The Role of Climate for Innovation in Enhancing Business Performance: The Case of Design Firms

Kriengsak Panuwatwanich, Rodney A. Stewart and Sherif Mohamed
Griffith School of Engineering, Griffith University, Gold Coast, Australia

Abstract

Purpose – Innovation and the process of diffusion have been widely acknowledged as hinging upon the complex social psychological process. Invariably, such a process manifests itself in the form of "climate" in an organisation, which influences people's behaviours. The purpose of this paper is to empirically investigate the roles of a facet-specific climate, namely "climate for innovation" in determining innovation-related outcomes. In particular, this paper focuses on interrelationships and roles of specific constructs forming such climate. Additionally, this paper attempts to determine the efficacy of innovation by examining the relationship between outcomes of innovation diffusion and business performance.

Design/methodology/approach – A conceptual model incorporating three climate for innovation constructs including leadership, team, and organisational culture along with two constructs addressing innovation diffusion outcomes and business performance was developed. Statistical analyses, specifically exploratory factor analysis (EFA) and structural equation modelling (SEM), were conducted based on the data collected from a questionnaire survey of 181 design professionals employed in Australian architecture and engineering design (AED) firms. EFA was employed as a preliminary step to ascertain the factors underlying each construct, and SEM was sequentially utilised to determine the factor structure of the model and to assess the relationships between model constructs.

Findings – The results revealed that perceived organisational culture functions as a gateway to the diffusion of innovation, by mediating the relationships between leadership and team climate, and innovation diffusion outcomes. More importantly, it was found that all pathways to innovation diffusion outcomes originated from the leadership construct, highlighting its critical role in creating a supportive culture that fosters and nurtures innovation. Finally, the findings warranted the benefits of innovation by demonstrating its significant contribution to business performance in AED firms.

Originality/value – The study presents an empirically developed model depicting pathways that explain the mechanisms of climate for innovation constructs in determining the degree of innovation diffusion outcomes and business performance. The model can potentially form the foundations of a framework for firms seeking to diagnose their existing condition and use such findings to enhance the diffusion of innovation which could, in turn, strengthen their business performance.

Keywords – Climate for innovation, construction, design, innovation diffusion, structural equation modelling, Australia

Paper type – Research paper

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Introduction

To many firms, innovation is considered to be a *sine qua non* for their business success and proliferation in the current competitive, complex and capricious environment. Despite construction being perceived as a mature industry where changes are developing slowly (Blayse and Manley, 2004; Manseau, 2005), innovation is required as a source of competitive advantage for firms operating in the industry to accommodate rapid changes embodied in complex products and processes (Eaton *et al.*, 2006; Manseau, 2005). The awareness of the significant role of innovation in the construction industry has led numerous scholars to study the critical factors that influence successful innovation (e.g. Eaton *et al.*, 2006; Egbu *et al.*, 1998; Peansupap and Walker, 2005; Stewart *et al.*, 2004). Amongst the many factors studied, firm-level factors have constantly received attention (see, for example, Barrett and Sexton, 2005; Egbu *et al.*, 1998; Peansupap and Walker, 2005; Seaden *et al.*, 2003). Analysis of factors at the firm level is particularly important because it is at this level where innovation activities mostly take place and are subsequently made into good currency (Winch, 1998). In other words, the locus of innovation is embedded in the firm, which is the place where the benefits of innovation activities can be observed and measured (Seaden *et al.*, 2003).

Innovation in this paper is eclectically defined as the generation and adoption of ideas, practices and technologies perceived to be new by an organisation involved (Damanpour and Gopalakrishnan, 1998; Van de Ven, 1986). The generation of innovation can be seen as a bottom-up effort whereas the adoption represents top-down innovation attempt (Winch, 1998); both of which require successful diffusion to ensure the efficacy of innovation. Theoretically, diffusion is defined by Rogers (2003) as the process in which an innovation is disseminated over times amongst the members of a social system, which in this case is an individual organisation. In fact, it is widely acknowledged that innovation involves a social psychological process, as it is the product of social relationships and complex systems of interaction (Bain *et al.*, 2001; Chandler *et al.*, 2000; Egbu *et al.*, 1998). Within an organisation, a social psychological process can manifest itself in a form of "climate", which is considered as a determinant of motivation and behaviour (Kozlowski and Doherty, 1989). To study climate of an organisation, Schneider and Reichers (1983) contend that researchers should focus on a specific facet in order to deliver meaningful results. The paper thus concentrates on the social psychological factors that constitute the "climate for innovation".

