Climate for Enhancing Innovation Diffusion: Pathways to improved business performance

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INTRODUCTION

Innovation is widely recognised as a driving force for a firm’s economic growth (Gann 2003). Particularly in the design sector where creativity and innovation dictate business competitiveness, firms capable of successfully generating and/or adopting innovation are more likely to stay competitive than those who do not. To achieve this, firms need to be able to understand how innovation can be effectively diffused. Diffusion, as defined by Rogers (1983), is the process by which an innovation is communicated through certain channels over time among the members of a social system. As a result, innovation diffusion has been viewed as a result of a social psychological process.

Generally, social psychological process can manifest itself in the form of an environmental stimulus namely ‘climate’, which is considered as a determinant of motivation and behaviour (Kozlowski and Doherty 1989). Climate is defined as ‘a shared and enduring molar perception of the psychologically important aspects of the work environment’ (Ashfort 1985). Furthermore, as pointed out by Schneider and Reichers (1983), members of an organisation are exposed to numerous events and situations which are perceived in related sets. Therefore, when examining climate in an organisation, it is imperative that climate be related to a specific issue. In view of this, the study presented in this paper concentrates on analysing ‘climate for innovation’. In addition, the study is concerned with the context of ‘design’, which is an important element of a construction project lifecycle. 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). Milne and Leifer (1999) maintain that what is less understood is how the quality of the environment (i.e. climate) may impact design activity aimed at developing innovative products. To address this gap,
the present study aims at examining the climate for innovation and its role in determining innovation-related outcomes among AED firms.

CONCEPTUAL MODEL

Overview

Past research studies have identified a number of social psychological factors forming a climate which can be perceived by members of an organisation. These factors can be grouped as leadership, organisational culture and team process (Amabile et al. 1996; West 1997). These groups of factors (constructs), acting as enablers to the diffusion of innovation, are also consistent with those identified and reported in the research conducted in the area of building and construction (e.g. Egbu et al. 1998; Steele and Murray 2004). However, the relationships between such enabling constructs and their outcomes have not been examined extensively from an empirical standpoint. To overcome this deficiency, the present study attempts to model the dynamics of these constructs by exploring the relationships between them, and their effects on innovation-related outcomes.

Figure 31.1 illustrates the conceptual model consisting of two main elements: climate for innovation and results. Within the element of climate for innovation, there are three key constructs: organisational culture for innovation, leadership for innovation, and team climate for innovation; whereas the ‘results’ element consists of two constructs: innovation diffusion outcomes, and business performance. The following section details the model constructs and the formation of associated research hypotheses.
Model constructs and hypotheses

Leadership for innovation construct

Leadership is a key ingredient if organisations are to function effectively. It generally involves a process whereby intentional influence is exerted by one person over other members in order to guide and facilitate activities and relationships in a group or an organisation (De Jong 2004). In construction, leaders and champions are commonly identified as crucial players in the success of innovation in construction projects (Nam and Tatum 1997). Generally, innovation-conducive leaders display championing behaviour by constantly seeking out and promoting creative and innovative ideas (Howell and Higgins 1990; Yukl et al. 2002). They also stimulate creativity from team members by inspiring a future vision and encourage members to develop their own ideas (Bass and Avolio 1994). To achieve innovative outcomes, these leaders obtain support from their subordinates by maintaining the quality of work relationships, and encourage team members to share ideas and resources (Bass and Avolio 1994; Yukl et al. 2002). Recent empirical studies have shown that supervisors/leaders who exhibit such behaviours significantly influence innovation directly and
indirectly through such variables as organisational learning and team cohesion (e.g. Aragón-Correa et al. 2007; Montes et al. 2005). Accordingly, it is expected that leadership will influence organisational culture, team climate, and the level of innovation diffusion outcomes; thus the following hypotheses:

• H1: Leadership for innovation positively influences team climate for innovation
• H2: Leadership for innovation positively influences organisational culture for innovation
• H3: Leadership for innovation positively influences innovation diffusion outcomes.

