 3: The transformational leadership behaviour of the project manager is positively related to the success criteria of the projects.*

On the other hand, preceding research on leadership outlined that the leader's ability to foster cooperative goals and motivate followers to attain such goals highly influences project performance (Müller and Turner, 2010; Yukl, 2002; Bass, 1985). Alternatively, Hersey and Blanchard's situational theory (1974) emphasises the different leadership styles of a leader based on a combination of task and relationship behaviours. Likewise, Northouse (2007) stated that “effective leaders are those who can change their own style based on the task requirements and the subordinates' needs, even in the middle of a project”. Consequently, different conditions may affect the leadership behaviour of a leader. Nevertheless, there has not been enough research on the effect of leadership competences and transformational leadership qualities on success criteria in sustainable building projects.

Accordingly, this study evaluated the leadership competence and the quality of transformational leadership of the project managers in sustainable building projects based on the works of Dulewicz and Higgs (2005) and Daft and Pirola-Merlo (2009).

**Table 2**
Ten leadership competencies and qualities assessed by the research.

| Group | Attributes | Reference |
|---|---|---|
| Intellectual competence | - Critical analysis and judgement<br>- Vision and imagination<br>- Strategic perspective | Dulewicz and Higgs (2005) |
| Managerial competence | - Resource management<br>- Engaging communication<br>- Empowering<br>- Developing<br>- Achieving | Dulewicz and Higgs (2005) |
| Transformational leadership qualities | - Develops followers into leaders<br>- Inspire followers to go beyond their own interest | Daft and Pirola-Merlo (2009) |

Table 2 shows the leadership competences and transformational leadership qualities assessed in this study.

A 5-point Likert scale (ranging from "not at all" to "a very great extent") was used to measure the quality of transformational leadership and the competencies of project managers in sustainable building projects.

### 1.4. Sustainable development and leadership

Growth attempts to take account of social requirements while taking care to reduce possible harmful environmental effects known as "sustainable development" (Hill and Bowen, 1997). The administration for sustainable development is generally distinct from conventional ecological management practices, which focuses more on systemic modification along with productivity enhancement metrics (Richards and Gladwin, 1999). Although during the past decades comprehensive literature has coated the concepts and feasible frameworks for sustainable building construction, such as that of Hill and Bowen (1997), Ofori (2008) and Shriberg (2002), even now there are disagreements concerning the ideally suited pattern of sustainable building construction and ongoing construction methods. This is due to difficulties in acknowledging the principles of sustainability in construction practices (Lam et al., 2011).

As outlined by Shriberg (2002), a management system for sustainability needs to incorporate the organizational culture and the environment within which the ecological, economic and social consequences are involved. Furthermore, Shriberg determined that the association of organizational management systems with the key aspects of sustainability requires complex strategies for operational and staff management procedures. Although the task of setting standards for sustainable development, particularly in the building industry, typically requires the scientific, governmental, corporate, and nongovernmental communities, the responsibility for guaranteeing sustainable building construction may fall on the part of managers and/or leaders in the industry (Lam et al., 2011; Ofori, 2008; Shriberg, 2002). However, a sustainable management model needs to be developed in order to counteract the harmful environmental issues of construction activities and to restore the environment. Consequently, an innovative and environmentally intelligent director and/or leader can minimize project costs, enhance service qualities, cut waste production and damaging ecological effects, in addition to strengthening the financial situation of the company (Shriberg, 2002). However, unproductive sustainable management, particularly in building planning and construction, has resulted in unsuccessful infrastructure investment and has caused restrictions for environmental cohesion (Chen et al., 2005). Accordingly, the most important aspects in executing a sustainability agenda may be linked to long term management decision making based on the social, environmental and economic aspects of sustainability.

Since the construction industry stands for one of the most dynamic and complex environments (Bresnen, 1990; Loosemore et al., 2003), managerial concerns and a challenging context for leadership trends are deemed necessary (Bresnen, 1990; Fellows et al., 2002). From this perspective, a need for effective leadership and management practices is particularly apparent within larger sustainable development projects, whose target is to deal with the execution process and leading different project teams during the construction process (Druker and White, 1995). Although leadership has been accepted as being a success component designed for a large number of organisations, there are not enough empirical studies to support an association between leadership competences or transformational leadership qualities of project managers with overall success in project-based environments (Kissi et al., 2013; Müller et al., 2012), particularly in sustainable development projects. Therefore, it is essential to evaluate aspects of leadership in terms of the competencies and the transformational leadership qualities of sustainable leaders as factors that can influence project success criteria.

## 2. Research methodology

This study proposes that leadership competences as well as transformational leadership qualities of project managers can be useful independent constructs in understanding how leadership behaviours influence the success criteria of sustainable building projects.

The research applies partial least squares (PLS) path modelling to assess the hierarchical hypothesised model in sustainable Malaysian building projects. For the purpose of data collection, survey questionnaire was distributed among the construction project managers in sustainable building projects. The questionnaires were primarily based on the Likert Scale of five ordinal measures from one (1) to five (5) according to the level of importance. The questionnaire was comprised of four sections and assessed the respondents' background, the leadership competences of the leaders (adopted from Dulewicz and Higgs, 2005) the transformational leadership qualities of project managers (Daft and Pirola-Merlo, 2009) and the attributes of success criteria for sustainable building based on the Malaysian GBI for new residential and non-residential buildings.

