Innovation creation, innovation adoption, and firm characteristics in the construction industry

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Innovation creation, innovation adoption, and firm characteristics in the construction industry

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Abstract

Purpose – This study aims to assess the construction firm’s innovation orientation and to investigate its relationship with firm characteristics.

Design/methodology/approach – A structured survey was conducted among 105 firms in the Malaysian construction industry. The results of the factor analysis revealed two underlying dimensions of innovation, namely, innovation creation and innovation adoption. For the cluster analysis, the firms were segmented into four subgroups according to four dimensions, namely, non-innovative, innovation-creator, imitator and innovative firms.

Findings – Firm’s business scale and age significantly affected the innovation orientation of construction firms.

Originality/value – This research contributes to the existing body of knowledge by adding a new firm characteristic, business scale, as a potential predictor of firms’ innovativeness. This study is the first to explore the effect of firm characteristics on the innovation orientation of firms.

Keywords Firm characteristics, Construction industry, Innovation adoption, Innovation creation

Paper type Research paper

Introduction

Numerous scholars have highlighted the construction industry’s paltry productivity levels and lower efficiency as compared to that of other industries (Bankvall et al., 2010). Construction companies manage their productivity and quality in one way or another. Some companies tend to control their costs, while others tend to train their laborers, some focus on design practices and some manage their productivity and quality by controlling the quality of their services (Arditi and Mochtar, 2000). Although these practices have improved the productivity and quality of these companies, they cannot depend solely on the benefits of these practices, as the pressure from an already competitive market continues to increase. In an increasingly competitive market,
innovation is a vital element that improves the productivity and competitive advantage of firms (Pérez-Luño et al., 2007; Zailani et al., 2014a; Zhao and Ordóñez de Pablos, 2009). Innovation aids construction firms in lowering their costs, achieving faster completion times and developing their brand in construction products (Lim et al., 2010; Yusof and Mohd Shafiei, 2011). Therefore, understanding how innovation can be directed successfully is crucial.

Despite the importance of innovation in increasing productivity and achieving competitive advantage, most construction firms suffer from a lack of innovation (Yusof and Zainul Abidin, 2011; Yusof et al., 2015). Some firms attempt to implement innovation, but many of them have failed for many reasons. Pérez-Luño et al. (2014) warned that the use of the same strategy will not encourage further innovations. Firms may apply various innovations, but a different innovation orientation necessitates the use of various strategies, skills and resources (Pérez-Luño et al., 2014). Diverse abilities, capitals and organizational cultures are required to foster innovation orientation and adoption (Pérez-Luño et al., 2011; Taghizadeh et al., 2013).

Moreover, the relationship between the characteristics and innovation orientation of firms is relatively unexplored. Previous studies show that small companies have greater flexibility to innovate and tend to focus on incremental innovations, such as improving existing technologies or designs. In contrast, large companies focus on radical innovations and high-technology inventions because they possess necessary resources to embark on research and development as well as the ability to handle more risks (Comacchio and Bonesso, 2007; Laforet, 2013). However, little is known as to whether these innovations are created or adopted by construction companies, as these firms adopt similar strategies to encourage innovation across the industry. A universal strategy would be too inflexible for a dynamic field such as innovation because previous studies have suggested that no single set of dominant best practices currently exists (Ortt and van der Duin, 2008). Consequently, companies need to lead innovation within their organizations according to their own situations and features. Given that innovation is a vibrant process and that construction companies differ in terms of size, main business, business scale and interest in innovation matters, company strategies and government regulations must be sufficiently flexible to accommodate innovation in various companies with diverse characteristics (e.g. different innovation policies for construction companies with varying main businesses).

Based on several criteria, this paper classifies innovation creation and adoption in the construction industry. Specifically, this paper aims to investigate the relationship between the characteristics and innovation orientation of a firm. This paper contributes to extant literature by clustering construction firms according to their innovation adoption and creation orientations and by determining the relationship between the characteristics and innovation orientation of firms.