In addition, the paper focuses on "design" as a context within which the climate for innovation was studied. In the construction industry, design is an important element in construction projects: good design is a precursor to quality deliverables. In the realm of innovation research, design has long been recognised as an important part of the innovation process, yet it is poorly understood in innovation studies (Salter and Torbett, 2003). To address this gap, the paper aims at studying the roles of climate for innovation amongst architecture and engineering design (AED) firms. Furthermore, the contribution of innovation to the performance of such firms will also be evaluated to ensure the efficacy of innovation. The paper begins with the development of a conceptual model, based on the literature review, which depicts the relations amongst the key constructs within the climate for innovation and their roles in determining innovation-related

outcomes. Each model construct and the rationale behind its development were delineated. A series of statistical analyses were then performed to assess the developed model and pertinent results elaborated. Finally, the paper concludes with a discussion of research findings and limitations.

Conceptual Model

A literature review regarding innovation and creativity was conducted in order to explore factors that contribute to successful innovation and effective diffusion. This effort revealed three levels of social psychological factors forming a climate which can be perceived by members of an organisation, namely, organisation, leadership and team (see Amabile *et al.*, 1996; Jung *et al.*, 2003; Sturges *et al.*, 1999). Although commonly identified in the literature, the interrelationships and roles of these sets of factors (will be referred as "constructs" onwards) have not been empirically examined extensively in the construction context. The present research therefore attempts to fill this gap by developing a model incorporating interrelationships of such constructs, and their effects on the innovation-related results, as illustrated in Figure 1. The model comprises two main elements: climate for innovation and results. Within the element of "climate for innovation", the model proposes three key constructs: organisational culture for innovation, leadership for innovation, and team climate for innovation. The "results" element is represented by two constructs: innovation diffusion outcomes; and business performance. As enablers, all of the three climate constructs are hypothesised to have a joint direct effect on the innovation diffusion outcomes. Further, the model proposes that organisational culture for innovation is dependent upon leadership and team climate for innovation; and also directly determines the outcomes of innovation diffusion. Finally, a direct relationship between innovation diffusion outcomes and business performance is proposed. The following sections elaborate on each model's construct, and the rationale behind its development and its presumed relationships with other constructs.

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Organisational Culture for Innovation

Many researchers have emphasised the role of organisation in the successful management and diffusion of innovation (Egbu *et al.*, 1998; Hivner *et al.*, 2003). More specifically, numerous research studies have highlighted the importance of factors characterising an organisational culture that stimulates creativity, motivates innovative behaviour and facilitates the diffusion process (Amabile *et al.*, 1996; Hartmann, 2006; Hivner *et al.*, 2003; Steele and Murray, 2004). According to Ahmed (1998), organisational culture is a major determinant of innovation, having major facilitating and constraining effects on the successful implementation and maintenance of innovation. These effects, as described by Martins and Terblanche (2003), have resulted from socialisation processes in organisations that constitute shared norms and basic values as an established form of behaviours and activities reflected as practice, procedures, policy and structures. When members perceive such supportive practice and so on, they believe that the organisation

values innovation and feel motivated to innovate (Ahmed, 1998; Hartmann, 2006). Such cultural perception has thus become a prerequisite to innovative behaviour.

A review of literature revealed a number of indicators reflecting a culture for innovation. In general, innovative organisations were consistently found to have a high level of freedom and autonomy, and to be flexible and risk tolerant (Amabile *et al.*, 1996; Egbu *et al.*, 1998; Martins and Terblanche, 2003; Steele and Murray, 2004). Within such organisations, creativity is encouraged and supported, innovation efforts are recognised and rewarded, and resources are usually set aside to facilitate such efforts (Amabile *et al.*, 1996; Ekvall, 1996; Chandler *et al.*, 2000; Hartmann, 2006). Several empirical studies have also found that the perceptions of these cultural characteristics directly impact on innovation and creativity in the workplace (e.g. Chandler *et al.*, 2000; Dulaimi *et al.*, 2005; Scott and Bruce, 1994). As such, it can be rationally expected that a high level of organisational culture for innovation in AED firms will lead to effective diffusion of innovation. As a final note, since leaders and members play a role in shaping an organisations' culture for innovation (Ahmed, 1998), the paper proposes that this construct is influenced by leadership and team climate for innovation.