### 2.1. Sampling

The participants included 70 project managers from those projects that applied for or were certified by the GBI assessment of Malaysia. Three research officers were sent to companies in different locations in large cities in Malaysia such as Kuala Lumpur, Penang and Johor Bahru to deliver the questionnaires to the relevant respondents and to collect them for the purpose of data analysis. As a total of the project managers, 65.7% were male and 34.3% were female. The percentages of different races were Malay 28.6, Chinese 64.3, Indian 4.3, and other races 2.9%. In addition, the level of experience for the project managers in the construction industry revealed that 20% had 1–5 years of experience, 15.7% had 6–10 years' experience and 64.3% had been involved in the industry for more than 11 years. Regarding educational level, 88.6% had a bachelor's degree or higher, and 11.4% had acquired a diploma from junior colleges. The minimum sample size was checked and a reactive Monte Carlo analysis was performed (Chin, 1998). Accordingly, our sample size of 70 exceeded the recommended minimum of 56 deemed adequate for model testing (Green, 1991).

## 3. Data analysis

To assess the hierarchical hypothesised model, Smart PLS was applied to determine the parameters of the model. In this case, PLS

path modelling was used with a path-weighting scheme for inside approximation (Chin, 2010; Tenenhaus et al., 2005; Wetzels et al., 2009). Afterwards, nonparametric bootstrapping was applied with 200 replications to obtain the standard estimate errors (Chin, 2010). To evaluate the higher order latent variable, the method of repeated indicators was used as directed by Wold (1985), Lohmöller (1989) and Efron and Tibshirani (1993).

### 3.1. Managerial competence assessment

The study extends existing research by conceptualising the managerial competence as a hierarchical, reflective construct (Hulland, 1999) and examining its relationship with success criteria that assessed project managers' level of achievement in their sustainable building projects. It is proposed that the managerial competence, determined by evaluating how the five extracted attributes by Dulewicz and Higgs (2005), including resource management, engaging communication, empowering, developing and achieving (see Table 2), affect achieved success criteria. However, each dimension of the managerial competence reflects a unique belief, while the set provides a solid foundation for hierarchical managerial competence modelling in a nomological network. Fig. 1 shows the managerial competence as a second order hierarchical, reflective latent variable, which is formed by connecting it to the block of underlying first order latent variables.

The degree of explained variance in this hierarchical construct was reflected in its components: resource management (76.9%), engaging communication (88.3%), empowering (19.7%), developing (82.2%), and achieving (83%, see Table 3). All of the path coefficients from managerial competence to its components were significant at $p < 0.01$. Here, the CR and AVE of managerial competence were 0.941and 0.536, respectively, which are above the cut-off values.

### 3.2. Intellectual competence assessment

In a similar fashion, the study extended the intellectual competence as a hierarchical, reflective construct (Hulland, 1999) and evaluated its relationship with those success criteria. The intellectual competence of a project manager was also evaluated. This was identified through the three extracted attributes by Dulewicz and Higgs (2005), including critical analysis, strategic perspective and vision and imagination (see Table 2), which affect the attained success criteria in sustainable building projects. Furthermore, each dimension of the intellectual competence also echoes an exclusive perception; whereas, the specified component features a reliable basis for hierarchical intellectual competence modelling in a nomological network. The degree of explained variance in this hierarchical construct was reflected in its components: critical analysis (87.2%), strategic perspective (87.6%), and vision and imagination (65.3%, see Table 4). All the path coefficients from intellectual competence to its components were also significant at $p < 0.01$. The CR and AVE of intellectual competence were 0.926 and 0.514, respectively, which are above the cut-off values.

### 3.3. Transformational leadership qualities

As noted earlier, Daft and Pirola-Merlo (2009) identified two dimensions of transformational leadership: develop followers into leaders and inspire followers to go beyond their own self-interest. This research also adopted their questionnaire to measure transformational leadership qualities of project managers. The data on transformational leadership qualities was obtained at the team leader level and scored and interpreted based on the criteria defined by Daft and Pirola-Merlo (2009). In terms of developing followers into leaders, Daft and Pirola-Merlo recommended that a score of 24 or above (up to 30) on this dimension should be deemed as high, since “many leaders do not practice transformational skills in their leadership or group works”. A score of 18 is around average, and a score of 12 or below would be presumed as being below average. The result shows that the average for developing followers to leaders was 23.98. Consequently, the respondents showed a high level of developing followers to leaders. Appropriately, followers were granted more significant freedom to control their own behaviour. These kinds of transformational leaders placed their employees together and around the project objectives and outlined the boundaries within which followers might manoeuvre in relative freedom to complete organizational assignments. Furthermore, transformational leaders made their followers aware of problems and issues and helped them look at things in new ways so that change in productivity could be realized (Purvanova and Bono, 2009; Bass, 1985; Daft and Pirola-Merlo, 2009).