**Innovation creation and adoption**

Innovation can either be created internally or adopted from others (Pérez-Luño et al., 2007). Innovation creation takes the form of product, process and administration or technical innovations, which can be generated or created by using the resources and research efforts of companies in response to local needs (Ghoshal and Bartlett, 1988). Adoption is also considered as innovation because it represents the product, process and administration or technical innovations adopted by companies from their competitors at
the local, national or international levels (Naranjo–Valencia et al., 2011). Diverse abilities, capitals and organizational cultures are required to foster both innovation creation and adoption (Pérez-Luño et al., 2011; Zailani et al., 2014b).

Innovation adoption must be distinguished from innovation creation because different skills, unique assets and ethos are required to inspire each type of innovation (Pérez-Luño et al., 2011). At the organizational level, few studies have distinguished the standards for innovation creation and adoption. The criteria and characteristics of innovation are addressed in many studies as individual concepts.

Previous studies use the degree or level of originality as a criterion for differentiating innovation creation from innovation adoption. According to Song and Montaya–Weiss (1998), innovation creation pertains to the creation of a new product that comprises new technology, makes noteworthy changes and makes an impression on the industry upon its introduction. This product must be completely new to the market. Ravichandran (2000) argued that innovation creation comprises an unseen, unknown and uncertain character, whereas innovation adoption shows familiarity and similarity.

Innovation creation and adoption serve different purposes because of their inherent differences. Duncan (1976) proposed that innovation creation merges new knowledge with existing knowledge in an original way, which results in invention. Drucker (1985) further proposed that innovation creation contributes to the efficiency and competitiveness of a firm by creating new opportunities and by using an existing opportunity in a new way. In contrast, innovation adoption contributes to the effectiveness and competitiveness of an organization by helping the adopting organization adapt itself to new situations in its external environment (Damanpour and Wischnevsky, 2006). Innovation adoption also solves problems by altering the standing knowledge on recognized problems (Pérez-Luño et al., 2007). Zhou (2006) defines innovation creation as a fundamental element of sustainable development, whereas innovation adoption involves the introduction of an improved product to help identify a potential market.

With respect to the activities involved, most scholars from technology- and science-based disciplines consider R&D to be imperative for a successful innovation (Czarnitzki and Thorwarth, 2012; Filippetti and Archibugi, 2011; Hollenstien, 2003; Zhao and Ordóñez de Pablos, 2011; Rogers, 2003). The major difference between innovation creation and innovation adoption lies in the method and regularity of R&D activities. For example, innovation creation involves exhaustive R&D activities by the organization. To create a new innovation in the market, the organization must collaborate with external sources of information, such as universities and suppliers (Zhao and Ordóñez de Pablos, 2011). However, not all innovation can result from R&D activities. Organizations considered as innovation adopters do not partake in R&D activities and are not adept at seeking external sources of knowledge (Arundel et al., 2007; Hollenstien, 2003). Instead, these organizations replicate the innovations of others. Innovation adoption is reflected in the rapid industrialization of Japan, Korea and Taiwan in the 1960s and the 1970s, which largely stemmed from the replication (reverse engineering) of foreign technologies (Kim and Nelson, 2000). Innovation adoption does not require R&D investments because the organizations are not required to create new knowledge, but only need to identify potential market requirements, search for pertinent information, promote effectual interactions among specialized members and devise a decent marketing strategy for the product (Kim and Nelson, 2000).
Several other criteria are used for distinguishing innovation creation from innovation adoption. The former refers to the introduction of new products to the market and is linked to slow market acceptance, longer time frame as well as higher costs and uncertainty because of the unpredictable markets and demand (Song and Montaya-Weiss, 1998; Zhou, 2006), while the latter is associated with fewer market uncertainties because innovation adoption only requires the broadening of existing knowledge that has already been proven successful in the market by the innovation creator (Pérez-Luño et al., 2011).