Team climate for innovation construct

Understanding factors that hinder or foster creativity and innovation in teams is crucial for firms seeking to enhance the diffusion of innovation since innovation has usually originated and subsequently been developed by teams into practice. To provide an understanding of such factors, the study adopted the ‘four-factor theory’ proposed by West (1990), which outlines four factors characterising team climate for innovation: (1) vision refers to an establishment of clearly defined and shared goals that provide focus and direction to team members as a motivating force at work; (2) participative safety is 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; and (4) support for innovation refers to the expectation, approval, and practical support of attempts to introduce new and improved ways of doing things. Empirically, innovative team climate was identified as a predictor of innovation outcomes by several authors. For example, Hurley (1995) studied employees’ perception of work group culture (i.e. team climate) and found a significant and positive influence of the innovative group’s culture on innovative productivity. Reasonably, it can be presumed that team climate for innovation can predict the level of innovation diffusion outcomes. The foregoing supposition led to the following hypothesis:

H4: Team climate for innovation positively influences innovation diffusion outcomes.

Organisational culture for innovation construct
Organisational culture is a primary determinant of innovation, having major facilitating and constraining effects on the successful implementation and maintenance of innovation (Ahmed 1998; West 1997). Thus, the promotion of a culture for innovation is most important in order to maintain a proactive and entrepreneurial organisation (Steele and Murray 2004). In general, an organisation that favours innovation always provides a high level of freedom and autonomy, and exhibits a propensity for creativity by having a culture where there is a presence of flexibility and risk tolerance (Amabile et al. 1996; Ekvall 1996). Within such culture, innovation efforts are recognised and supported, and adequate resources are usually set aside to facilitate such efforts (Amabile et al. 1996; Fernando 2006). Several empirical studies have found a significant contribution of the perceptions of such cultural characteristics on innovation-related outcomes (e.g. Lau and Ngo 2004).

As such, it can be expected that organisational culture for innovation will influence the outcomes of innovation diffusion. As a final note, since creative people in an organisation play a significant role in shaping a culture of innovation (Ahmed 1998), it is also proposed that organisational culture for innovation will be influenced by team climate for innovation; hence:

- **H5**: Team climate for innovation positively influences organisational culture for innovation
- **H6**: Organisational culture for innovation positively influences innovation diffusion outcomes.

**Innovation diffusion outcomes and business performance constructs**

Innovation can come to an organisation by means of generation or adoption (Damanpour and Gopalakrishnan 1998). In the design sector, innovative design solutions can be considered as a generated innovation representing a bottom-up diffusion process, whereas the adoption of advanced design technologies and/or practices represents a top-down diffusion effort. Both of these were considered as indicators of innovation diffusion outcomes in the present study. Although there is no empirical study on the direct benefits of such design innovation on business performance of AED firms, it is anticipated that business performance will be improved with the presence of design
innovation. In other industries, innovation was empirically found to have a positive impact on business performance (e.g. Aragón Correa et al. 2007; Han et al. 1998); thus the last hypothesis:

H7: Innovation diffusion outcomes positively influence business performance

It should, however, be noted that past research regarding the benefits of innovation on the business performance also produced inconsistent results. For example, Darroch (2005) and Kemp et al. (2003) found no relationship between innovation and business performance.

RESEARCH METHOD

The study adopted a sequential mixed method research design which combines quantitative and qualitative research approaches (Tashakkori and Teddlie 1998). The use of such a hybrid strategy has been strongly encouraged in the area of construction management research (see Wing et al. 1998). As a predominant method in the measurement of climate, a quantitative (based questionnaire survey was first conducted to provide an initial step for assessing the developed conceptual model. This involved employing a quantitative analysis of survey data to determine how well the model represents the prevalent phenomena among AED firms. Following this, qualitative case studies were sequentially conducted to further ascertain the validity of the model. As a result, the analysis consisted of two phases: quantitative analysis serving the conceptual model assessment; and qualitative analysis ascertaining the model’s validity. The details of both analyses are presented in the following sections.