Leadership for Innovation

It has been widely accepted that leaders play a key role in determining innovation and creativity in organisations (Montes *et al.*, 2005; Nam and Tatum, 1997). More specifically, leadership style is perceived to be an important individual attribute that influences innovation (Aragón-Correa *et al.*, 2007; Bossink, 2004). In particular, it has been consistently suggested that transformational leadership is a preferred style for inducing creativity and innovation through developing, intellectually stimulating and inspiring followers to transcend their own self-interests for a higher collective purpose (Howell and Avolio, 1993). Transformational leadership is also commonly related to three other innovative leadership styles including: innovation championing (Howell and Shea, 2001); change-oriented leadership (Yukl, 1999); and leader-member exchange (Graen and Uhl-Bien, 1995). According to Howell and Shea (2001), innovation champions can make a decisive contribution to innovation by actively promoting its progress through the critical organisational stages. In the same manner, change-oriented leaders influence culture, structure, and management systems in such a way that organisations can adapt themselves to a changing environment thus creating a potential to innovate (Yukl, 1999). By focusing on dyadic relationships, leaders who possess high degrees of leader-member exchange will be able to develop mature partnerships based on mutual trust and emotional support (Tierney, 1999). These partnerships can bring about many benefits such as a greater autonomy and decision latitude, which are essential for creativity and innovation as they lead to employees' propensity to take risks and deviate from the status quo (Scott and Bruce, 1994; Tierney, 1999). By synthesising the features of these leadership styles, it can be summarised that leadership for innovation is characterised by the following fundamental behaviours:

- Create and communicate exciting visions of the future;
- Seek out and promote new ideas, techniques, or innovative approaches in solving problems;
- Encourage members to develop their own ideas and support them;
- Spend time mentoring members;
- Engage members and encourage them to share resource through out the entire work processes; and
- Consult with members when making decisions.

Past empirical studies have shown that leaders possessing the above characteristics significantly influence innovation outcomes directly as well as indirectly through such variables as organisational learning and team (e.g. Aragón-Correa *et al.*, 2007; Montes *et al.*, 2005). In view of this, it is expected that leadership will influence organisational culture, team climate for innovation, and the level of innovation diffusion outcomes.

Team Climate for Innovation

It is critical to understand factors that hinder or foster innovation in teams since innovation has usually originated and subsequently been developed into practice by a team (Anderson and West, 1998). According to Bain *et al.* (2001), by combining knowledge, skills, and abilities of individual with different perspectives and backgrounds, teams provide ideal conditions for stimulating creativity and innovation via social and psychological processes. As a result, focusing on teams and creating the necessary condition for them is one means by which innovation can be fostered in organisations. To study key characteristics of innovative teams, West (1990) proposed the model of "team climate for innovation" which outlines four critical factors comprising an innovation-conducive team condition including:

(1) *Vision* refers to an establishment of clearly defined and shared objectives that provides focus and direction to team members as a motivating force at work;
(2) *Participative safety* refers to a climate in which involvement in decision making is motivated and reinforced without fear of criticism;
(3) *Task orientation* refers to a shared concern with excellence and quality of task performance in relation to shared objectives by means of critically reflecting upon tasks, goals, strategies, and processes; and
(4) *Support for innovation* refers to the expectation, approval, and practical support of attempts to introduce new and improved ways of doing things.

Innovative team climate was identified as a predictor of innovation outcomes by many authors. For example, Hurley (1995) studied employees' perception of work group culture (similar to team climate) and found a significant and positive influence of the innovative group's culture on innovative productivity in terms of a number of science and technical awards. Reasonably, it can be presumed that a team climate for innovation could predict the level of innovation diffusion outcomes.

Innovation Diffusion Outcomes and Business Performance

As mentioned earlier, innovation can be appropriated by means of generation and/or adoption. As a bottom-up approach, innovative design solutions represent a kind of innovation that is successfully generated via effective harnessing and diffusion of creative ideas. Utilisation of innovative design technologies and practices, on the other hand, indicates effective diffusion through successful top-down adoption and implementation of innovation. Whilst the mainstream of innovation research in the area of construction concentrates on the adopted innovation (e.g. Kale and Arditi, 2005; Peansupap and Walker, 2005), both innovation types were considered in this paper as outcome indicators of effective diffusion.

According Kemp *et al.* (2003), innovation should ultimately result in an improved level of business performance in a firm when comparing with firms that do not innovate. In a study of 900 firms operating in the farming, manufacturing, construction and services industry, Aragón-Correa *et al.* (2007) found that innovation has a positive impact on business performance. Although there is currently no empirical study specifically verifying the direct influence of design innovation on the business performance of AED firms, it is intuitively anticipated that such a link exists. To ascertain the benefits of design innovation, the present study investigated the relationship between innovation diffusion outcomes and business performance.

