

## **Investigating the Link between Climate for Innovation and Diffusion Outcomes in Architecture and Engineering Design Organisations**

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### **Abstract**

Innovation is widely recognised as a driving force for a firm’s economic growth. Generally, innovation can come to an organisation by means of adoption or generation. Either way, the process of innovation diffusion is involved. Diffusion is a process by which an innovation is disseminated through communication channels among members of a social system over time. In this regard, social influence, in terms of organisational climate, is conceived of as a critical innovation enabler. This paper thus focuses on studying the impacts of a facet-specific climate namely “climate for innovation” on innovation diffusion outcomes in architecture and engineering design (AED) firms. This paper argues that there are three main factors forming climate for innovation: organisation culture, leadership and team climate. Despite the existing literature within the context of construction highlighting the importance of such factors, empirical studies addressing their impacts on firm-level innovation diffusion and business performance are sparse. To overcome this deficiency, a conceptual model was developed to be used for empirical investigation. This paper details the theoretical development of such a model and outlines a research method and plan of future research activities.

### **Keywords**

Innovation, Construction, Organisational Culture, Leadership, Team Climate, Architecture and Engineering Design

### **1. Introduction**

Innovation is widely recognised as a driving force for a firm’s economic growth (Gann, 2003). In construction, innovation is also an essential component of a company’s strategy to accommodate rapid changes embodied in complex products and processes (Manseau, 2005). Innovation is particularly important for architecture and engineering design (AED) organisations since design is a combination of creativity, intellectual content, technical possibilities and market demand (Torbett *et al.*, 2001) as well as a critical element in construction projects. Moreover, there is a tie between innovation and design in a sense that they both relate to the social context of an organisation. Innovation is the product of social relationships and a complex system of interactions (Bain *et al.*, 2001; Dackert *et al.*, 2004) whereas design is a complex social activity (Milne and Leifer, 1999). According to Eaton *et al.* (2006) innovation research from a social perspective is in demand.

This paper focuses on one of the important social constructs in an organisation namely “climate for innovation”. This paper attempts to investigate the link between organisational climate and the diffusion of innovation in AED organisations. Based on the outlining theoretical background, this paper elaborates on the development of a conceptual model and delineates its constructs, sub-factors and corresponding hypotheses. The model will undergo a process of testing and validation through future research activities presented at the end of this paper.

## **2. Theoretical Background**

### **2.1 Diffusion of Innovation in an Organisation**

Innovation is defined as any idea, practice, or material artefact perceived as new by the individuals involved (Zaltman *et al.*, 1973). According to Damanpour and Gopalakrishnan (1998), innovation comes to organisations either by being generated or adopted. Either way involves the process of innovation diffusion. Diffusion is “the process by which an innovation is communicated through certain channels over time among the members of a social system” (Rogers, 1983). As mentioned earlier, innovation is the product of social relationships and a system of interactions. Diffusion of innovation in particular creates a process of social change by which alteration occurs in the structure and function of a social system (Rogers, 1983). Based on these premises, a social system is considered in this research to be a critical element of innovation diffusion.

### **2.2 Social Psychology and Innovation Diffusion**

Essentially, Roger’s Innovation Diffusion Theory “builds on well established theories in sociology, psychology, and communication” (Kale and Ardit, 2005). Social psychology, in terms of social influence, accounts for some certain phenomena that drive the process of innovation diffusion such as an imitative behaviour resulting from bandwagon pressure (Abrahamson and Rosenkopf, 1993). For instance, Kale and Ardit (2005) found that the diffusion of CAD technology among the Turkish architectural design firms is primarily driven by imitative behaviour rather than external factors.

