

DEVELOPMENT OF A CONCEPTUAL MODEL FOR ORGANIZATIONAL LEARNING CULTURE AND INNOVATION DIFFUSION IN CONSTRUCTION

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Driven by vigorous competition and continuously escalating demands of clients in construction, innovation is increasingly important for enhancing performance of contractors and designers in design, planning and management of construction projects. Instead of intra-organization innovation, innovation in construction often diffuses across inter-organization boundaries. Influenced by various organizational learning and culture, innovation diffusion may be problematic. This paper aims to develop a conceptual framework of the relationships between organizational learning culture, learning and innovation diffusion in the construction industry via systematic review. Seven learning culture variables were identified, including creating opportunity, communication, collaboration and teamwork, knowledge sharing, collective vision, connection with the environment and leader support and reward system. There are six stages of innovation diffusion, namely acquisition, decision, assimilation, transformation, exploitation and confirmation. The resulted model provides preliminary support on the propositional relationship between organizational learning culture and innovation diffusion, and that this relationship can be mediated by organization learning. The model provides researchers and practitioners a foundation for further validations by empirical studies.

Keywords: learning, innovation diffusion, organizational culture.

INTRODUCTION

Innovation has found to be essential in enhancing financial performance, competitiveness of an organization and quality of life of employees (Blayse and Manley, 2004). Driven by vigorous competition and continuously escalating demands of clients in construction, innovation is increasingly important for enhancing performance of contractors and designers in design, planning and management of construction projects. The definition of innovation is widely discussed in different disciplines. There are generally two schools of thought, namely outcome school and process school. The first considers innovation as a new idea, product or process that can create value (e.g. Rogers 1962); while the second considers it as successful implementation of creative ideas within an organization, from the conceptualization to the utilization stage of a new item of economic or social value (e.g. Amabile 1996). Innovation in construction often refers to new technology or system adopted by an organization, so innovation is defined as any new things which brings value to an organization in this study, which follows the outcome school.

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There are not many traditional research and development activities in the construction industry. Lots of innovation is resulted from the diffusion of external knowledge within an organization. The recent spread of a novel and effective computer-related technologies, Building Information Model (BIM), in construction implies that the future of construction industry may depend on the rapid diffusion and successful utilization of new technologies in workplace. Damanpour and Wischnevsky (2006) distinguished two types of innovation - primarily generated innovation and primarily adopted innovation. A construction firm plays an important role as innovation-adopting organization, which undertakes an innovation diffusion process. Innovation diffusion is “a process by which an innovation is communicated through certain channels over time among the members of a social system” (Rogers 1962: 79). Although innovation diffusion can be competence-enhancing for a firm, depending on its complicated diffusion process, it can also be competence-destroying (Tushman and Anderson 1986).

Many researchers have investigated how innovation process is influenced by various organizational contexts (e.g., organizational culture and context and climate). However, due to the unitary view of innovation generation and adoption in previous research studies, there are comparatively fewer studies conducted to specifically investigate the impact of organizational culture on innovation diffusion process.

Innovation diffusion is highly dependent on organizational learning (Attewell 1992). Organizational learning refers to as a continuous testing of experience and its transformation into knowledge available to whole organization and relevant to their mission (Senge 1997). It may be an outstanding feature which distinguishes the successful innovation diffusion from successful innovation generation. Since learning culture of an organization can facilitate learning outcomes (Buckler 1998; Buhler 2002), the aim of this paper is to explore the relationship between organizational learning culture and innovation diffusion process in the construction industry.

INNOVATION DIFFUSION

The term “diffusion” was firstly adopted by physicians and chemists as the movement of particles from an area of high concentration to an area of low concentration at the beginning. This concept was then introduced into other disciplines, like biology, sociology, communication, management, and so on. Rogers (1962) divided diffusion into five stages based on his investigation on diffusion process, including knowledge, persuasion, decision, implementation and confirmation. Rogers’s model contains individual adoption process, but it does not include the processes of learning and assimilation. These learning stages were later revealed in the absorptive capacity model. Absorptive capacity is defined as a firm’s “ability to recognize the value of new information, assimilate it, and apply it to commercial ends” (Cohen and Levinthal 1989). The absorptive process thereby includes three stages: recognition, assimilation and application. Based on the absorptive capacity model developed by Cohen and Levinthal (1989), Zahra and George (2002) added a transformation stage in their innovation diffusion model and redefined the absorptive capacity as “a set of organizational routines and processes by which firms acquire, assimilate, transforms and exploit knowledge to produce a dynamic organizational capability” (p.186).