Research Methodology

Questionnaire survey

According to Patterson *et al.* (2005), the measurement of climate is generally conducted primarily via quantitative-based questionnaire applied comparatively across several organisations. Therefore, a questionnaire survey approach was deemed appropriate for the purpose of this research. A draft questionnaire was developed based on the review of existing literature and past empirical studies, and was subsequently pre-tested using an expert review technique resulting in some minor changes. Postal mail was chosen as a primary method for delivering the questionnaire since it can cover a wider geographical area. Additionally, a web-based version of the questionnaire was also developed to provide an alternative method for respondents to complete the survey online.

The disseminated questionnaire contained three distinct parts. The first part of the questionnaire (36 items) is pertinent to the model's enablers addressing climate for innovation, which consisted of three sections: (1) supervisor's leadership; (2) team climate; and (3) organisational culture, each containing 12 items measured with a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). These sections represented the construct of leadership for innovation, team climate for innovation and organisational culture for innovation, respectively. The second part of the questionnaire (29 items), which focused on the element of results, contained four sections: (1) innovative design solutions; (2) innovative design practices; (3) advanced technology utilisation; and (4) business performance. The section addressing innovative design solutions asked the respondents to rate their opinion on nine statements reflecting the innovativeness of their firm's design products (e.g. the extent of buildability and sustainability of the

products). The section relating to innovative design practices contained six items requesting respondents to rate the extent to which their firm utilise best practice in design (e.g. value management, life cycle costing, etc.). All items in both sections were measured with a five-point Likert scale ranging from 1 (not at all) to 5 (very great extent). The section addressing advanced technology utilisation contained six items asking respondents to rate, on a five-point scale, the firm's most common practices in utilising information and communication technology (ICT) for different design activities. For example, advanced technology utilisation for the design drafting activity was measured by a scale ranging from 1 (paper-based design drafting) to 5 (three-dimensional object-oriented modelling). In total, these three sections contained 21 items measuring the innovation diffusion outcomes construct. The last section addressing the business performance construct consisted of eight items measuring how well the firm performs against its comparable competitors, based on a five-point scale ranging from 1 (under performer) to 5 (top performer). Finally, the last part of the questionnaire solicited background information of the respondents.

Sample

The national survey was conducted in Australia between May and August 2007. Target respondents were design professionals employed in AED firms. The sampling frame was compiled by selecting a number of AED firms from the Dun and Bradstreet's *Australian Business Who is Who* database, on the basis of the following criteria: (1) firm should have at least 10 employees; (2) firm's main scope of work should include the design of buildings and/or infrastructure; and (3) firm should operate as a private business. In total, approximately 300 firms were selected to comprise a research population. Convenient sampling was then conducted based on whether contact details of target respondents, which include engineers, architects and paraprofessionals (e.g. draftsperson), can be obtained. In total, 520 survey packages including a questionnaire, an introductory letter, an incentive and a pre-paid reply envelope were sent out via postal mail. Of the 520 surveys sent, 181 usable questionnaires from 57 firms were returned thus achieving a response rate of 34.8%. The majority of the respondents were engineers (44.8%) and architects (39.2%) aged between 26-30 (37.0%) and 31-40 (22.1%) with a bachelor degree (77.3%). Most of them were employed in engineering consultancy firms (48.6%) and architecture firms (41.4%) with a size ranging from small-to-medium (10-200 employees, 57.8%) to large (>200 employees, 42.2%). Additionally, most of the respondents (64.2%) reported that design activity accounts for a large portion (61%-100%) of their firm's turnover. In summary, the responses were considered to be a good representation of the survey population.

Data Analysis and Results

Exploratory Factor Analysis

Exploratory factor analysis (EFA) was employed to confirm the number of factors underlying the model constructs and the pattern of loadings. Since the research considered each construct as a separate scale, EFA was conducted for each construct using principal component analysis with VARIMAX orthogonal rotation method. The 181 cases met the minimum acceptable sample size of 100 and exceeded the requirement in terms of cases-to-variable ratio (5:1) for each construct as recommended by Hair *et al.* (2006). Moreover, the

values of Kaiser-Meyer-Olkin (KMO), ranging from 0.82 to 0.89, are well above the recommended level of 0.6 thus indicating sampling adequacy (Tabachnick and Fidell, 2007). The results of EFA are summarised in Table 1.