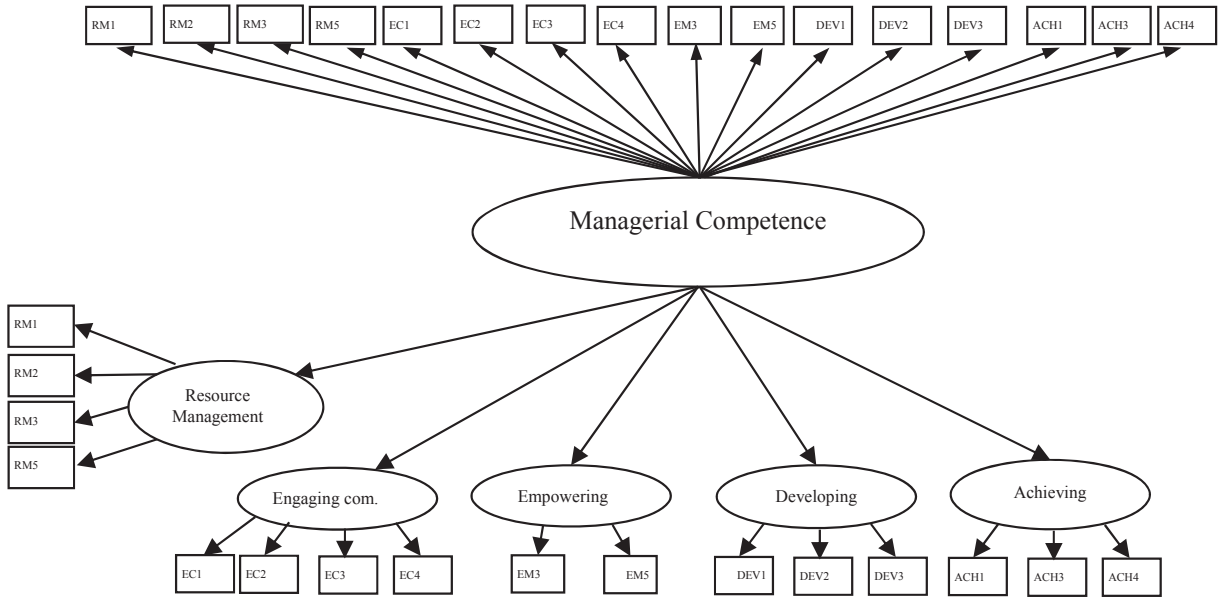


**Fig. 1.** Managerial competence as a second-order hierarchical model.

**Table 3**
Second-order managerial competence and its association with the first-order components.

| Resource management | Engaging communication | Empowering | Developing | Achieving |
|---|---|---|---|---|
| $R^2 = 0.769157$ | $R^2 = 0.883001$ | $R^2 = 0.197417$ | $R^2 = 0.821685$ | $R^2 = 0.829843$ |
| $\beta = 0.8477$ | $\beta = 0.9187$ | $\beta = 0.6584$ | $\beta = 0.8956$ | $\beta = 0.9063$ |
| $p < 0.01$ | $p < 0.01$ | $p < 0.01$ | $p < 0.01$ | $p < 0.01$ |

With regard to inspiring followers to go beyond their own self-interests, similarly, a score of 24 or more was also proposed as being high-transformational leadership qualities. From the survey results, the average of the questions associated with motivating followers to go beyond their own self-interests for the good of the group was 23.94. As a result, a good consideration of stimulating individuals to perform more than initially was expected of them was seen in the transformational leadership qualities of the respondents. These people informed followers of the worth of change objectives and, therefore, helped them to surpass their own present pursuits for the good of the group and to achieve organizational aims.

The study likewise prolonged the transformational leadership qualities as a hierarchical, reflective construct and assessed their relationship with the success criteria (Table 1). The degree of explained variance in this hierarchical construct was also reflected in its components: developing followers into leaders (97.5%) and inspiring followers to go beyond their own self-interest (96.7%, see Table 5). All the path coefficients from transformational leadership to its components were also significant at $p < 0.01$. The CR and AVE of this second order construct were 0.945 and 0.611, respectively, which are both above the cut-off values.

### 3.4. Model development and validation

To examine the attributes of the measurement scales, a confirmatory factor analysis (CFA) was carried out, based on Chin (2010), to evaluate the reliability, convergent validity, and discriminant validity of the scales (see Tables 6 and 7). Table 6 shows the common method variance (CMV) results. Accordingly, the average variance extracted (AVE) for all constructs was more than 0.5 (Fornell and Larcker, 1981), and the composite reliability (CR) of the constructs was above 0.7 (Gefen et al., 2000). As a result, CMV was not deemed to be a major issue in this study. As shown in Table 6, all item loadings were larger than 0.7 and significant at 0.01. As a result, the Vision and Imagination construct demonstrated the lowest CR of 0.765; even so, all of the values were greater than the recommended standard thresholds. The results also confirmed convergent validity since all indicators loaded significantly higher on their hypothesised component than on other variables (own construct loadings were greater than cross loadings; Chin, 2010). In addition, in Table 7, the square root of the AVE was calculated to guarantee the discriminant validity, which was greater than the inter-correlations of the construct with the other constructs in the model (Chin, 2010; Fornell and Larcker, 1981); nonetheless, there was no correlation above 0.9 among the constructs observed (Chin, 2010). Consequently, the proposed model was perceived to be satisfactory, with proof of sufficient reliability, convergent validity, and discriminant validity and was accepted for testing the hypotheses and verifying the research model.

**Table 4**
Second-order intellectual competence and its association with the first-order components.

| Critical analysis | Strategic perspective | Vision and imagination |
|---|---|---|
| $R^2 = 0.872285$ | $R^2 = 0.876312$ | $R^2 = 0.652551$ |
| $\beta = 0.9361$ | $\beta = 0.9449$ | $\beta = 0.7962$ |
| $p < 0.01$ | $p < 0.01$ | $p < 0.01$ |

**Table 5**
Second-order transformational leadership competence and its association with the first-order components.

| Inspire followers | Develop followers into leader |
|---|---|
| $R^2 = 0.968585$ | $R^2 = 0.975202$ |
| $\beta = 0.9842$ | $\beta = 0.9875$ |
| $p < 0.01$ | $p < 0.01$ |

### 3.5. Assessment of the structural model

In Table 8 and Fig. 2, the results give a standardised beta of 0.596 from intellectual competence to success criteria, 0.239 from managerial competence to success criteria, and 0.0953 from transformational leadership to success criteria. Thus, support could be found only for H1 and H2. For H3, the results show that the $p$ value was above 0.05, and therefore, transformational leadership did not have a positive significant relationship with success criteria in this model. However, the total $R^2$ for this model was 0.685.