Quantitative analysis: Conceptual model assessment

Questionnaire survey

A questionnaire was developed based on an extensive review of literature and past empirical studies. Questionnaire design was carried out following Dillman (2000) and was pretested using the expert (review technique. Postal mail was the primary method for delivering the questionnaire. Additionally, respondents were provided an option to complete the questionnaire online.
Overall, the questionnaire contained three distinct parts. The first part consisted of a set of questions measuring the three climate constructs, based on a five-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). Organisational culture for innovation was measured by 12 items ($\alpha = 0.877$) drawn up from Amabile et al. (1996), Ekvall (1996), and Scott and Bruce (1994), which represent three factors: propensity for creativity, freedom and autonomy, and innovation support and facilitation. Leadership for innovation was measured using 12 items ($\alpha = 0.883$) derived from Bass and Avolio (1994), Howell and Higgins (1990), and Yukl (2002). This construct consists of three factors: innovation championing, creativity stimulation, and engagement and support. Team climate for innovation was measured by a modified short version of team climate inventory (TCI) by Kivimaki and Elovainio (1999). The TCI consists of four factors: vision, participative safety, task orientation, and support for innovation. The original short version of the TCI contains 14 items; however, two items were dropped as a result of the questionnaire pretesting thus resulting in the modified 12-item scale ($\alpha = 0.883$).

The second part comprised questions measuring the ‘results’ element of the model. Innovation diffusion outcomes were measured by 21 items ($\alpha = 0.849$) reflecting three aspects: innovative design solutions (e.g. awards and recognition received), innovative design practices (e.g. the use of value-based design methods), and advanced technology utilisation (e.g. the use of IT in design development and integration). Business performance was measured by eight items ($\alpha = 0.870$) capturing two aspects: economic growth, and client satisfaction. Finally, the third and last part focused on soliciting respondents’ background information.

Model assessment

Structural equation modelling (SEM) technique using AMOS 7.0 was employed to assess model fit and to test the hypotheses. In general, SEM is a technique to determine whether an a priori model is valid by specifying, estimating and evaluating linear relationships among a set of observed and unobserved variables (Shah and Goldstein 2006). These linear relationships imply causal links whose
estimated path coefficients can be used as a basis for hypothesis testing. In order to estimate model parameters, maximum likelihood (ML) method with covariance input matrix was used. The study employed five common indices to assess model fit: (1) normed chi-square ($\chi^2/df$); (2) goodness-of-fit index (GFI); (3) comparative fit index (CFI); (4) incremental fit index (IFI); and (5) root mean square error of approximation (RMSEA). To be considered as having an adequate fit, all the indices were measured against the following criteria: $\chi^2/df < 2.00$; GFI, CFI, and IFI > 0.90; and RMSEA < 0.08 (Hair et al. 2006; Kline 2005).

In order to ease the assessment process, the conceptual model was represented as partial disaggregation (Bagozzi and Edwards 1998) where the questionnaire items were averaged into a first-order factor within a respective construct. As a result, each model construct was treated as a second-order factor having multiple first-order factors as its reflective indicators (See Figure 30.1). This partial disaggregation model was used in the subsequent analysis.

**Qualitative analysis: Model validation**

After the conceptual model had been quantitatively assessed, qualitative analysis was sequentially conducted to validate the model through case studies. In general, case studies can be classified as descriptive, exploratory and explanatory: descriptive case studies focus on determining what needs to be described; exploratory case studies usually focus on theory and/or hypothesis development; and explanatory case studies focus on theory and/or hypothesis testing (Yin 2003). Since the aim of conducting case studies was to validate the results from the conceptual model assessment phase, an explanatory approach was adopted. In this regard, the final model derived from the quantitative analysis served as a set of hypotheses to be tested. In order to perform the model validation, the paper employed the ‘pattern matching’ technique whereby patterns of the relationships between the constructs obtained from each of the case studies were compared with those predicted (hypothesised) by the model (Yin 2003). Specifically, the paper followed a pattern-matching approach described in Nicholson and Kiel (2007). Such a technique provides a test of the model’s
ability to describe actual organisational phenomena that take into account the significance of people and reality of the situation.