Different models have different focuses. This study adopts a comprehensive approach, which develops an innovation diffusion model by integrating the different stages included in different models. Table 1 summarizes seven stages, including acquisition, decision, assimilation, transformation, exploitation and confirmation. Definitions of these stages mainly follow the works conducted by Rogers (2003) and Zahra and George (2002).

Table 1: Definition of Innovation Diffusion Stages

| Diffusion stages | Definition |
|------------------|--|
| Acquisition | Recognize, value, and acquire external knowledge that is critical to a firm's operations (Rogers 2003) |
| Decision | Weigh the advantages/disadvantages and decide whether to adopt or reject the innovation (Rogers 2003) |
| Assimilation | Routines and processes that allow it to analyze, process, interpret and understand the information obtained from external sources (Zahra and George 2002). |
| Transformation | Develop and refine the routines that facilitate combining existing knowledge and the newly acquired and assimilated knowledge (Zahra and George 2002) |
| Exploitation | Apply new external knowledge and to create new ones by incorporating acquired and transformed knowledge into its operations (Zahra and George 2002) |
| Confirmation | Finalize decision to continue using the innovation (Rogers 2003) |

ORGANIZATIONAL LEARNING CULTURE

Culture is defined as the collective programming of human mind which distinguishes members of one human group from those of another (Hofstede, 1981). According to Hofstede (1990), there are four layers of culture, including values, rituals, heroes, symbols, and symbols, heroes, and rituals can be subsumed under the term “practices” because they are visible to an observer. Therefore, the definition of organization culture includes both shared values and perceived common practices that carry a specific meaning within the organizational unit. There are two basic approaches of studying organizational culture, the typological approach and the trait approach (Liu et al. 2006). Amongst these two approaches, researchers adopting trait approach believe that culture can be measured as a multidimensional set of values and practices embraced by an organization (Hofstede et al. 1990). The Hofstede model of organizational culture includes several key dimensions, namely means oriented versus goal oriented; internally driven versus externally driven; easy going work discipline versus strict work discipline; local versus professional, open versus closed; employee oriented versus work oriented. This does not only serve as a tool to map organizational culture, but also provide a better way to measure and manage culture.

Following the Hofstede model of organizational culture, researchers tried to investigate organizational learning from different cultural levels, such as shared values or practices. The majority of these studies focus on the practice aspects. For instance, Watkins and Marsick (1993) defines seven dimensions of organizational learning culture, such as creating continuous learning opportunities, encouraging teamwork and empowering people towards a collective vision. Gephart et al. (1997) defines three dimensions of organizational learning culture, including facilitating knowledge sharing and transferring, sharing a common goal, and encouraging independent thinking and trying new ideas. Bishop et al. (2006) established a framework of organizational learning culture and identify four possible features of a learning-supportive culture, such as easy access to knowledge resources, collaborative working, and encourage and reward the acquisition and sharing of knowledge. The similarities and differences of these models are summarized in Table 2. These dimensions have been verified by later empirical studies under different organization contexts (e.g., Ellinger et al. 2003; Hernandez 2003; Bates and Khasawneh 2005; Alzawahreh 2012).

Table 2: Dimensions of Organizational Learning Culture

| Authors | (Watkins and Marsick (1993)) | Gephart et al (1997) | Bishop et al. (2006) |
|----------------------------------|--|---|---|
| Dimensions | | | |
| Creating opportunities | Create continuous learning opportunities | - | Easy access to knowledge resources |
| Promote communication | Promote inquiry and dialogue | - | - |
| Collaboration and teamwork | Encourage collaboration and team learning | - | Collaborative working |
| Knowledge sharing | Create systems to capture and share learning | Facilitate knowledge sharing and transferring | - |
| Collective vision | Empower people toward a collective vision | Share a common goal | - |
| Connection with the environment | Connect the organization to its environment | - | - |
| Leader support and reward system | Provide strategic leadership for learning | Encourage independent thinking and trying new ideas | Encourage and reward the acquisition, sharing and exploitation of knowledge |

INNOVATION DIFFUSION AND ORGANIZATIONAL LEARNING

Adopting new process technologies is a process of “learning by doing” (Arrow 1962). As verified by empirical study, organizational learning is the core of innovation diffusion (Attewell 1992). In order to successfully assimilate a new process technology, an organization must reach a state where its bundles of knowledge and skills encompass those needed to apply the new technology effectively (Fichman and Kemerer 1997). In the case of BIM, for example, successful diffusion requires understanding of its technical features, discerning of any potential problems in application, and accommodation of this new technology to the new work procedure and standards. Organizational learning, similar to innovation, is a very elusive concept due to the variety of perspectives that come under scrutiny in the academic literature. Senge (1997) defines organizational learning as a continuous testing of experience and its transformation into knowledge available to whole organization and relevant to their mission.