### 3.6. Analysis of goodness-of-fit

Goodness-of-fit (GOF) (Tenenhaus et al., 2005) is employed to determine the overall fit of the model; GOF is the geometric mean of the average communality (outer measurement model) and the average $R^2$ of the endogenous latent variables. GOF signifies an index for validating the PLS model globally and seeks a compromise between the performance of the measurement and the structural model (Chin, 2010). Pursuing the instructions of Chin (2010), Vinzi et al. (2010) and Wetzels et al. (2009), the GOF value was computed. This value acted as a threshold value for the global validation of the PLS models. Accordingly, a GOF value of 0.7088 was achieved for the main model, which surpassed the threshold value of 0.36 for large $R^2$ effect sizes. Consequently, it can be concluded that the model has better detailing strength in comparison with the baseline values ($GOF_{small} = 0.1$, $GOF_{medium} = 0.25$, $GOF_{large} = 0.36$). This result also provides sufficient support to validate the PLS model globally (Vinzi et al., 2010; Wetzels et al., 2009).

$$GOF = \sqrt{\overline{AVE} \times \overline{R^2}} = 0.7088$$

## 4. Discussion and conclusion

The construction industry, particularly the building sector, plays an essential role in sustainable development in both developed and developing countries. A great deal of researchers have outlined different features of sustainability, particularly in the construction industry and a multitude of definitions and interpretations on building and sustainability have been presented throughout the literature. However, unlike developed countries, sustainability awareness issues in the construction industry of developing countries are usually low and developing countries like Malaysia have only just started to deal with the challenges of sustainable development in the construction industry in general. In sustainable building construction, a leader by his/her leadership competencies and the quality of managing the project, as well as the subordinates may also make the project more sustainable and achieve better productivity. Accordingly, research on sustainable building construction and leadership phenomena in the industry will be able to

**Table 6**
Common method variance.

| Construct | Item | Loading | AVE | CR |
|---|---|---|---|---|
| Achieving | ACH1 | 0.695633 | 0.631901 | 0.83639 |
| | ACH3 | 0.837310 | | |
| | ACH4 | 0.843036 | | |
| Critical analysis and judgement | CAJ1 | 0.841406 | 0.616726 | 0.886607 |
| | CAJ2 | 0.905731 | | |
| | CAJ3 | 0.856036 | | |
| | CAJ4 | 0.536553 | | |
| | CAJ5 | 0.731184 | | |
| DFL | DFL1 | 0.817657 | 0.603974 | 0.900921 |
| | DFL2 | 0.790349 | | |
| | DFL3 | 0.836260 | | |
| | DFL4 | 0.722641 | | |
| | DFL5 | 0.817764 | | |
| | DFL6 | 0.663591 | | |
| Developing | DEV1 | 0.838028 | 0.739794 | 0.895029 |
| | DEV2 | 0.867399 | | |
| | DEV3 | 0.874477 | | |
| Empowering | EM3 | 0.846946 | 0.700275 | 0.823698 |
| | EM5 | 0.826581 | | |
| Engaging Communication | EC1 | 0.793961 | 0.663756 | 0.887468 |
| | EC2 | 0.807861 | | |
| | EC3 | 0.862739 | | |
| | EC4 | 0.792301 | | |
| Inspire Followers | INS1 | 0.798018 | 0.658911 | 0.90607 |
| | INS2 | 0.860751 | | |
| | INS3 | 0.779275 | | |
| | INS4 | 0.827235 | | |
| | INS5 | 0.790724 | | |
| Resource Management | RM1 | 0.745226 | 0.586488 | 0.849711 |
| | RM2 | 0.794592 | | |
| | RM3 | 0.701306 | | |
| | RM5 | 0.816935 | | |
| Strategic perspective | SP2 | 0.623591 | 0.614548 | 0.887261 |
| | SP3 | 0.767925 | | |
| | SP4 | 0.779573 | | |
| | SP5 | 0.836757 | | |
| | SP6 | 0.886722 | | |
| Vision and imagination | VI1 | 0.770338 | 0.61971 | 0.76513 |
| | VI2 | 0.803741 | | |
| Success criteria | EE | 0.796365 | 0.689372 | 0.929845 |
| | IEQ | 0.854482 | | |
| | SM | 0.873842 | | |
| | MR | 0.910105 | | |
| | WE | 0.741905 | | |
| | IN | 0.793462 | | |

CR = composite reliability; AVE = average variance extracted.

have a positive influence on the sustainable development of projects and draw up a future strategy for effective performance in the building industry. Lamentably, not enough research has been performed on leadership competences and quality practices in sustainable development, particularly in Malaysian construction building companies. Consequently, this study has aimed to be a signpost in order to study the proper leadership styles of the leaders in terms of more sustainable building construction. Accordingly, some of the important parameters related to leadership competence assessment have been collected from the existing literature and have been extended in the context of construction project managers. The leadership managerial and intellectual competences, as well as transformational leadership qualities have been successfully framed as second-order hierarchical constructs, indicating that all dimensions have a significant impact upon leadership competences and qualities. Thus, this study contributes theoretical support for Daft and Pirola-Merlo (2009), Dulewicz and Higgs (2005) and Müller and Turner (2010), who identified the parameters for this study in leadership assessment as a set of practices that lead to better performance. From another point of view, efficacious performance and remarkable work outcomes from projects are always desirable, but do not always happen. Different qualities of leadership styles may bring different levels of performance in the industry. Referencing the above, the research generated the model to assess the effects of the leadership competences and transformational leadership qualities of project managers on the success criteria for sustainable buildings based on the GBI requirements for buildings in Malaysia. Accordingly, the present study extends some of the significant components from leadership assessment in the context of construction project managers in sustainable building projects and has generated a new model.