In summary, innovation adoption can be differentiated from innovation creation according to the degree or level of originality, its purpose, the activities involved and its nature (with regard to risk, cost and time).

**Firm’s characteristics and innovation orientation**

Innovation studies have long questioned the effect of firm characteristics on the innovative power of firms (Rahmouni et al., 2010; Kannebley et al., 2005). Many studies have examined the relationship among the size, age and inclination of firms to innovate. For example, Janz et al. (2004), Roud (2007) and Ganotakis and Love (2011) all found a positive relationship between firm size and innovativeness, while Heimonen (2012) showed that firm size is not a decisive factor in determining innovativeness. Churchill (2000), Balasubramanian and Lee (2008) and Coad et al. (2013) determined a significant negative relationship between firm age and innovativeness, whereas Huergo and Jaumandreu (2004) found a positive relationship. In developing countries such as Malaysia, firm size is an important factor that can determine the amount of financing of firms (Rahmouni et al., 2010). Larger firms also have to manage more complex processes and are more frequently confronted by organizational problems because they tend to implement innovative processes. Such increased complexity may promote the sluggishness of firms and subsequently reduce their innovativeness (Zailani et al., 2015).

A firm is expected to undergo various stages of development during its life cycle. For example, those firms at the beginning of their life cycle may grow and mature through innovation, whereas older firms will experience plateaus in their growth and may even see declines in growth over time (Churchill, 2000). Established or older firms are expected to produce a decreasing amount of innovation, but some evidence confirms that older firms remain significantly innovative and exhibit an exceptional market performance (Huergo and Jaumandreu, 2004). Other potential firm characteristics that have not been investigated in the literature can serve as an explanation of exceptions. For example, two matured firms may differ in terms of their business scale or major clients, and such a difference may lead to a dissimilar innovation orientation. Firm business scale refers to whether the firm operates within the state level, at the national level or at the international level. Janz et al. (2004) proposed that firms that operate internationally have a significantly higher probability to become innovative as compared with firms that act nationally, which may be attributed to the higher competition in international markets. Hall et al. (2009) showed that international competition fosters R&D intensity, which can enhance the likelihood of innovation. Therefore, firm business scale has an important role in the innovativeness of construction firms. Several new firm characteristics, such as type, main business, business scale and major clients, are considered in this study to identify additional factors that may affect the innovation orientation of construction firms.
Ortt and van der Duin (2008) showed that a single mainstream innovation orientation does not match the successful innovation orientations of companies and suggested that the appropriate innovation practices of companies must be determined based on their context. In the manufacturing and service industries of Portugal, Barbosa et al. (2014) found that the inclination of large firms toward innovation adoption may be attributed to their accumulation of knowledge and capabilities. However, the relationship between the characteristics and innovation orientation (creation and adoption) of firms in the construction industry remains unknown. Such a research gap may be attributed to the unique characteristics of the construction industry, such as its fragmentation, reliance on multiple firms to produce a product, project-centric focus and traditional separation of design and construction functions (Kong-Seng and Yusof, 2011). Additionally, the difficulties in extending an innovation from one project to another because of customization and different owners/clients of each project may cause the difference between innovation in construction firms and innovation of other industries (Gambatese and Hallowell, 2011). This study aims to fill this research gap.

Research methods
Measure of constructs
This study performed a quantitative survey using a structured questionnaire with 26 items and 4 sections, namely, company’s basic information, innovation adoption, innovation creation and respondents’ personal information. Sixteen items were used to measure innovation creation and innovation adoption (Table I). Five of these items were negatively worded. These items were then transformed to their actual meaning before performing the factor analysis. All items were measured using a six-point Likert scale ranging from 1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = slightly agree, 5 = agree and 6 = strongly agree. Neutral answers (neither agree nor disagree) were avoided to ensure that the respondents would show their stance and preference. The items were adapted from Yusof et al. (2014) to ensure content validity.