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On the basis of the eigenvalue (greater than 1.0), the scree test and *a priori* criterion, the constructs of leadership for innovation (LFI, 12 items), team climate for innovation (TCI, 12 items), organisational culture for innovation (OCI, 12 items), innovation diffusion outcomes (IDO, 21 items), and business performance (BPM, 8 items) are represented with three, four, three, three and two factors, respectively. As presented in Table 1, these factor solutions were supported by the cumulative percentage of variance extracted, ranging from 49.0% to 69.9%. To ensure that the items are representative of each factor, the recommended cut-off factor loading of 0.50 was used (Hair *et al.*, 2006), resulting in the elimination of five items from the set of IDO measures. Finally, the reliability coefficients (Cronbach's alpha) of all scales were relative high, ranging from 0.82 to 0.88 and being well above the 0.70 threshold level (Hair *et al.*, 2006), thus demonstrating internal consistency. In sum, these results confirmed that the developed measures comprised reliable and valid items which adequately capture the meaning of the model constructs and their related factors. The results also provided a basis for creating aggregated factors to ease the subsequent model analysis.

Structural Equation Modelling

In order to analyse the conceptual model, a structural equation modelling (SEM) technique was utilised. SEM is considered as an extension of multivariate techniques such as regression analysis as it allows the use of multiple indicators to measure unobserved variables (i.e. constructs) whilst taking into account measurement errors when statistically analysing data (Hair *et al.*, 2006). In general, SEM requires a theoretical model as a starting point in the process (Mohamed, 2003). Analysis is then performed to determine whether such a theoretical model is valid by specifying, estimating and evaluating linear relationships amongst a set of observed and unobserved variables (Shah and Goldstein, 2006). For the purpose of this research, SEM was carried out using a two-step approach as recommended by Anderson and Gerbing (1988). This involves: (1) specifying and assessing the "measurement model"; and then (2) testing the "structural model" to examine the relationships between constructs. Both steps require an assessment of model fit – an indication of how well the hypothesised model represents the data, which was conducted on a basis of five common model fit indices: normed chi-square (χ^2/df); goodness-of-fit index (GFI); comparative-fit index (CFI); incremental-fit index (IFI); and root mean square error of approximation (RMSEA). To be considered as having an adequate fit, all the indices were measured against the following criteria: $\chi^2/df < 3.00$; GFI, CFI, and IFI > 0.90; and RMSEA < 0.08 (Hair *et al.*, 2006).

Measurement Model Assessment

Confirmatory factor analysis (CFA) was employed to establish a valid measurement model prior to testing the structural model. Following the results of EFA described previously, the measurement model was specified as partial disaggregation (Bagozzi and Edwards, 1998) where questionnaire items were averaged into their respective factors to ease the model assessment process. These aggregated factors were then treated as reflective indicators of their respective construct (Figure 2). CFA was conducted using AMOS 7.0 with maximum likelihood estimation (MLE) method. The results of the measurement model are presented in Table 2. Based on the criteria mentioned in the preceding section, the model exhibited an acceptable level of fit (χ^2 = 150.95, df = 80, χ^2/df = 1.89, GFI = 0.90, CFI = 0.94, IFI = 0.94, RMSEA = 0.07). All indicators loaded significantly ($p < 0.001$) on their respective constructs with all loadings, except for one indicator, being greater than 0.50 (Hair *et al.*, 2006). In terms of indicator reliability, only two indicators, namely, freedom and autonomy, and advanced technology utilisation had R^2 values substantially lower than the common acceptable level of 0.50, suggesting a potential for elimination. However, since their factor loadings were meaningful and highly significant, both indicators were retained in the measurement model. These results suggested that the measurement model seems to possess adequate convergent validity. Moreover, since its fit indices proved to be satisfactory, the measurement model can be justifiably utilised for the subsequent structural model assessment.

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Structural Model Assessment

Once the measurement model had been validated, a structural model was examined. Initially, the model fit was assessed and the hypothesised relationships between the model constructs were tested. Non-significant relationships were removed from the conceptual structural model resulting in a refined model. The fit indices of the conceptual model were then compared with those of the refined model in order to ensure that the final model best explains the data. Figure 3 shows the results for the final structural model with standardised path coefficients. Overall, the fit indices indicated an adequate level of model fit (χ^2 = 158.20, df = 85, χ^2/df = 1.86, GFI = 0.89, CFI = 0.93, IFI = 0.93, RMSEA = 0.07). According to the results, leadership for innovation, as an exogenous construct, was found to have a strong and positive influence on organisational culture (0.52, $p < 0.001$) and team climate for innovation (0.72, $p < 0.001$). Team climate for innovation was found to have a moderate and positive influence on organisational culture for innovation (0.35, $p < 0.01$). However, both leadership and team climate for innovation were not found to directly influence the outcomes of innovation diffusion as hypothesised in the conceptual model presented in Figure 1. Instead, they appear to influence this construct indirectly through organisational culture for innovation which had a very strong and positive direct effect on innovation diffusion outcomes (0.93, $p < 0.001$). Finally, business performance

in terms of economic growth and client satisfaction appears to be strongly influenced by the outcomes of innovation diffusion (0.77, $p < 0.001$).