The results of the study show that among all dimensions of leadership competencies, strategic perspective ($\beta = 0.945$) is the most significant factor, followed by critical analysis ($\beta = 0.936$), engaging communication ($\beta = 0.918$), achieving ($\beta = 0.906$), developing ($\beta = 0.896$), resource management ($\beta = 0.848$), vision and imagination ($\beta = 0.796$) and empowering ($\beta = 0.658$) in project managers. However, the results are supported and validated by those of Dulewicz and Higgs (2005) and Müller and Turner (2010). Although the results of the study indicate that the project managers in sustainable building projects show almost high qualities of transformational leadership in both dimensions, these qualities have an insignificant impact on the success criteria for sustainable achievements ($p > 0.05$). In this regard, Keegan and Hartog (2004) determined that the majority of findings in terms of transformational leadership style have been developed in non-project-based-organizations, and therefore, it is possible that not every management approach will be suitable for non-project oriented organization or will be matched in project based organizations including the construction industry. Keegan and Hartog further determined that the effect of transformational leadership on employee commitment and performance in a temporary arrangement such as a construction project is not the same as for long term projects. However, they observed that project managers in projectized organizations with the same transformational behaviour as

**Table 7**
Correlations among constructs.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Achieving | **0.7949**[a] | | | | | | | | | | |
| 2. Critical Analysis | 0.6564 | **0.7853**[a] | | | | | | | | | |
| 3. DFL | 0.4425 | 0.4239 | **0.7772**[a] | | | | | | | | |
| 4. Developing | 0.3006 | 0.6379 | 0.5078 | **0.8601**[a] | | | | | | | |
| 5. Empowering | 0.4369 | 0.2235 | 0.5913 | 0.4682 | **0.8368**[a] | | | | | | |
| 6. Engaging Communication | 0.6336 | 0.6564 | 0.5677 | 0.6898 | 0.4054 | **0.8147**[a] | | | | | |
| 7. Inspire Followers | 0.4251 | 0.4347 | 0.3441 | 0.4875 | 0.5474 | 0.5505 | **0.8117**[a] | | | | |
| 8. Resource Management | 0.5071 | 0.3814 | 0.3698 | 0.4163 | 0.3111 | 0.4618 | 0.3728 | **0.7658**[a] | | | |
| 9. Strategic Perspective | 0.4652 | 0.3736 | 0.5226 | 0.3359 | 0.3291 | 0.5543 | 0.5109 | 0.3668 | **0.7839**[a] | | |
| 10. Success Criteria | 0.6167 | 0.5507 | 0.5096 | 0.2649 | 0.4341 | 0.4125 | 0.4923 | 0.4315 | 0.5669 | **0.8303**[a] | |
| 11. Vision and Imagination | 0.3203 | 0.4066 | 0.4638 | 0.3241 | 0.3257 | 0.4696 | 0.4534 | 0.6749 | 0.5922 | 0.684 | **0.7872**[a] |

[a] Square root of the AVE on the diagonal.

**Table 8**
Total effects.

| | Beta value | *t*-Value | *p*-value | Standard error |
|---|---|---|---|---|
| Intellectual competence → critical analysis | 0.9361 | 61.6492 | ******* | 0.0152 |
| Intellectual competence → strategic perspective | 0.9449 | 67.7289 | ******* | 0.014 |
| Intellectual competence → success criteria | 0.5962 | 5.0341 | ******* | 0.1184 |
| Intellectual competence → vision and imagination | 0.7962 | 14.5999 | ******* | 0.0545 |
| Managerial competence → achieving | 0.9063 | 40.7708 | ******* | 0.0222 |
| Managerial competence → developing | 0.8956 | 40.3198 | ******* | 0.0222 |
| Managerial competence → empowering | 0.6584 | 6.9908 | ******* | 0.0942 |
| Managerial competence → engaging Communication | 0.9187 | 54.6438 | ******* | 0.0168 |
| Managerial competence → resource management | 0.8477 | 24.9433 | ******* | 0.034 |
| Managerial competence → success criteria | 0.2391 | 2.178 | 0.01494 | 0.1098 |
| Transformational leadership → DFL | 0.9875 | 248.45 | ******* | 0.004 |
| Transformational leadership → inspire followers | 0.9842 | 196.146 | ******* | 0.005 |
| Transformational leadership → success criteria | 0.0953 | 0.8711 | 0.192059 | 0.1022 |

those managers in functional organizations have a lower impact on motivation and commitment of their followers. It may be as a result of multiple project leaders and the limited periods of time that they are involved with employees in a project context, while team members in a permanent or a long-lasting environment are engaged with mainly one manager for a long period of time. Due to this fact, the transformational leadership qualities of project managers do not make a significant contribution in achieving the sustainable success criteria for building projects.

Despite the fact that the transformational leadership qualities of the project managers have not contributed significantly to the model, when it blended with the leadership competences, the $R^2$ of 0.685 (Fig. 2) was scored, which means that this model accounted for 68.5% of the variance in achieving the sustainable success criteria. In other words, intellectual and managerial competencies in addition to transformational leadership qualities of project managers accounted for 68.5% of the variance in attaining the GBI sustainable success criteria of these projects. On top of that, intellectual competence of the leaders shows the highest $\beta$ value ($\beta = 0.596$) in the model followed by managerial competence ($\beta = 0.239$), which indicates that the intellectual competence of project managers seems to be the most significant competence toward sustainable project achievement. As a result, it may be concluded that the intellectual competencies of a leader are more significant than managerial competencies and transformational leadership qualities in terms of sustainable achievement.