### **2.3 Climate for Innovation**

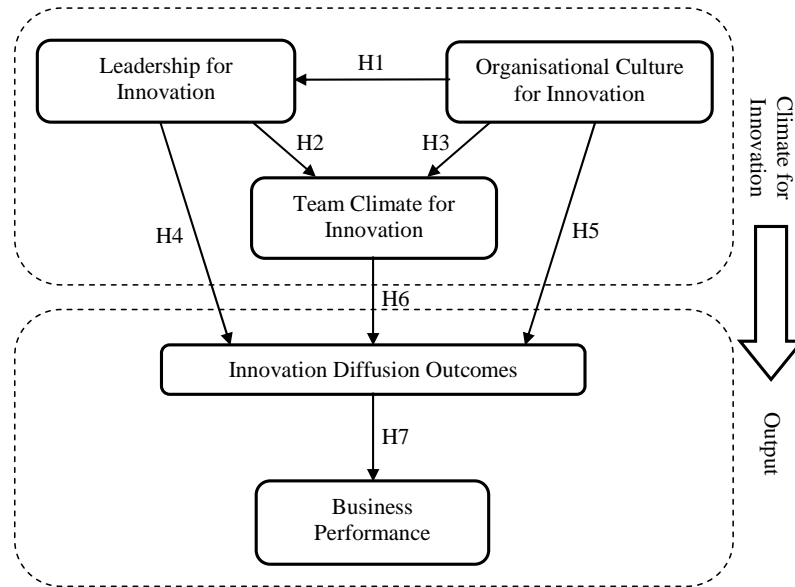
Social influence can manifest itself in the form of a salient environmental stimulus namely “climate”, which is considered as a determinant of motivation and behaviour (Kozlowski and Doherty, 1989). Climate is defined as “a shared and enduring molar perception of the psychologically important aspects of the work environment” (Ashfort, 1985). However, 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. For the purpose of this research, “climate for innovation” is employed.

## **3. Conceptual Model Development**

Past research works have suggested three major social psychological factors forming a climate which can be perceived by a member of an organisation. These are organisational culture, leadership, and team climate (Amabile *et al.*, 1996; West, 1997). These factors, acting as enablers to the diffusion of innovation, are also consistent with those identified and reported in the research conducted in the area of construction (e.g. Egbu *et al.*, 1998; Steele and Murray, 2004). However, there is a lack of empirical investigation of the relationships between such enablers and their outcomes under this context. To

overcome this deficiency, this paper attempts to develop a model that can be used to study such relationships.

According to Figure 1, the model consists of two main parts: Climate for Innovation and Output. Within the Climate for Innovation, there are three major constructs: Organisational Culture for Innovation; Leadership for Innovation; and Team Climate for Innovation. It should be noted that these three constructs are facet-specific because the climate will only be measured based on the issue of innovation. The Output part consists of two constructs: Innovation Diffusion Outcomes and Business Performance. The following sections detail the operationalisation of these constructs.



**Figure 1: Conceptual Model**

### 3.1 Organisational Culture for Innovation

Organisational culture has major facilitating and constraining effects on the successful implementation and maintenance of innovation within organisations (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). During the past decades, research on innovation has demonstrated a number of cultural factors that lead to creativity and innovation in organisations. Table 1 describes the three sub-factors of “Organisational Culture for Innovation” which have been commonly identified in the existing literature (e.g. Amabile *et al.*, 1996; Egbu *et al.*, 1998; Hartmann, 2006).

**Table 1: Organisational Culture for Innovation Sub-Factors**

Sub-factor	Description	References
Creativity stimulation and encouragement	Concerned with the culture that stimulates and encourages creativity in terms of perceived degree of flexibility, risk propensity, support and collaboration in the organisation	Amabile <i>et al.</i> , 1996; Egbu <i>et al.</i> , 1998
Freedom and autonomy	Concerned with the extent to which an organisation allows members to have choice in carrying out their own work	Amabile <i>et al.</i> , 1996; Hartmann, 2006
Resource allocation	Concerned with the perceived availability of resource in terms of training, manpower, time and money set aside for innovation activities	Dulaimi <i>et al.</i> , 2005; Scott and Bruce, 1994

### 3.2 Leadership for Innovation

Leadership is a key ingredient for organisations to function effectively. It basically 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). During the past decades, various scholars have suggested numerous styles of effective leadership. In particular, there are four leadership styles pertaining to innovation and creativity in organisations. These are transformational leadership (Bass and Avolio, 1994), change-oriented leadership (Yukl *et al.*, 2002), innovation championing (Howell and Higgins, 1990) and leader-member exchange (LMX) (Graen and Uhl-Bien, 1995). These leadership styles can be synthesised into four factors characterising innovation-conducive leaders. Table 2 details sub-factors of the “Leadership for Innovation” along with their associated references.