Data collection and the sample
Data were collected from the top management of developer, consultant and contractor firms operating in Penang, Malaysia. The questionnaire was distributed to each respondent by hand. The state of Penang, which is the most active state in Malaysia in terms of construction activities, was chosen for the case study. Purposive sampling was used because the targeted respondents were obtained randomly from the members lists of housing developer associations, contractor associations and professional bodies (Board of Architects Malaysia, 2013; Board of Engineers Malaysia, 2013). These respondents were working in firms that operate in Penang. A total of 870 firms were identified and the survey forms were distributed to all firms. Following the suggestions in previous studies, several procedures were followed to increase the response rate (Ryu et al., 2005; Zagorsky and Rhoton, 2008). These procedures included completing the survey in less than 10 minutes, providing a ballpoint pen to all respondents and arranging reminder calls and follow-up visits to respondents who did not provide a response. A total of 105 firms returned the questionnaires and all their answers were useable for analysis.
Analysis and results

Profile of respondents

Among the returned questionnaires, 40.0 per cent were answered by males and 60.0 per cent were answered by females. The majority of the respondents were Malay (75.2 per cent), followed by Chinese (16.2 per cent) and Indian (7.6 per cent). A total of 67 respondents (64.4 per cent) had bachelor degrees. Around 18.3 per cent of the respondents had diplomas and 12.5 per cent had PhD degrees. In terms of position, 27.9 per cent of the respondents held managerial positions, 23.1 per cent held senior roles and 19.2 per cent held assistant managerial positions. The majority of the respondents (57.1 per cent) had less than 10 years’ experience in the construction industry.

Table I.
Factor analysis – rotated component matrix

<table>
<thead>
<tr>
<th>Innovation adoption</th>
<th>Factor loadings</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>We are the creative imitator instead of a design pioneer</td>
<td>0.673</td>
<td>0.801</td>
</tr>
<tr>
<td>We usually introduce a familiar and well-known design to the client</td>
<td>0.619</td>
<td></td>
</tr>
<tr>
<td>For us, innovation is just a tool for getting things better, rather than an end-product</td>
<td>0.613</td>
<td></td>
</tr>
<tr>
<td>We do not make modification based on the existing/proven succeed products</td>
<td>0.607</td>
<td></td>
</tr>
<tr>
<td>We are imitating designs from the market to minimize the uncertainty of our products</td>
<td>0.595</td>
<td></td>
</tr>
<tr>
<td>It has been a culture to adapt a well-known design</td>
<td>0.568</td>
<td></td>
</tr>
<tr>
<td>As long as the design/product meet the client’s criteria, proposing something extraordinary/beyond the expectation would not necessary</td>
<td>0.554</td>
<td></td>
</tr>
<tr>
<td>Whenever there is a new designed product introduced by other design firm, we would try to imitate their design</td>
<td>0.528</td>
<td></td>
</tr>
<tr>
<td>We never refer to the existing design in the market when we design</td>
<td>0.514</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Innovation creation</th>
<th>Factor loadings</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>We do not compete to be the first to introduce new design ahead other design firms</td>
<td>0.693</td>
<td>0.723</td>
</tr>
<tr>
<td>We design to surprise the market rather than to please the market</td>
<td>0.668</td>
<td></td>
</tr>
<tr>
<td>My firm invests heavily in R&amp;D for new idea and technology</td>
<td>0.638</td>
<td></td>
</tr>
<tr>
<td>In any chances, we tried to impress the client with our novel and “dare-to-try” design</td>
<td>0.607</td>
<td></td>
</tr>
<tr>
<td>We do not aim to be the first to introduce a new design</td>
<td>0.600</td>
<td></td>
</tr>
<tr>
<td>We would never want to be the pioneer of new product</td>
<td>0.542</td>
<td></td>
</tr>
<tr>
<td>My firm has a very strong linkage with the universities and research centers</td>
<td>0.503</td>
<td></td>
</tr>
<tr>
<td>KMO sampling of adequacy</td>
<td>0.704</td>
<td></td>
</tr>
<tr>
<td>Bartlett’s test of sphericity</td>
<td>$X^2 = 1,311.350, p = 0.000$</td>
<td></td>
</tr>
<tr>
<td>Variance explained (%)</td>
<td>53.79</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Extraction method: principal component analysis; rotation method: varimax with Kaiser normalization
Profile of respondents’ firms
The survey focused mainly on contractors (65.7 per cent), consultancy firms (21.0 per cent), property developers (8.6 per cent) and others (4.8 per cent). In terms of main business, 41.0 per cent of the firms had mixed businesses, 27.5 per cent were in infrastructure, 17.1 per cent were in commercial services, 9.5 per cent were in residential services and 3.8 per cent were in industrial services. The majority of these firms (64.8 per cent) were operating at the national level and their major clients were from the public sector (57.1 per cent). About 60.0 per cent of these firms were aged between 11 years and 20 years, 28.6 per cent were aged between 6 years and 10 years and 11.4 per cent were aged below 5 years. In terms of number of employees, 46.5 per cent of the firms had more than 51 permanent employees, while 53.5 per cent had less than 50 permanent employees, of which 29.3 per cent had less than 20 employees and 24.2 per cent had between 21 and 50 employees.