Since PLS is regarded as being better suited for outlining structured interactions and relationships (Chin, 2010) and because it has fewer requirements regarding sample size (Urbach and Ahlemann, 2010), the application of PLS path modelling has made it feasible to prolong the hypothetical contributions of this investigation. By applying the technique of repeated indicators (Wold, 1985) to determine the higher order latent variable, this study has found adequate dimensions and structural advantages for the research model. In addition, this study shows that transformational leadership, intellectual and managerial competences are second-order reflective constructs that have considerable impacts on the success criteria of sustainable performance in a hierarchical model. This study has made a significant contribution to knowledge by enhancing project managers' leadership competencies as well as their qualities of transformational leadership in the construction industry, which provides a holistic view for the project manager when building an effective project team geared toward sustainable building achievements. Because prior research has not frequently explored the relationship between leadership competencies and the transformational leadership behaviour of leaders and their effects on sustainable performance, this study provides perhaps the most comprehensive understanding to date on managing sustainable based practices in the building industry. In general, this study provides a helpful framework by clarifying the distinct role of project manager leadership competencies, transformational leadership and sustainable building construction. Similarly, the study has a continuous theoretical contribution to make by featuring the research model in a new setting; that is, the leadership competence-sustainable success criteria in the context of the construction industry. The study assessed leadership behaviour based on eight competencies and two transformational leadership qualities extracted from the literature and ranked their contribution to success criteria from the project managers' perspective. The results show that all attributes are essential to sustainable achievement and are relatively significant in facilitating sustainable building construction. The results also clarify that project managers should possess the necessary leadership competencies, skills and knowledge to be able to achieve sustainability in building projects. Aside from that, the essential aspects of leadership that highlighted in the study will contribute strategically to the transition towards sustainable societies. The ultimate result also provides support for the critical role of project manager in sustainable development, which prompted the LEED rating system to involve project management development tools and techniques into the most up-to-date overhauling of the rating system. In this regard, the study would like to recommend other green building ratings systems, particularly the GBI of Malaysia, on the way to improve the current rating system in dealing with building construction by incorporating some points and credits for leadership as one of the project management competencies that related with increasing functionality and flexibility of the construction teams in sustainable or green building projects.

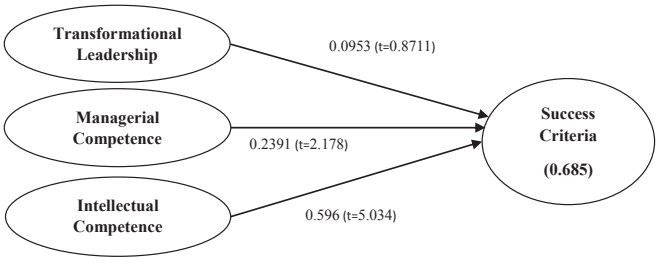


**Fig. 2.** Results of model testing.

## 5. Limitations and future research directions

The current research has some constraints that provides a framework with regard to future study. This study was carried out within sustainable building projects in Malaysia as a specific

context. Consequently, the theoretical results may not be transferred to other industries or other sustainable building projects in different countries. Thus, more investigation is necessary to figure out how precise the findings of this research are in other countries as well as in other industries. In addition, significant variables that may possibly guide the predictive strength of the model should be enquired in future studies. While the present model points out 68.5% of the variance in sustainable achievement, it is probable that leadership behaviour could be further enhanced by integrating other additional constructs, such as situational theories, emotional and social dimensions in the behaviour of leaders, as well as the moderating roles of education, experience of the leaders or the gender.

## Acknowledgements

The authors would like to acknowledge Malaysian Government for providing the FRGS Grant No. 203/PPBGN/6711301 as financial support to conduct the research.