RESULTS

Conceptual model assessment

Survey respondent profiles

A survey was conducted in Australia from May to August 2007. Target respondents were design professionals employed in AED firms. The sample was chosen first by randomly selecting a number of AED firms from the Dun and Bradstreet’s The Business Who’s Who of Australia directory. An attempt was then made to obtain individual contact details of engineers, architects and para(professionals (e.g. civil/structural designers, draftspersons) working in the selected firms. In total, 520 design professionals were identified. Questionnaires were mailed to each individual along with an incentive and a cover letter explaining the purpose and benefits of the study. As a result, 181 usable questionnaires from 57 firms were received thus achieving a response rate of 34.8 per cent. Most of the respondents are engineers (44.8%) and architects (39.2%) aged between 26–30 (37%) and 31–40 (22.1%) with a bachelor degree (77.3%). Most of them are employed in engineering consultancy firms (48.6%) and architecture firms (41.4%) with a size ranging from small(to(medium (≤ 200 employees, 57.8%) to large (> 200 employees, 42.2%). Overall, the respondents were considered a good representation of the survey population.

Model assessment results

SEM was performed to initially evaluate the fit of the conceptual model as well as to test the hypothesised relationships between the constructs. According to Table 31.1, the results of the initial conceptual model assessment show that the paths from leadership for innovation to innovation diffusion outcomes (LFI → IDO) and from team climate for innovation to innovation diffusion outcomes (TCI → IDO) are not statistically significant. As a result, these two paths were removed
from the conceptual model resulting in a refined model which was then reassessed. Chi-squared difference test between the conceptual model and the refined model shows non-significant results ($\chi^2 = 0.73, p = 0.694, \text{n.s.}$) – indicating that both models fit the data equally well. Accordingly, the refined model was chosen as a final model since it is more parsimonious (Kline 2005). As presented in Table 31.1, the fit indices of the final model proved to be satisfactory: $\chi^2/df = 1.86$; GFI = 0.89; CFI = 0.93; IFI = 0.93; and RMSEA = 0.07. The final model along with its standardised path coefficients are illustrated in Figure 31.2.

### Table 31.1 SEM Results

<table>
<thead>
<tr>
<th>Path</th>
<th>Initial model†</th>
<th>Final model†</th>
<th>Hypothesis testing results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standardised path coefficient</td>
<td>$t$-value</td>
<td>Standardised path coefficient</td>
</tr>
<tr>
<td>LFI $\rightarrow$ TCI (H1)</td>
<td>0.71</td>
<td>7.15***</td>
<td>0.72</td>
</tr>
<tr>
<td>LFI $\rightarrow$ OCI</td>
<td>0.54</td>
<td>4.18**</td>
<td>0.52</td>
</tr>
<tr>
<td>LFI $\rightarrow$ IDO</td>
<td>-0.01</td>
<td>0.05 n.s.</td>
<td></td>
</tr>
<tr>
<td>TCI $\rightarrow$ IDO</td>
<td>0.11</td>
<td>0.66 n.s.</td>
<td></td>
</tr>
<tr>
<td>TCI $\rightarrow$ OCI</td>
<td>0.32</td>
<td>2.58**</td>
<td>0.35</td>
</tr>
<tr>
<td>OCI $\rightarrow$ IDO</td>
<td>0.85</td>
<td>4.78**</td>
<td>0.93</td>
</tr>
<tr>
<td>IDO $\rightarrow$ BPM</td>
<td>0.77</td>
<td>7.66***</td>
<td>0.77</td>
</tr>
</tbody>
</table>

†Initial model fit indices: $\chi^2 = 157.47, df = 83, \chi^2/df = 1.90$, GFI = 0.89, CFI = 0.93, IFI = 0.93, RMSEA = 0.07

†Final model fit indices: $\chi^2 = 158.20, df = 85, \chi^2/df = 1.86$, GFI = 0.89, CFI = 0.93, IFI = 0.93, RMSEA = 0.07