When talking about organizational learning, the important role of individual learning in organization cannot be ignored. Individual learning involves the distillation of an individual's experiences regarding a technology into understandings that may be viewed as personal skills and knowledge. An organization learns when individual insights and skills become embodied in organizational routines, practices, and beliefs that outlast the presence of the originating

individual (Attewell 1992). Organizational learning emerges when an organization acquires information (knowledge, understandings, know-how, techniques and procedures) of any kind by any means (Argyris and Schön 1996). It can be achieved by both formal (training programs, seminars and workshops) and informal methods (experience and mistakes) (Suggs 2003). Informal learning happens in various situations and relies on interactions among people, which is highly associated with the innovative culture of an organization (Bishop et al. 2006). Bishop et al (2006) consider an organizational learning culture is one that values the creation, sharing and application of new knowledge, and manifestation of such values in different aspects of an organization. Hence, this study aims to develop a conceptual model associating organizational learning culture and innovation diffusion.

RESEARCH METHOD

To develop a conceptual model for organizational learning and innovation diffusion, systematic review was conducted to summarize the outcomes of various relevant research studies based on a systematic plan and search strategy. Since research studies covering both organizational learning and innovation diffusion in construction are rare, both construction-related and non-construction studies covering dimension(s) of the above two concepts are included in this paper. The study aims to develop a conceptual framework regarding the impact of various learning culture dimensions on the innovation diffusion process. Studies were selected by identifying keywords such as “innovation”, “diffusion”, “learning” and /or “culture” in paper title, abstract and /or keywords. To ensure quality of studies, only papers listed in the Academic Journal Quality Guide (ABS version 4, 2010) (general management) and the top-ten ranking list developed by Chau (1997) (construction management) are included.

CONCEPTUAL MODEL DEVELOPMENT

Based on the literature review, a preliminary conceptual model was developed to illustrate the relationships between organizational learning culture, learning and innovation diffusion revealed by previous studies. Organizational learning culture has impact on various innovation diffusion stages through the mediating role of organization learning.

As illustrated in Figure 1, there are seven identified dimensions of learning culture, which was found to have different influences on the six innovation diffusion stages.