## References

Alias, A., Sin, T.K., Aziz, W.N.A.W.A., 2010. The green home concept – acceptability and development problems. J. Build. Perform. 1, 130–139.
Anink, D., Boonstra, C., Mak, J., 1996. Handbook of Sustainable Building. James & James Science Publishers, London.
Avolio, B.J., Bass, B.M., Jung, D.I., 1999. Re-examining the components of transformational and transactional leadership using the multifactor leadership questionnaire. J. Occup. Organ. Psychol. 72, 441–462.
Ayoko, O.B., Callan, V.J., 2010. Teams' reactions to conflict and teams' task and social outcomes: the moderating role of transformational and emotional leadership. Eur. Manag. J. 28, 220–235.
Bass, B.M., 1985. Leadership and Performance beyond Expectations. Free Press, New York, NY.
Bass, B.M., Avolio, B.J., 1997. Full Range Leadership Development: Manual for the Multifactor Leadership Questionnaire. Mindgarden, Palo Alto, CA.
Boyatzis, R., 1982. The Competent Manager – A Model for Effective Performance. Wiley, New York.
Bresnen, M.J., 1990. Organising Construction, Project Organisation and Matrix Management. Routledge, London.
Broman, G., Robèrt, K.-H., Basile, G., Larsson, T., Baumgartner, R., Collins, T., Huisingh, D., 2014. Systematic leadership towards sustainability. J. Clean. Prod. 64, 1–2.
Brundtland, 1987. Our Common Future. Oxford University Press, London.
Burns, J.M., 1978. Leadership. Harper & Row, New York, NY.
Chan, A.T.S., Chan, E.H.W., 2005. Impact of perceived leadership styles on work outcomes: case of building professionals. J. Constr. Eng. Manag. 13, 413–422.
Chen, H., Ganesan, S., Jia, B., 2005. Environmental challenges of post-reform housing development in Beijing. Habitat Int. 29, 571–589.
Chin, W.W., 1998. Issues and opinion on structural equation modelling. MIS Q. 22, vii–xvi.
Chin, W.W., 2010. How to write up and report PLS analyses. In: Vinzi, V.E., Chin, W.W., Henseler, J., Wang, H. (Eds.), Handbook of Partial Least Squares: Concepts, Methods and Application. Springer, New York, pp. 645–689.
Chou, J.-S., Yeh, K.-C., 2015. Life cycle carbon dioxide emissions simulation and environmental cost analysis for building construction. J. Clean. Prod. 101, 137–147.
Daft, R.L., Pirola-Merlo, A., 2009. The Leadership Experience, Asia Pacific Edition, 1 ed. Cengage Learning Australia, South Melbourne.
Deb, K., Agrawal, S., Pratab, A., Meyarivan, T., 2000. A fast elitist non-dominated sorting genetic algorithm for multi-objective optimization: NSGA-II. In: Parallel Problem Solving from Nature VI Conference, France.
Druker, J., White, G., 1995. Misunderstood and undervalued? Personnel management in construction. Hum. Resour. Manag. J. 5, 77–91.
DuBrin, A.J., 2004. Leadership Research Findings, Practice, and Skills, fourth ed. Houghton Mifflin Company, Indianapolis.
Dulewicz, V., Higgs, M., 2005. Assessing leadership styles and organisational context. J. Manag. Psychol. 20, 105–123.
Edwards, B., 2005. Rough Guide to Sustainability. London.
Efron, B., Tibshirani, R.J., 1993. An introduction to the bootstrap. In: Monographs on Statistics and Applied Probability, #57. Chapman & Hall, New York.
Fellows, R., Langford, D., Newcombe, R., Urry, S., 2002. Construction Management in Practice, second ed. Blackwell Science, Oxford.
Fornell, C., Larcker, D.F., 1981. Evaluating structural equation models with unobserved variables and measurement error. J. Mark. Res. 18, 39–50.
Fryer, B., Ellis, R., Egbu, C., Gorse, C., 2004. The Practice of Construction Management: People and Business Performance, fourth ed. Blackwell Publishing.
Gefen, D., Straub, D.W., Boudreau, M.-C., 2000. Structural equation modeling and regression: guidelines for research practice. Commun. Assoc. Inf. Syst. 4, 1–79.
Green, S.B., 1991. How many subjects does it take to do a regression analysis? Multivar. Behav. Res. 26, 499–510.
Hawkins, J., Dulewicz, V., 2007. The relationship between performance as a leader and emotional intelligence, intellectual and managerial competences. J. Gen. Manag. 33, 54–78.
Hersey, P., Blanchard, K.H., 1974. So you want to know your leadership style? Train. Dev. J. February, 1–15.
Hill, R.C., Bowen, P.A., 1997. Sustainable construction: principles and a framework for attainment. Constr. Manag. Econ. 15, 223–239.
Hulland, J., 1999. Use of partial least squares (PLS) in strategic management research: a review of four recent studies. Strateg. Manag. J. 20, 195–204.
Jones, S.A., Michelfelder, D., Nair, I., 2015. Engineering managers and sustainable systems: the need for and challenges of using an ethical framework for transformative leadership. J. Clean. Prod. http://dx.doi.org/10.1016/j.jclepro.2015.02.009.
Keegan, A.E., Hartog, D.N.D., 2004. Transformational leadership in a project-based environment: a comparative study of the leadership styles of project managers and line managers. Int. J. Proj. Manag. 22, 609–617.
Kissi, J., Dainty, A., Tuuli, M., 2013. Examining the role of transformational leadership of portfolio managers in project performance. Int. J. Proj. Manag. 31, 485–497.
Kubba, S., 2010. Chapter 2 – Elements of Green Design and Construction, Green Construction Project Management and Cost Oversight. Architectural Press, Boston, pp. 28–70.
Lam, P.T.I., Chan, E.H.W., Chau, C.K., Poon, C.S., Chun, K.P., 2011. Environmental management system vs green specifications: how do they complement each other in the construction industry? J. Environ. Manag. 92, 788–795.
Lohmöller, J.-B., 1989. Latent Variable Path Modeling with Partial Least Squares. Physica-Verlag, Heidelberg.
Loosemore, M., Dainty, A.R.J., Lingard, H., 2003. Human resource management in construction projects, strategic and operational approaches. Spon Press, London.
Lovell, H., 2004. Framing sustainable housing as a solution to climate change. J. Environ. Policy Plan. 6, 35–55.
Lu, Y., Zhang, X., 2016. Corporate sustainability for architecture engineering and construction (AEC) organizations: framework, transition and implication strategies. Ecol. Indic. 61, 911–922.
Maliene, V., Malys, N., 2009. High-quality housing, a key issue in delivering sustainable communities. Build. Environ. 44, 426–430.
McColl-Kennedy, J.R., Anderson, R.D., 2002. Impact of leadership style and emotions on subordinate performance. Leadersh. Q. 13, 545–559.
Melchert, L., 2007. The Dutch sustainable building policy: a model for developing countries? Build. Environ. 42, 893–901.
Müller, R., Geraldi, J., Turner, J.R., 2012. Relationships between leadership and success in different types of project complexities. IEEE Trans. Eng. Manag. 59, 77–90.
Müller, R., Turner, R., 2010. Leadership competency profiles of successful project managers. Int. J. Proj. Manag. 28, 437–448.
Mumford, A., Zaccaro, S.J., Johnson, J.F., Diana, M., Gilbert, J.A., Threlfall, K.V., 2000. Patterns of leader characteristics: implications for performance and development. Leadersh. Q. 11, 115–133.
Murphy, S.E., Ensher, E.A., 2008. A qualitative analysis of charismatic leadership in creative teams: the case of television directors. Leadersh. Q. 19, 335–352.
Nelms, C., Russell, A.D., Lence, B.J., 2005. Assessing the performance of sustainable technologies for building projects. Can. J. Civ. Eng. 32, 114–128.
Northouse, P.G., 2007. Leadership: Theory and Practice, fourth ed. SAGE Publications, Thousand Oaks, California.
Ofori, G., 2008. Leadership: a pivotal factor for sustainable development. Constr. Inf. Q. 10, 67–72.
Oktay, D., 2002. Design with the climate in housing environments: an analysis in Northern Cyprus. Build. Environ. 37, 1003–1012.
Pakir, A.H.K., Tabassi, A.A., Ramli, M., Bakar, A.H.A., Roufechaei, K.M., 2012. Sustainable housing development and leadership: a review. Aust. J. Basic Appl. Sci. 6, 385–395.
Passmore, J.A., 1974. Man's Responsibility for Nature: Ecological Problems and Western Tradition. London.
Purvanova, R.K., Bono, J.E., 2009. Transformational leadership in context: face-to-face and virtual teams. Leadersh. Q. 20, 343–357.
Richards, D.J., Gladwin, T.N., 1999. Sustainability metrics for the business enterprise. Environ. Qual. Manag. Spring 11–20.
Roufechaei, K.M., Bakar, A.H.A., Tabassi, A.A., 2014. Energy-efficient design for sustainable housing development. J. Clean. Prod. 65, 380–388.
Seyfang, G., 2010. Community action for sustainable housing: building a low-carbon future. Energy Policy 38, 7624–7633.
Shriberg, M., 2002. Toward sustainable management: the University of Michigan Housing Division's approach. J. Clean. Prod. 10, 41–45.
Sieffert, Y., Huygen, J.M., Daudon, D., 2014. Sustainable construction with repurposed materials in the context of a civil engineering-architecture collaboration. J. Clean. Prod. 67, 125–138.
Tabassi, A.A., Bakar, A.H.A., 2010. Towards assessing the leadership style and quality of transformational leadership: the case of construction firms of Iran. J. Technol. Manag. China 5, 245–258.