**$p < 0.01$; ***$p < 0.001$; n.s. = not significant
According to the results, leadership for innovation was found to have a very strong and positive influence on team climate for innovation (0.72, p < 0.001), accounting for 51 per cent of its variance (R² = 0.51), thus supporting H1. Both leadership (0.52, p < 0.001) and team climate for innovation (0.35, p < 0.01) were found to positively influence organisational culture for innovation and jointly account for 65 per cent of the variance of this construct (R² = 0.65), thus providing support for H2 and H5. Organisational culture for innovation, in turn, strongly and positively influence the innovation diffusion outcomes (0.93, p < 0.001), accounting for 86 per cent of its variance (R² = 0.86); hence H6 was supported. However, since the construct of innovation diffusion outcomes was not found to be influenced by leadership and team climate for innovation in the initial model assessment; H3 and H4 were not supported. Finally, business performance was found to be strongly and positively influenced by innovation diffusion outcomes (0.77, p < 0.001) with 59 per cent of variance accounted for (R² = 0.59), thus providing support for H7.

**Model validation**

**Predicted pattern development**

Following model assessment, predicted patterns were formulated based on the final outcome of the quantitative analysis (refer to Figure 31.2). Overall, the predicted patterns were developed using
high, medium and low value descriptors for the exogenous construct (i.e. LFI). The values of other corresponding endogenous constructs (i.e. TCI, OCI, IDO and BPM) were determined by following the paths depicted in the model and by taking into account their standardised coefficients. Specifically, the standardised path coefficients in the model were classified on the basis of Cohen’s (1988) effect size criteria as small (0.10 – 0.29), medium (0.30 – 0.49) and large (≥ 0.50). As a result, three main predicted patterns were developed as presented in Figure 31.3.

![Figure 31.3 Predicted Patterns](image)

**Case study results**

During the first quarter of 2008, case studies were conducted with three Australian AED firms. The profiles of the three cases are summarised in Table 31.2. In each case, four members from the design team participated in the study. Semi-structured, face-to-face interviews were carried out to solicit opinions from the participants. Each interview was tape-recorded and transcribed. The contents of each interview were coded, summarised and rated against the developed criteria. To increase the internal validity of the results, secondary sources of information including newsletters and online documents published on the website were obtained from each firm and were analysed to complement the interview findings. Table 31.2 presents the final results of the case studies in terms of the qualitative evaluation for the constructs and a systematic assessment as to whether the cases match the predicted patterns illustrated in Figure 31.3.
According to Table 31.3, the patterns of relationships between the observed constructs for Firm A and Firm C show a perfect and a good match to the predicted pattern no. 1, respectively. At both firms, the level of LFI seems to highly correlate with the level of TCI. Both of the two constructs are also associated with the high level of OCI. The participants from both firms agreed that their supervisors/team leaders greatly influence the climate for innovation within their teams. They also pointed out that innovative leaders and teams definitely have an influence on the firms’ culture of innovation. The pattern also indicates that the higher level of OCI contributes to the higher level of IDO. Most of the participants also shared similar views. For example, in Firm A, the participants
believed that by instilling a ‘think beyond the square’ culture, the firm can consistently introduce innovative solutions and is always ahead in the use of advanced engineering design techniques.

Similarly, participants from Firm C believed that by having a culture that is inclusive and supportive, new ideas and knowledge can be quickly diffused and implemented to produce high(quality designs.

In addition, the higher level of IDO results in the higher level of BPM, as evident from the pattern matching results for both firms. This can be exemplified by a comment made by the senior structural engineer from Firm A that the high level of the firm’s innovativeness has helped it to maintain business competitiveness as well as a high level of client satisfaction.