**Table 2: Leadership for Innovation Sub-Factors**

<b>Sub-factor</b>	<b>Description</b>	<b>References</b>
Encouraging and stimulating innovation	Concerned with the degree to which a supervisor inspires, seeks out, promotes and support creative idea and innovative approach in solving problems	Bass and Avolio, 1994; Howell and Higgins, 1990; Yukl <i>et al.</i> , 2002
Providing and inspiring vision	Concerned with the extent to which a supervisor creates, communicates and inspires a shared vision	Bass and Avolio, 1994;
Individualised support	Concerned with the quality of supportive relationships between a supervisor and subordinates	Graen and Uhl-Bien, 1995; Tierney, 1999
Teamwork development	Concerned with the degree to which leaders involve team members and share information and resources when making decisions	Bass and Avolio, 1994; Yukl <i>et al.</i> , 2002

### 3.3 Team Climate for Innovation

Since teams are an important building block in organisations, understanding factors that hinder and foster creativity and innovation in teams is of utmost important. In construction, teams are particularly important since successful construction projects depend on the ability to integrate dispersed knowledge, skills and abilities (KSAs) of team members. By combining KSAs of individuals, teams provide ideal conditions for stimulating creativity and innovation via social and psychological processes (Bain *et al.*, 2001). As a result, focusing on teams is one mean by which innovation can be fostered in organisations. This paper adopts the instrument for studying the climate for innovation in teams developed by Anderson and West (1998), namely “Team Climate Inventory (TCI)”. Table 3 describes the “Team Climate for Innovation” sub-factors and their associated references.

### 3.4 Innovation Diffusion Outcomes

As mentioned earlier, innovation can be appropriated by means of generation or adoption. Thus, innovation diffusion is evaluated based on two indicators: Innovation utilisation and Innovative design solutions. Innovation utilisation aims at measuring the level of use of state-of-the-art AED technologies (e.g. CAD, VR), and pioneered methods or concepts (e.g. green design, value-based design) that facilitate the design activities and practices. Innovative design solutions aim to evaluate how creative and innovative ideas are managed and diffused to produce innovative products (e.g. awarded design, flexible design). Table 4 describes “Innovation Diffusion Outcomes” sub-factors and their related references.

**Table 3: Team Climate for Innovation Sub-Factors**

<b>Sub-factor</b>	<b>Description</b>	<b>References</b>
Vision	Concerned with the establishment of a team's clearly defined and shared vision that provides focus and direction to team members as a motivating force at work	Anderson and West, 1998
Participative safety	Concerned with the degree to which involvement in decision making is motivated and reinforced without fear of criticism among team members	Anderson and West, 1998
Task orientation	Concerned with the degree of shared concern with quality of task performance in relation to shared vision or outcomes among team members	Anderson and West, 1998
Support for innovation	Concerned with the degree of expectation, approval and practical support of attempts among team members to introduce new and improved ways of doing things	Anderson and West, 1998

**Table 4: Innovation Diffusion Outcomes Sub-Factors**

<b>Sub-factor</b>	<b>Description</b>	<b>References</b>
Innovation utilisation	Concerned with the degree of utilisation of state-of-the-art technologies and pioneered theories or concepts that facilitates the design activities and practices	Kale and Ardit, 2005; Tang <i>et al.</i> , 2003
Innovative design products	Concerned with the level of innovativeness of the design solutions	Ng and Chow, 2004 ; Tang <i>et al.</i> , 2003

### 3.5 Business Performance

Ultimately, all the innovation activities must result in improved firm performance when comparing with firms that do not innovate (Kemp *et al.*, 2003). One mean by which the assessment of firm performance can be carried out is to look at the business performance, which can be measured in a number of ways. Table 5 presents "Business Performance" sub-factors along with their associated references.

**Table 5: Business Performance Sub-Factors**

<b>Sub-factor</b>	<b>Description</b>	<b>References</b>
Financial performance	Concerned with the level of profitability, turnover growth, and market share	Darroch, 2005; Kale and Ardit, 2003
Business competitiveness	Concerned with the degree of business competitiveness in terms of reputation and ability to gain new contracts	Kale and Ardit, 2003
Client satisfaction	Concerned with the level of client satisfaction	Agarwal <i>et al.</i> , 2003
Goal achievement	Concerned with the degree to which the firm's most important goals are being met	Darroch, 2005

## 4. Research Hypotheses

As illustrated in Figure 1, seven hypotheses representing the relationships between constructs of the proposed conceptual model have been developed. The following sections detail the development of such hypotheses.