Tabassi, A.A., Ramli, M., Bakar, A.H.A., 2012. Effects of training and motivation practices on teamwork improvement and task efficiency: the case of construction firms. Int. J. Proj. Manag. 30, 213–224.
Tabassi, A.A., Ramli, M., Roufechaei, K.M., Tabasi, A.A., 2014. Team development and performance in construction design teams: an assessment of a hierarchical model with mediating effect of compensation. Constr. Manag. Econ. 32, 932–949.
Tenenhaus, M., Vinzi, V.E., Chatelin, Y.-M., Lauro, C., 2005. PLS path modeling. Comput. Stat. Data Anal. 48, 159–205.
Tsai, C.Y., Chang, A.S., 2012. Framework for developing construction sustainability items: the example of highway design. J. Clean. Prod. 20, 127–136.
UN, 1992. Agenda 21, United Nations Conference on Environment & Development, Rio de Janerio, Brazil, 3 to 14 June 1992 [Online] Available from: https://sustainabledevelopment.un.org/outcomedocuments/agenda21.
Urbach, N., Ahlemann, F., 2010. Structural equation modeling in information systems research using partial least squares. J. Inf. Technol. Theory Appl. 11, 5–40.
Vinzi, V.E., Trinchera, L., Amato, S., 2010. PLS path modeling: from foundations to recent developments and open issues for model assessment and improvement. In: Vinzi, V.E., Chin, W.W., Henseler, J., Wang, H. (Eds.), Handbook of Partial Least Squares: Concepts, Methods and Application. Springer, New York.
Wetzels, M., Schroder, G.O., Oppen, V.C., 2009. Using PLS path modeling for assessing hierarchical construct models: guidelines and empirical illustration. MIS Q. 33, 177–195.
Wold, H., 1985. Partial least squares. In: Kotz, S., Johnson, N.L. (Eds.), Encyclopedia of Statistical Sciences. Wiley, New York.
World Energy Outlook, 2011. International Energy Agency, Paris. Available at: www.iea.org/about/copyright.asp.
Wren, J., Dulewicz, V., 2005. Leader competencies, activities and the successful change in the royal airforce. J. Change Manag. 5, 295–306.
Yang, L.-R., Huang, C.-F., Hsu, T.-J., 2014. Knowledge leadership to improve project and organizational performance. Int. J. Proj. Manag. 32, 40–53.
Yukl, G., 2002. Leadership in Organizations, fifth ed. Prentice-Hall, Englewood Cliffs, NJ.
Zhang, X., 2015. Green real estate development in China: state of art and prospect agenda – a review. Renew. Sustain. Energy Rev. 47, 1–13.
Zhang, X., Shen, L., Wu, Y., 2011. Green strategy for gaining competitive advantage in housing development: a China study. J. Clean. Prod. 19, 157–167.
Zhang, X., Wu, Y., Shen, L., 2015a. Embedding “green” in project-based organizations: the way ahead in the construction industry? J. Clean. Prod. 107, 420–427.
Zhang, X., Wu, Z., Feng, Y., Xu, P., 2015b. “Turning green into gold”: a framework for energy performance contracting (EPC) in China's real estate industry. J. Clean. Prod. 109, 166–173.