The pattern of relationships between the observed constructs of Firm B indicates a partial match with the predicted pattern no. 2. The level of leadership for innovation appears to highly correlate with that of team climate. Both constructs are also shown to correlate with the level of organisational culture for innovation, but with a slightly weaker effect. The level of organisational culture for innovation, however, is not strongly associated with the level of innovation diffusion outcomes as predicted, thus does not match the predicted relationship completely. Perhaps this deficiency can be explained by the fact that the firm has recently undergone a management restructure. According to the engineering manager who championed the restructuring process, such a change has started to drive the firm toward an improved culture for innovation by being more flexible and more inclined to use innovative approaches in carrying out its works. Finally, despite innovation diffusion outcomes being rated as low to medium, this construct was found to have a slight strengthening effect on business performance, which was rated as medium.

**DISCUSSION**

The results from the conceptual model assessment indicate that leadership for innovation is the most influential construct among the underlying climates for innovation. Leaders/supervisors who possess an innovation(conducive leadership style seem to directly shape an innovation culture by creating and maintaining policies and practices that are suitable for the diffusion of innovation.
Indirectly, they create such a culture by influencing the climate for innovation among teams, and this has, in turn, become an important building block of a culture for innovation.

Examining the relationships between the three climate constructs and innovation diffusion outcomes revealed that organisational culture for innovation is the only construct that directly influences the outcomes of innovation diffusion. Moreover, leadership and team climate for innovation appear to contribute to this construct indirectly through organisational culture. Such a pattern of relationships implies that organisational culture is a mediating construct, functioning as a portal to an effective diffusion of new technologies and creative ideas. Without a culture for innovation, it is unlikely that creative ideas will be transformed into innovative products. In the same manner, even though a firm decided to adopt a particular innovation, such innovation is not likely to be fully used if the employees perceive no encouragement and support from the organisation. In addition, such a pattern also suggests that the pathways to innovation diffusion outcomes appear to originate from leadership for innovation. This highlights a critical role that leadership plays in bringing about innovation through stimulating and motivating creativity in teams, whilst creating an innovation-conducive culture to support such creativity and foster innovation adoption.

Although past empirical research studies have shown mixed results regarding the benefits of innovation, this study demonstrates a significant relationship between the outcomes of innovation diffusion and the business performance of AED firms. With the prevalent uses of advanced technologies and innovative design practices coupled with innovative design solutions, firms can improve the overall quality of 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 overall business performance.

Regarding the results from the case studies, it appears that for firms A and C the derived model can be used adequately to explain the actual relationships between the climate constructs and their contribution toward innovation-related outcomes. In the case of Firm B, however, the results of
pattern matching suggest that the model does not fully explain the actual phenomena. The degree
to which the pattern of the observed constructs deviates from the pattern predicted by the model,
in this case, does not appear to be substantial when considering the possibility that the actual
constructs might be affected by other factors, as evident from the presence of unexplained variance
in the model. Reasonably, it can thus be concluded that the model derived from the quantitative
analysis was adequately validated by the findings of the case studies.

CONCLUSIONS

This paper presents an empirical study of climate for innovation and its outcomes regarding
innovation diffusion and business performance of Australian AED firms. Specifically, the study
highlights three climate constructs: leadership for innovation, team climate for innovation, and
organisational culture for innovation. Based on the developed conceptual model, the study was
carried out using a sequential mixed method design integrating quantitative(based questionnaire
survey and qualitative case study research. The final model derived from the SEM analysis of the
survey data indicates that organisational culture for innovation appears to be a gateway to
innovation diffusion by mediating the relationships between both leadership and team climate, and
innovation diffusion outcomes. To create such a culture, the model suggests that firms should place
an emphasis on cultivating a leadership( for(innovation style among leaders/supervisors. More
importantly, the study found that the level of innovation diffusion outcomes significantly leads to an
improved business performance, thus supporting the benefits of innovation in AED firms. Finally, by
using an explanatory case study approach, the model was validated through three cases of
Australian AED firms. Pattern matching analysis corroborated findings from the quantitative study
indicating that the actual relationship patterns can be reasonably explained by the model. This
confirms the identified mechanisms of climate for innovation in enhancing innovation diffusion that
ultimately leads to improved business performance.
REFERENCES


Reading: dates unknown.