==========INSERT FIGURE 3 ==========

Discussion and Conclusion

Based on the results, the hypotheses associated with the conceptual model that the three perceived social psychological constructs (i.e. leadership, organisational culture, and team climate) would influence the extent of innovation diffusion outcomes which, in turn, would influence business performance, was partially supported by the data. Only two links from leadership and team climate to innovation diffusion outcomes were not significant, implying that both constructs exert no direct influence on the outcomes of innovation diffusion. Instead, both leadership and team climate contribute to innovation diffusion outcomes indirectly through organisational culture. This pattern of relationships underlies the importance of organisational culture, as a mediating variable, that appears to function as a portal to effective diffusion of innovation. This result reinforces findings from other studies highlighting the vital role of organisational culture (e.g. Egbu *et al.*, 1998; Hartmann, 2006). Without a culture for innovation, it is unlikely that creative ideas will be transformed into innovative products. In the same manner, even though an organisation decided to adopt a particular innovation, such innovation is not likely to be fully utilised if the employees perceive no encouragement and support from the firm. Therefore, to unleash and exploit the innovative capacity that team members and managers/supervisors may possess, it is imperative that the firm ensures the culture for innovation is in place and can be perceived by all members rather than being simply enshrined in the firm's policy.

In addition to the apparent mediating role of organisational culture, the pattern of relationships indicates dual pathways to achieving innovation diffusion outcomes; both of which emerged from the leadership for innovation construct. This finding is consistent with the literature (e.g. Amabile *et al.*, 1996; Jung *et al.*, 2003; Scott and Bruce, 1994) highlighting a critical role that managers/supervisors play in bringing about innovation through inducing innovative team climate whilst influencing a culture that supports creative ideas and fosters innovation efforts in team. Therefore, it is recommended that firms should place an emphasis on developing highly innovative leaders, which could be achieved by cultivating transformational leadership amongst managers/supervisors. Once achieved, these leaders will act as a momentous force in shaping and sustaining innovative traits within individual teams and the firm at large.

Focusing on the benefits of design innovation, this study demonstrated a significant relationship between the outcomes of innovation diffusion and the business performance of design firms. With the prevalent uses of advanced technologies and innovative design practices, coupled with innovative design products, firms can enhance the overall quality of their design deliverables, thus increasing the level of client

satisfaction. This in turn improves the ability to expand market share which leads to turnover and profit growth; thereby strengthening the overall business performance.

In conclusion, by drawing attention to the social psychological aspect of innovation and uncovering the mechanisms for enhancing innovation diffusion and business performance, this paper sheds additional light on the implications of fostering innovation practices, especially within the AED context. More importantly, the paper provides evidence that design innovation is an essential driver of business performance, thus warranting the benefits of design innovation in AED firms. Finally, the developed model presented in this paper could serve as a framework for firms seeking to diagnose the health of their innovation practices. This could help guide firms to devise custom strategies that serve to enhance innovation diffusion and ultimately business performance.

Study Limitations

The research findings reported herein should be interpreted in light of limitations. As cross-sectional research, this study did not consider the "time" factor, which is one important element in the theory of innovation diffusion. To do this requires a longitudinal research design where the study is conducted at different points in time. Also, the use of a cross-sectional study precludes a definite conclusion regarding the causal relationships between model constructs, which can only be achieved via quasi-experimental research. Furthermore, the use of self-reported measures means that the responses have an element of subjectivity. This is acceptable for the measuring fuzzy innovation climate constructs; however, business performance is ideally measured by objective metrics. Lastly, the use of questionnaire survey does not necessarily explain how relationships have manifested themselves in AED firms. Thus a series of case studies is beneficial to complement the empirical findings by qualitatively validating identified relationships and uncovering the real industry strategies underpinning them. Such case studies are currently being completed by the research team.