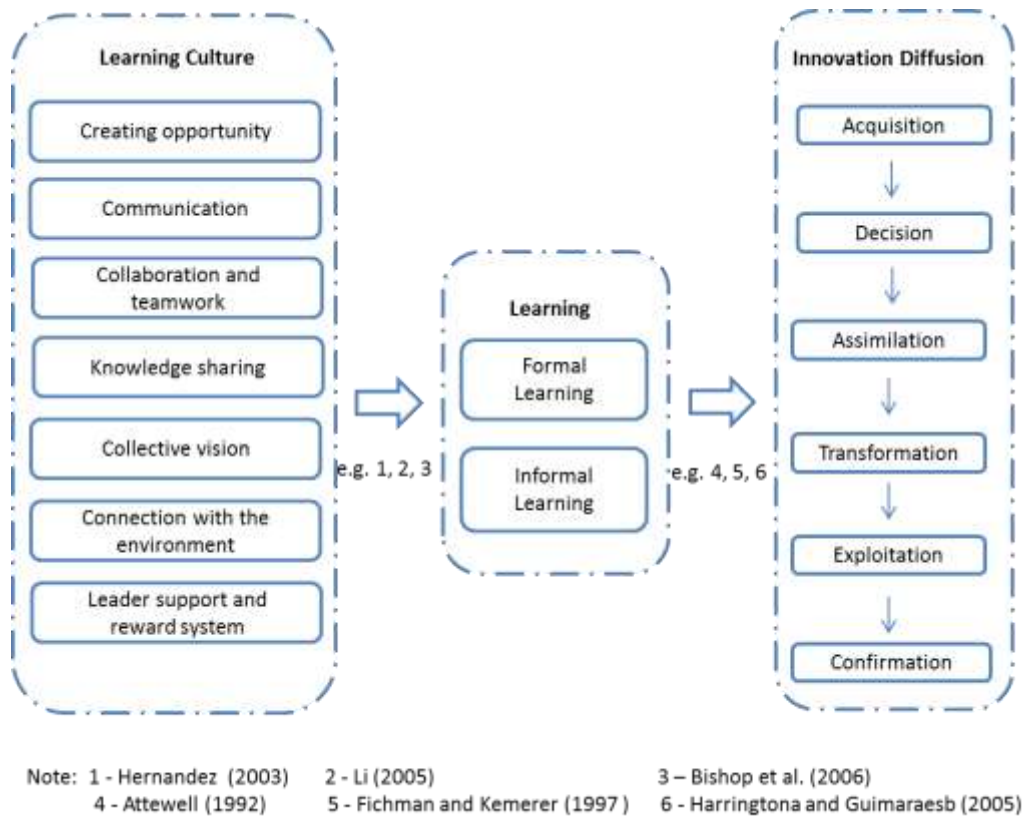


Figure 1: A Conceptual Model for Organizational Learning Culture and Innovation Diffusion

Creating opportunities for learning provides platform for employees to acquire innovative knowledge. Without adequate learning and understanding about an innovative technique, it is hard to assimilate and incorporate it into traditional work tasks. Creating opportunities for learning has thus found to enhance success of innovation implementation (Fichman 1997; Meyers et al. 1999). It can be achieved by considering and incorporating learning opportunities at work design stage. Another approach is providing opportunities for on-going education and growth, such as training and rotation. On the other hand, effective communication broadens sources of innovation acquirement, provides support for decision making and decreases inconsistency and mistakes in implementation stage. An organization learning culture which facilitates communication can be fostered by providing sufficient and effective questioning and feedback channels. Effective communication can be enhanced by equipping employees with productive reasoning skills for expressing and exchanging individual views (Boer et al. 1999; Meyers et al.1999). Moreover, adopting and implementing a new technology in an organization involves participation of different departments and individuals, in which collaboration between these parties is essential (Gambatese and Hallowell 2011; Kosine 2003). Effective collaboration and teamwork can be achieved by providing platforms for multi-departmental groups to access different modes of thinking, learning and working together, and by providing proper rewards for collaboration with fruitful outcomes.

Knowledge sharing is the cornerstone of innovation diffusion. This is especially important for the confirmation stage. After exploitation, the confirmed innovative knowledge /technique should be transferred and promoted to other parties in an organization, so as to facilitate effective implementation. To foster knowledge sharing, both high and low technology systems, such as using internet based communication technology and stimulating conversation between colleagues, should be created and integrated with work (Jones 2004;

Kearns 2003; Liao 2007). On the other hand, collective vision refers to the setting, owning, and implementation of a joint vision by employees in an organization. Responsibility is distributed for decision making so that employees are motivated to learn toward what they are held accountable to do. Shared values and understandings between parties in an exchange relationship facilitate meaningful communication that is essential in both the exchange and combination required for knowledge creation (Bates 2005; Gyampah 2004; Li 2005). Moreover, cultural dimensions regarding external environment (Harringtona and Guimaraesb 2005) and network ties (Abrahamson and Rosenkopf 1997; Singh 2005) are also found to be related to innovation diffusion. To enable access to innovative knowledge from the external environment, organizations may collect documents describing new developments in the industry, encourage personal contacts with knowledgeable individuals outside the organization, and use other external communication channels. Lastly, Politis (2005) found that coercive and referent power is likely to have a negative influence on employees' knowledge acquisition and knowledge sharing processes. Leadership for innovation can be demonstrated by behaviour (e.g., providing vision, organizing feedback, rewards, Jong and Hartog 2007) and personal characteristics of individual leaders (e.g., manager's tenure, education background, pro-innovation attitude, Damanpour and Scheider 2009).

Innovation Diffusion and Learning Culture in the Construction Industry

Researchers in the construction management field mainly concentrate on the positive effects of collaboration and team work, connection with the environment and leader support on innovation diffusion (Gambatese and Hallowell 2011; Linderoth 2010; Larsen 2011; Park et al. 2004). This may due to the project-oriented and multi-stakeholder natures in construction. Practitioners are thus suggested to put emphases on promoting collaboration, building network with other companies and increasing support for R&D, in order to facilitate innovation diffusion. Comparatively, opportunity to learning, communication, knowledge sharing, and collective vision attract less attention. One of the possible reasons may be that innovation diffusion is a new research area in construction management. The conceptual model sheds light on the knowledge gap for further comprehensive studies investigating the associations between organizational learning culture and various innovation diffusion stages in these aspects of construction.