Factor analysis
We performed an exploratory factor analysis and a principal component analysis to determine the underlying dimensions of innovation. The chosen solution with two principal components was constructed using the varimax rotation technique and could explain 53.79 per cent of the total variance. We named these two components as innovation creation and innovation adoption. The Kaiser–Mayer–Olkin test measured the sampling adequacy as 0.704 (as shown in Table I), which was above the minimum acceptable value of 0.6 (Tabachnick and Fidell, 2001). The results of the Bartlett’s test of sphericity was significant ($p < 0.05$), which supported the factorability of the correlation matrix (Pallant, 2005). The Cronbach’s alpha (an index of reliability) of each component was also computed. Table I shows that both components have Cronbach’s alpha values of above 0.6, supporting the internal cohesiveness of the items that form each component (Hair et al., 2010).

Cluster analysis
A two-step cluster analysis was performed to identify the groups of firms that shared certain levels of innovation adoption and creation. Each cluster should have similar members, and the members of one cluster should be different from those of another cluster. Table II shows that 105 construction firms were classified into four clusters, with cluster sizes ranging from 21 to 32 firms. The four clusters were labeled:

1. non-innovative (both types of innovation were below the average; the firms represented 30.5 per cent of the sample);
2. innovation creator (innovation creation was above while innovation adoption was below the average; the firms represented 20.0 per cent of the sample);
3. innovation adopter (innovation adoption was above while innovation creation was below the average; the firms represented 21.0 per cent of the sample);
4. innovative organization (both types of innovation were above the average; the firms represented 28.6 per cent of the sample).

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Non-innovative</th>
<th>Innovation-creator</th>
<th>Innovation-adopter</th>
<th>Innovative organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation adoption</td>
<td>Low (3.82)</td>
<td>Low (3.45)</td>
<td>High (4.56)</td>
<td>High (4.34)</td>
</tr>
<tr>
<td>Innovation creation</td>
<td>Low (3.18)</td>
<td>High (3.94)</td>
<td>Low (2.88)</td>
<td>High (4.20)</td>
</tr>
<tr>
<td>Number of firms</td>
<td>32</td>
<td>21</td>
<td>22</td>
<td>30</td>
</tr>
<tr>
<td>Percentage (%)</td>
<td>30.5</td>
<td>20.0</td>
<td>21.0</td>
<td>28.6</td>
</tr>
</tbody>
</table>

Table II. Profiling of construction firms based on final cluster centers.
(3) innovation adopter (innovation creation was below while innovation adoption was above the average; the firms represented 21.0 per cent of the sample); and

(4) innovative organization (both types of innovation were above the average; the firms represented 28.6 per cent of the sample).