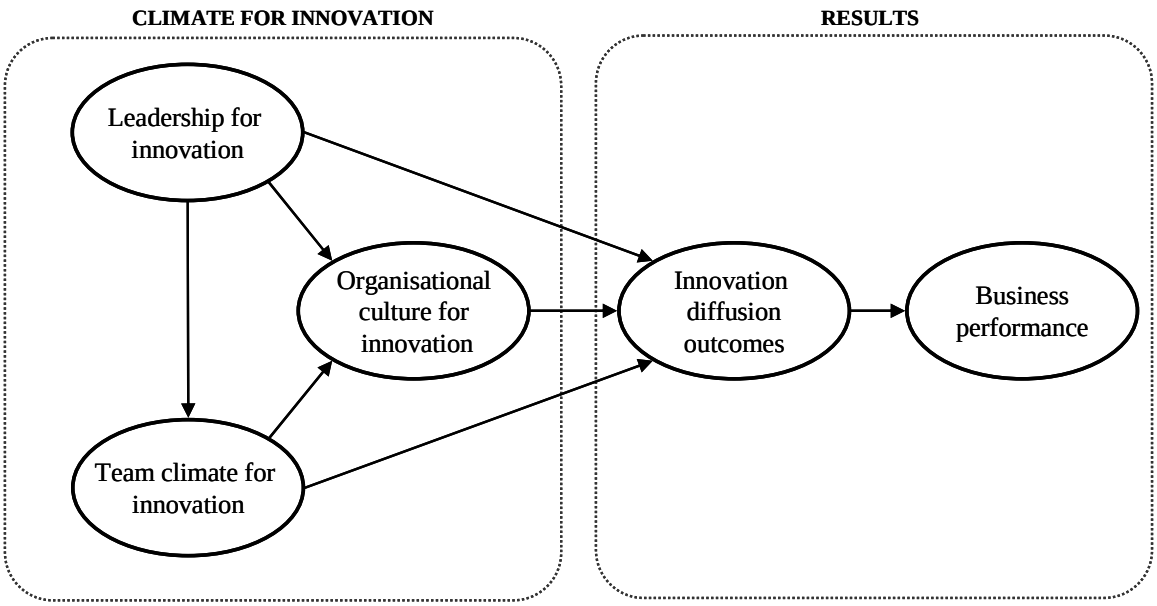

Figure 1 Conceptual Model

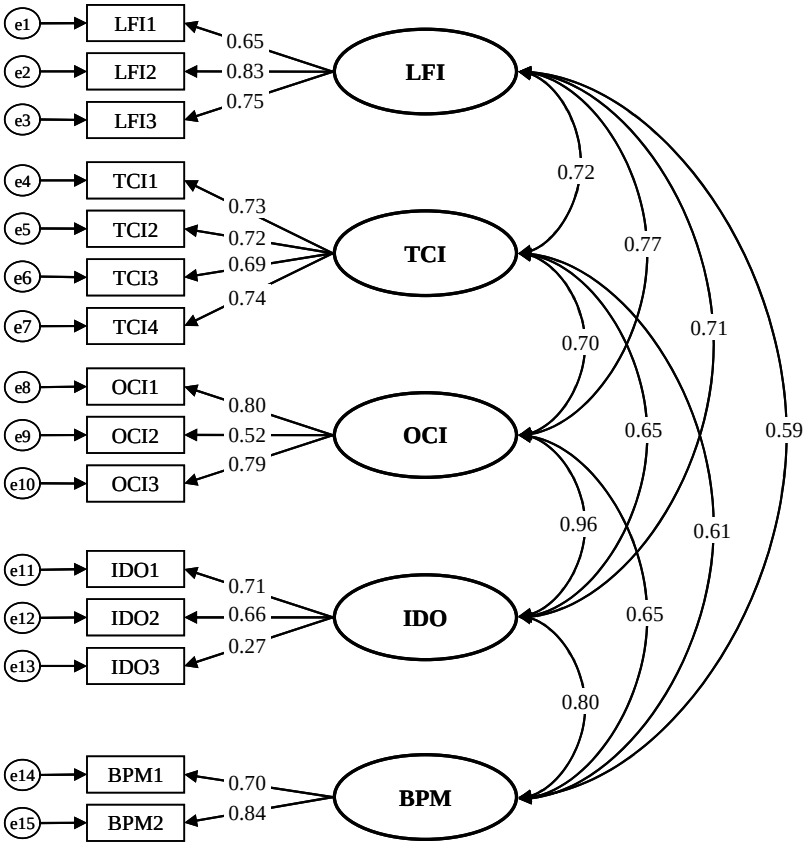

Figure 2 Measurement Model

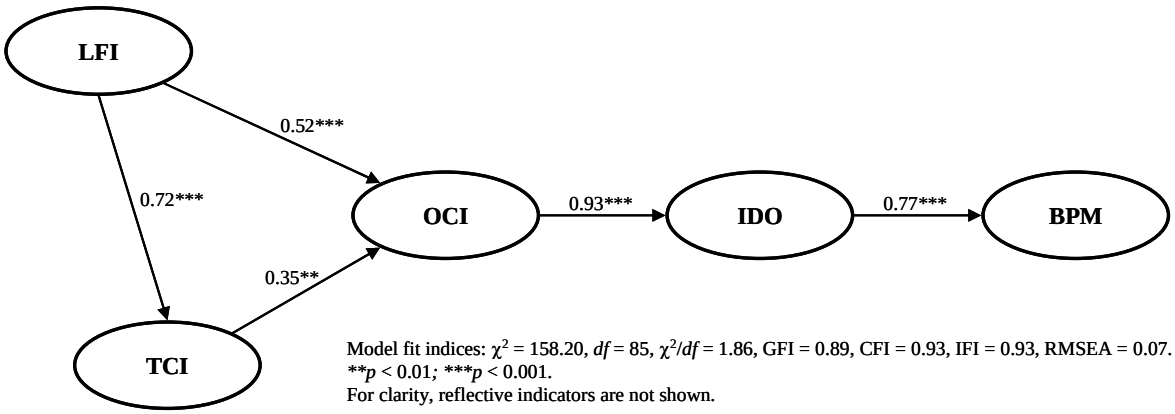

Figure 3 Final structural model with standardised path coefficients

Table 1 Summary of EFA results

Construct	KMO*	Factors extracted	Cumulative variance	Cronbach's alpha	Factor details
Leadership for Innovation (LFI)	0.88	3	63.2%	0.88	LFI1: Innovation championing (4 items) LFI2: Creativity stimulation and inspiration (3 items) LFI3: Engagement and support (5 items)
Team Climate for Innovation (TCI)	0.87	4	69.9%	0.88	TCI1: Vision (4 items) TCI2: Participative safety (3 items) TCI3: Task orientation (2 items) TCI4: Support for innovation (3 items)
Organisational Culture for Innovation (OCI)	0.86	3	63.3%	0.88	OCI1: Propensity for creativity (5 items) OCI2: Freedom and autonomy (2 items) OCI3: Innovation support and facilitation (5 items)
Innovation Diffusion Outcomes (IDO)	0.83	3	49.0%	0.82	IDO1: Innovative design products (6 items) IDO2: Innovative design practices (5 items) IDO3: Advanced technology utilisation (5 items)
Business Performance (BPM)	0.83	2	67.3%	0.87	BPM1: Economic growth (4 items) BPM2: Client satisfaction (4 items)