Limitation and Future Study

The resulted model was developed based on literature review, in which it only acts as a preliminary conceptual model for further research studies. Although the propositional organizational learning culture - innovation diffusion relationships have been tested by various studies, these results are fragmented. Validation by a comprehensive study supported by data collected from the construction context is necessary. Further research studies are suggested to test the model by an in-depth case study. The diffusion of BIM amongst construction organizations can be adopted as a proxy for innovation in construction.

BIM was recognized as an innovation in the construction industry to improve the efficiency in the late 1980s and early 1990s (Linderoth 2010). However, the process and outcomes of adopting BIM differ greatly across different construction enterprises. Researchers have started to investigate the success factors of BIM diffusion in construction, including BIM proficiencies of team members, communication of project team (Barlish and Sullivan, 2012) and technical tool functional requirements and needs (Gu and London, 2010). Although some of the researchers acknowledged the importance of non-technical strategic issues in the innovation diffusion process (Gu and London, 2010), studies concerning the impact of culture on innovation diffusion are still rare. Hence, the proposed further case study is essential for the development of innovation diffusion theory in the construction industry.

CONCLUSION

The conceptual model reveals that organizational learning culture generally includes opportunities and access to learning, promote communication, collaboration and teamwork, knowledge sharing, collective vision, connection with the environment, and leader support and reward system, which may have indirect impact on the innovation diffusion process covering acquisition, decision, assimilation, transformation, exploitation and confirmation through the mediating role of organization learning. Although only limited construction-related research is found, the literature review provides partial support to the comprehensive model. The preliminary results provide researchers a platform for further empirical studies to investigate how to facilitate innovation diffusion by fostering an effective organization learning culture.

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REFERENCES

- Abrahamson, E and Rosenkopf, L (1997) Social network effects on the extent of innovation diffusion: a computer simulation. "Organization Science", 8(3), 289-309.
- Amabile, T M, Conti, R, Coon, H, Lazenby, J, and Herron, M (1996) Assessing the work environment for creativity. "Academy of Management Journal", 39(5), 1154-1184.
- Arrow, K (1962) The economic implications of learning by doing. "Review of Economic Studies", 29, 166-170.
- Attewell, P (1992) Technology diffusion and organizational learning: The case of business computing, "Organization Science", 3(1), 1-19.
- Barlish, K and Sullivan, K (2012) How to measure the benefits of BIM-A case study approach. "Automation in construction", 24, 149-159.
- Bates, R and Khasawneh, S (2005) Organizational learning culture, learning transfer climate and perceived innovation in Jordanian organizations. "International Journal of Training and Development", 9(2), 96-109.
- Bishop, D (2011) The importance of being an insider: how networks influence the small firm's engagement with formal training. "Journal of European Industrial Training" 35(4), 326 -344.
- Bishop, D, Felstead, A, Fuller, A, Jewson, N, Lee, T, and Unwin, L (2006) Connecting culture and learning in organisations: a review of current themes. Learning as Work Research Paper 5.
- Blayse, A M, and Manley, K (2004) Key influences on construction innovation. "Construction Innovation", 4(3), 143-154.
- Boer, M, Bosch, F A J V, and Volberda, H W (1999) Co-evolution of firm absorptive capacity and knowledge environment: organizational forms and combinative capabilities. "Organization Science", 10(5), 551-568.
- Buckler, B (1998) Practical steps towards a learning organization: applying academic knowledge to improvement and innovation in business. "The Learning Organization", 5(1), 15-23.
- Buhler, P M (2002), Managing the new millennium: building the learning organization for the 21st century: a necessary challenge. "Supervision", 63(12), 20-23.
- Chau, K W (1997) The ranking of construction management journals. "Constr. Manage. Econom", 15, 387-398.