**Firm’s characteristics and innovation orientation**

Table III shows that the firms’ characteristics, including age and business scale, have significant differences in their distribution over the four clusters. The distribution of firms that work within the state, nationally and internationally differs significantly in each cluster. Nearly 50 per cent of the firms that operate within the state or at the international level belong to the cluster of “Innovative Organizations”, but only 16 per cent of the firms that operate at the national level are included in this group. Firms that work at the national level are mostly included in the “Non-Innovative” cluster (35 per cent non-innovative vs 16 per cent innovative firms). Most of the five-year-old firms (75 per cent) are included in the “Innovative Organization” cluster, whereas the six- and ten-year-old firms are evenly distributed across all clusters.

The new firms (less than five years) tend to be classified as both innovation creators and adopters because they are new to the industry and are still finding the directions of their business. In contrast, the six- to ten-year-old firms tend to be innovation adopters, while those firms that have been operating for more than 11 years tend to be innovation creators, which indicates that companies become more confident in generating innovations to benefit themselves and their industries as they become more mature and extend their tenure in their respective industries. The “older” firms are more comfortable with setting new trends than in following existing trends. The firms were evenly distributed across all clusters in terms of type, main business, major clients and size.

**Discussion and implications**

This study aims to classify construction firms according to their innovation adoption and creation practices as well as to examine the relationship between the characteristics and innovation orientation of firms. The results could aid the government in identifying the characteristics of innovative firms and strategizing their policies appropriately to promote innovation in the construction industry. The results can also help managers promote innovation according to the characteristics of their construction firms. The distribution of firms with dissimilar business scales and age is significantly different across all four clusters.