*Kaiser-Meyer-Olkin measure of sampling adequacy.

Table 2 Measurement model results

Constructs/Factors	Loadings	*t*-value[†]	R^2
Leadership for Innovation (LFI)			
LFI1: Innovation championing	0.65	f.p.	0.53
LFI2: Creativity stimulation and inspiration	0.83	8.54	0.52
LFI3: Engagement and support	0.75	8.11	0.56
Team Climate for Innovation (TCI)			
TCI1: Vision	0.73	f.p.	0.53
TCI2: Participative safety	0.72	8.78	0.52
TCI3: Task orientation	0.69	8.39	0.48
TCI4: Support for innovation	0.74	8.90	0.54
Organisational Culture for Innovation (OCI)			
OCI1: Propensity for creativity	0.80	f.p.	0.64
OCI2: Freedom and autonomy	0.52	6.75	0.27
OCI3: Innovation support and facilitation	0.79	10.88	0.62
Innovation Diffusion Outcomes (IDO)			
IDO1: Innovative design solutions	0.71	f.p.	0.50
IDO2: Innovative design practices	0.66	8.08	0.44
IDO3: Advanced technology utilisation	0.27	3.38	0.07
Business Performance (BPM)			
BPM1: Economic growth	0.70	f.p.	0.49
BPM2: Client satisfaction	0.84	7.92	0.71

Model fit indices: $\chi^2 = 150.95$; $df = 80$; $\chi^2/df = 1.89$; GFI = 0.90; CFI = 0.94; IFI = 0.94; RMSEA = 0.07.
f.p., Parameter is fixed for estimation purpose.
[†]All *t*-values are significant at $p < 0.001$.

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