- Cohen, W M and Levinthal, D A (1989) Innovation and learning: the two faces of R&D. "The Economic Journal", 99(9), 569-596.
- Cohen, W M and Levinthal, D A (1990) Absorptive capacity: a new perspective on learning and innovation. "Administration Science Quarterly", 35(1), 128-152.
- Damanpour, F and Scheider, M (2009) Characteristics of innovation and innovation adoption in public organizations: assessing the role of managers. "J Public Adm Res Theory", 19(3), 495-522.
- Damanpour, F and Wischnevsky, J D (2006) Research on innovation in organizations: distinguishing innovation-generating from innovation-adopting organizations. "Journal of Engineering and Technology Management", 23, 269-291.
- Ellinger, A D, Ellinger, A E, Yang, B and Howton, S H (2003) Making the business case for the learning organization concept. "Advances in Developing Human Resources", 5, 163-172.
- Fichman, R G and Kemerer, C F (1997) The assimilation of software process innovations: an organizational learning perspective. "Management Science", 43(10), 1345-1363.
- Gambatese, J A and Hallowell, M (2011) Enabling and measuring innovation in the construction industry. "Construction Management and Economics", 29(6), 553-567.
- Gephart, M A, Holton, E F, Marsick, V J, and Redding, J C (1997) Assessing strategic leverage for the learning organization-group and organizational outcomes, Climate and Support Systems. Unpublished Manuscript.
- Gluch, P, Gustafsson, M, Thuvander, L. (2009) An absorptive capacity model for green innovation and performance in the construction industry. "Construction Management and Economics", 27(5), 451-464.
- Gu, N, and London, K (2010) Understanding and facilitating BIM adoption in the ACE industry. "Automation in Construction", 19(8), 988-999.
- Gyampah, K A and Salam, A F (2004) An extension of the technology acceptance model in an ERP implementation environment. "Information and Management", 41(6), 731-745.
- Harringtona, S J and Guimaraesb, T (2005) Corporate culture, absorptive capacity and IT success. "Information and Organization", 15(1), 39-63.
- Hernandez, M H (2003) Assessing tacit knowledge transfer and dimensions of a learning environment in Colombian businesses. "Advances in Developing Human Resources", 5, 215-221.
- Hoecklin, L (1996) "Managing cultural differences: strategies for competitive advantage", Addison-Wesley, Wokingham.
- Hofstede, G (1981) Culture and organization. "International Studies of Management and Organization", 10(4), 15-41.
- Hofstede, G, Neuyen, B, Ohayv, D D and Sanders, G (1990) Measuring organisational cultures: a qualitative and quantitative study across twenty cases. "Administrative Science Quarterly", 35(6), 286-316.
- Jong, J P J and Hartog, D N D (2007) How leaders influence employees' innovative behaviour. "European Journal of Innovation Management", 10(1), 41- 64.
- Kearns, G S and Lederer, A L (2003) A resource-based view of strategic IT alignment: how knowledge sharing creates competitive advantage. "Decision Sciences", 34(1), 1-29.
- Larsen, G D (2011) Understanding the early stages of the innovation diffusion process: awareness, influence and communication networks. "Construction Management and Economics", 29(10), 987-1002.
- Li, L (2005) The effects of trust and shared vision on inward knowledge transfer in subsidiaries' intra- and inter-organizational relationships. "International Business Review", 14(1), 77-95.

- Linderoth, H C J (2010) Understanding adoption and use of BIM as the creation of actor networks. "Automation in Construction", 19(1), 66-72.
- Meyers, P W, Sivakumar, K, and Nakata, C (1999) Implementation of industrial process innovations: factors, effects, and marketing implications. "Journal of Product Innovation Management", 16(3), 295-311.
- Park M, Nepal M P, and Dulaimi M F (2004) Dynamic modelling for construction innovation. "Journal of Management and Engineering", 20(4), 170-177.
- Politis, J D (2005) The influence of managerial power and credibility on knowledge acquisition attributes. "Leadership & Organization Development Journal", 26(3), 197-214.
- Rogers, E M (1962) "Diffusion of innovations", Glencoe, Free Press.
- Roper, S, Hales, C, Bryson, J R and Love, J (2009) Measuring sectoral innovation capability in nine areas of the UK economy. (Available on line (http://www.nesta.org.uk/publications/reports/assets/features/measuring_sectoral_innovation_capability_in_nine_areas_of_the_uk_economy [accessed on 24/8/2010])
- Senge, P M (1997) The fifth discipline. "Measuring Business Excellence", 1(3), 46 - 51.
- Singh, J (2005) Collaborative networks as determinants of knowledge diffusion patterns. "Management Science", 51(5), 756-770.
- Suggs, S (2003) More than one way to learn. "Information Outlook", 7(5), 42-3.
- Tushman, M and Anderson, P (1986) Technological discontinuities and organizational environments. "Administrative Science Quarterly", 31 (9), 439-465.
- Watkins, K E and Marsick, V J (1993) "Sculpting the learning organization", San Francisco, Jossey-Bass.
- Zahra, S A and George, G (2002) Absorptive capacity: A review, re-conceptualization, and extension. "Academy of Management Review", 27(2), 185-203.