A significant relationship is observed between business scale and innovativeness. Firms that operate within the state and at the international level adopt both innovation creation and adoption, whereas firms that operate at the national level are non-innovative. Construction firms that operate within the state and at the international level have high innovation creation and adoption because they are competing with reputable firms (Janz et al., 2004). Firms that operate within the state invest in both innovation orientations to improve their competitive advantage over those firms that operate at the national level. Similarly, Malaysian construction companies that operate at the international level need to embark on both innovation orientations to compete with large international construction firms from Japan, Korea and Singapore that possess advanced technologies. Previous studies show a positive relationship between competition and innovation (Hall et al., 2009), which suggests that lower barriers for
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Descriptions</th>
<th>Non-innovative (%)</th>
<th>Innovation-creator (%)</th>
<th>Innovation-adopter (%)</th>
<th>Innovative organization (%)</th>
<th>$\chi^2_{(df)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of firms</td>
<td>Properties developer</td>
<td>4 (44.4)</td>
<td>1 (11.1)</td>
<td>3 (33.3)</td>
<td>1 (11.1)</td>
<td>12.584&lt;sub&gt;9&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>Contractor</td>
<td>23 (33.3)</td>
<td>15 (21.7)</td>
<td>12 (17.4)</td>
<td>19 (27.5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Consultancy</td>
<td>5 (22.7)</td>
<td>6 (27.3)</td>
<td>5 (22.7)</td>
<td>6 (27.3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>1 (20.0)</td>
<td>4 (80.0)</td>
<td></td>
</tr>
<tr>
<td>Main business</td>
<td>Residential</td>
<td>3 (30.0)</td>
<td>2 (20.0)</td>
<td>4 (40.0)</td>
<td>1 (10.0)</td>
<td>20.996&lt;sub&gt;15&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>Commercial</td>
<td>3 (16.7)</td>
<td>3 (16.7)</td>
<td>6 (33.3)</td>
<td>6 (33.3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mixed</td>
<td>12 (27.9)</td>
<td>6 (14.0)</td>
<td>9 (25.9)</td>
<td>16 (37.2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Infrastructure</td>
<td>12 (41.4)</td>
<td>10 (34.5)</td>
<td>2 (6.9)</td>
<td>5 (17.2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Industrial</td>
<td>2 (50.0)</td>
<td>1 (25.0)</td>
<td>0 (0.0)</td>
<td>1 (25.0)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>1 (100.0)</td>
<td></td>
</tr>
<tr>
<td>Firm business scale</td>
<td>Within state</td>
<td>7 (25.0)</td>
<td>2 (7.1)</td>
<td>5 (17.9)</td>
<td>14 (50.0)</td>
<td>22.078&lt;sub&gt;9&lt;/sub&gt; **</td>
</tr>
<tr>
<td></td>
<td>National</td>
<td>24 (35.3)</td>
<td>20 (29.4)</td>
<td>13 (19.1)</td>
<td>11 (16.2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>International</td>
<td>1 (11.1)</td>
<td>0 (0.0)</td>
<td>3 (33.3)</td>
<td>5 (55.6)</td>
<td></td>
</tr>
<tr>
<td>Firm’s major clients</td>
<td>Individual</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>1 (33.3)</td>
<td>2 (66.7)</td>
<td>16.528&lt;sub&gt;9&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>Public sector</td>
<td>17 (28.3)</td>
<td>13 (21.7)</td>
<td>9 (15.0)</td>
<td>21 (35.0)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Private company</td>
<td>13 (36.1)</td>
<td>8 (22.2)</td>
<td>11 (30.6)</td>
<td>4 (11.1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>2 (33.3)</td>
<td>1 (16.7)</td>
<td>0 (0.0)</td>
<td>3 (50.0)</td>
<td></td>
</tr>
<tr>
<td>Firm age</td>
<td>0–5 years</td>
<td>2 (16.7)</td>
<td>1 (8.3)</td>
<td>0 (0.0)</td>
<td>9 (75.0)</td>
<td>20.985&lt;sub&gt;9&lt;/sub&gt; **</td>
</tr>
<tr>
<td></td>
<td>6–10 years</td>
<td>9 (30.0)</td>
<td>3 (10.0)</td>
<td>10 (33.3)</td>
<td>8 (26.7)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Above 11 years</td>
<td>21 (33.3)</td>
<td>18 (28.6)</td>
<td>11 (17.5)</td>
<td>13 (20.6)</td>
<td></td>
</tr>
<tr>
<td>Firm size</td>
<td>1–20 employees</td>
<td>12 (36.4)</td>
<td>5 (15.2)</td>
<td>5 (15.2)</td>
<td>11 (33.3)</td>
<td>4.710&lt;sub&gt;9&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>21–50 employees</td>
<td>6 (24.0)</td>
<td>6 (24.0)</td>
<td>8 (32.0)</td>
<td>5 (20.0)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Above 51 employees</td>
<td>14 (29.8)</td>
<td>11 (23.4)</td>
<td>8 (17.0)</td>
<td>14 (29.8)</td>
<td></td>
</tr>
</tbody>
</table>

Notes: * $p < 0.05$; ** $p < 0.01$
competition can help promote innovation and that policy makers must enhance competitive pressure in the market to push forward both innovation orientations in the construction industry. The government must also enhance competition at the national level by reducing the barriers for foreign construction companies to operate in Malaysia.

This study highlights the negative relationship between firm age and innovation orientation, which is consistent with the findings of many other studies, such as Churchill (2000), Balasubramanian and Lee (2008) and Coad et al. (2013). Organizational inflexibility and inertial forces tend to increase as firms become more mature, thereby hampering the ability of firms to innovate. As companies continue to age, they begin to derive inflexible procedures that often “constrain innovation unless special systems are put into place to motivate and enable innovative behavior” (Van de Ven et al., 1999, p. 201). In highly mature firms, routines that elicit procedural, personnel-related or process innovations can often be observed, but these firms are less able to change quickly enough to develop new innovations. The findings of this study suggest that managers of old construction firms must decentralize their decision-making processes (Bresnahan et al., 2002; Zoghi et al., 2010), as centralization may limit the discussion and exchange of ideas necessary for innovation. Innovation outsourcing can also help old companies enhance their innovation capability (Quinn, 2000). However, not all older firms are non-innovative, as some of these firms tend to create innovations within those industries in which they are most experienced.