#### **4.1 Relationships among Factors of Climate for Innovation**

In a study among a group of engineers and scientists, Scott and Bruce (1994) found that perceived organisational support for innovation (characterised by flexibility, creativity encouragement, freedom and recognition) is positively related to innovative behaviour. By adapting Scott and Bruce's measurement, Dulaimi *et al.* (2005), found that resource supply influences the championing behaviour of construction project managers and is a motivator that drive innovation effort in team. In a study of a Swedish manufacturing unit, Dackert *et al.* (2004) found a positive relationship between a leadership high in change/development-orientation combined with employee/relation-orientation and the team climate for innovation. Pirola-Merlo *et al.* (2002) found a positive relationship between the leadership with facilitative and transformational behaviour and the team climate for innovation among members of large Australian R&D organisations. These empirical evidence lead to the following hypotheses:

- H1: Organisational culture for innovation positively influences leadership for innovation.
- H2: Leadership for innovation positively influences team climate for innovation.
- H3: Organisational culture for innovation positively influences team climate for innovation.

#### **4.2 Impacts of Factors of Climate for Innovation on Innovation Diffusion Outcomes**

In addition to their interrelationships, the factors of climate for innovation are also found to affect the outcomes of innovation diffusion. In a study of four categories of Spanish firms including farming, manufacturing, construction and services by Aragón-Correa *et al.* (in press), it is found that innovation (in terms of rate of new product/service introduction and changes in internal operating practices) is strongly influenced by transformational leadership. Within the construction context, Dulaimi *et al.* (2005), found a positive relationship between perceived support for innovation and resource supply and the level of innovation of construction projects.

The team climate for innovation has been identified as a predictor of innovation outcomes by many authors. In a study among work groups of a U.K. oil company, Burningham and West (1995) found a relationship between team climate and innovative ideas. Pirola-Merlo *et al.* (2002) found that team climate mediates the relationship between leadership and performance among the members of R&D teams. These findings suggest the following hypotheses.

- H4: Leadership for innovation positively influences innovation diffusion outcomes.
- H5: Organisational culture for innovation positively influences innovation diffusion outcomes.
- H6: Team climate for innovation positively influences innovation diffusion outcomes.

#### **4.3 Contributions of Innovation Diffusion Outcomes to Business Performance**

Generally, it has been anticipated that business performance will be improved with the presence of innovation. In a study of 225 banks, Han *et al.* (1998) found positive relationships between administrative innovation and business performance, and between technical innovation and business performance. Aragón-Correa *et al.* (in press) also found a positive relationship between innovation and business performance, leading to the last hypothesis:

- H7: Innovation diffusion outcomes positively influence business performance.

To ascertain the validity of the factors and relationships illustrated in the proposed model, a questionnaire has been developed based on the extensive review of existing literature and past empirical studies. It has been pre-tested using the expert-review method. The complete questionnaire will be administered in Australia, targeting design team members of various AED firms. The respondents will be requested to rate the performance of individual innovation enabler and outcome variables. Following the questionnaire

dissemination and data analysis, a series of case studies with specific AED firms in Australia will be conducted to confirm the validity of the model.

## 5. Summary

Innovation has become an essential component of firms since it is a key driving force for economic growth in the knowledge economy. Social psychology, in terms of a supportive climate for innovation, plays an important role in the successful diffusion of innovation in an organisation. However, there is still a lack of empirical research undertaken from this perspective within the context of AED firms. This paper thus aims to overcome this deficiency by developing a model to investigate the relationships between climate for innovation, which encapsulates three major social psychological factors, and its outcomes. Based on a comprehensive literature review, a total of seven hypotheses representing the relationships between the model's constructs were developed. The model will be refined and validated through a questionnaire survey and a series of case studies conducted with various Australian AED firms. Ultimately, the study should yield an empirically justified model which would vastly improve the current level of understanding on the impact of a climate for innovation on diffusion outcomes in AED firms.

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