Surprisingly, we find no evidence that larger firms in the construction industry tend to be more innovative than smaller firms. However, such lack of evidence does not indicate the absence of any difference in the innovation capacities of large and small firms. This finding is in contrast with that of Bhattacharya and Bloch (2004) and Ayyagari et al. (2012), who claimed that larger firms have a resource advantage for practicing innovation. This finding is also in contrast with the viewpoint that established large firms are innovation adopters (Barbosa et al., 2014). This finding is in parallel with that of Heimonen (2012), who suggested that firm size is not significant in determining innovation orientation because both small and large firms have some innovation creation and adoption advantages over one another. Therefore, firm size is a poor predictor of innovation practices. Sizeable organizations have more multifaceted and varied resources, such as financial slack, marketing skills, research capabilities and product development experience, which can contribute to the creation and adoption of more innovations (Laforet, 2013). Large organizations also have a high technical knowledge base and technical potential because of their employment of highly professional and skilled workers. In contrast, smaller organizations are less rigid, have a high ability to adapt and improve and can easily accept and implement changes; therefore, these firms can become more innovative (Comacchio and Bonesso, 2007; Leal–Rodríguez et al., 2015). Innovation drives the linking of numerous parts of an organization (Leeuwis, 2013), which can be achieved more easily in small organizations than in large ones (Leal–Rodríguez et al., 2015). Consequently, a larger firm size does not automatically result in increased innovativeness.

Conclusion

Innovation has a wide scope and comes in many forms. This multifaceted, random process does not move directly from one point to another. The boundaries between two types of innovation cannot be distinguished clearly. However, despite this difficulty,
innovation creation can be differentiated from innovation adoption according to their criteria and characteristics. This study aims to demonstrate the relationship between the characteristics and innovation orientations of construction firms. The business scale and age of firms have a significant effect on their innovation orientation. Construction firms that operate within the state and at the international level are more innovative as compared with those that operate at the national level. Young construction firms are also more innovative than older ones.

This research presents theoretical contributions to the existing body of knowledge by identifying a new firm characteristic, business scale, as a potential predictor of innovativeness of construction firms. Although previous studies also reveal that the effect of firm characteristics on innovation orientation is highly related to the field of research and differs from one industry to another (Arvanitis, 1997; Rogers, 2004), this study is the first to explore the effect of firm characteristics on innovation orientation within firms. The importance of innovation creation, which has a substantial effect on the market, is emphasized in this paper. Innovation adoption, which provides better value and cheaper price for an improved service or product, can help construction firms gain competitive advantage over their competitors.

The findings can benefit policy makers and managers of construction companies. The government can encourage innovation practices in the construction industry by lowering barriers for competition and increasing competitive pressure in the market. Zhao and Ordóñez de Pablos (2010) suggest that young innovative firms must be provided financial and tax support to enhance their innovation. By providing tax incentives, the Malaysian Government can encourage companies to increase their R&D activities and support their collaboration with knowledge providers, such as universities and research institutes, to generate innovations that will have a significant effect on the construction industry. Managers of mature companies must consider innovation outsourcing as a means of enhancing the innovation capability of their firms. The relationships between firm characteristics and common innovation practices in construction firms must also be understood to help managers select the appropriate type of innovation according to the characteristics of their firms.

This study has some limitations which need to be considered before the results can be generalized. First, the sample is limited to construction firms in Penang, Malaysia. Future studies must test the research model of this study in different regions of Malaysia and other countries. Second, this study does not cover the potential effect of manager characteristics on the innovation of construction firms. Future studies must propose a more exhaustive model. Third, this study is conducted using a questionnaire survey and has a cross-sectional nature. Therefore, the survey results will be affected by the fact that the dynamic changes in the innovation orientation of firms cannot be observed by this study. Hence, a longitudinal study that examines the relationships for an extended period must be conducted to provide more precise results.

References


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