

RECONCEPTUALIZING THE MANAGEMENT OF TECHNOLOGY IN CONSTRUCTION: A MALAYSIAN PERSPECTIVE

Christy Pathrose Gomez¹

Department of Construction and Property Management, Tun Hussein Onn University College of Technology, Batu Pahat, Johor, Malaysia.

It is identified in the Egan Report (1998) that technology on its own cannot provide the answer to the need for greater efficiency and quality in construction, noting that there has been well publicized cases of new technology being used which does not work. It is suggested in this paper that a wholly functionalist/technical approach towards issues that relate to the complex problem of technology management, specifically technology transfer may misguide efforts towards collaborative working relationships. The transfer and innovation of knowledge within a multidisciplinary context requires a different conceptualization of related issues from the traditional and dominant technocratic discipline-based approach as is evident in the Malaysian context. The notion of networks as a form for coordinating action is forwarded as a structuring element within a multi-disciplinary context and inter-organizational context for accommodating the socio-technical perspective required for addressing the phenomena of transfer of technology in construction. It is suggested in this paper that a socio-technical systems (STS) approach that is based on a constructivist-constructionist epistemology towards decision making relating to the critical area of technology management, more specifically technology transfer, can provide a more inclusive strategy for dynamic analysis and synthesis of developing issues (current and future) that can be critically understood in a generative sense to be shared and analyzed. It is further suggested that the STS approach provides an avenue for addressing the key issue of value-chain relationships in construction projects that can serve as a basis for a genuine buy-in to the complex phenomena of technology transfer amongst stakeholders. However, it is recommended that a critical aspect in undertaking the STS approach is the necessity for securing the services of the construction industry research community, as STS analysts who are engaged in focused legitimate peripheral participation amongst the dynamic array of networks.

Keywords: conceptualization, Malaysia, socio-technical systems (STS), technology, technology management.

INTRODUCTION

The importance of technology for development in construction is widely recognized (Egan, 1998; Sexton and Barret, 2004; Rezgui *et al.*, 2000, Adriaanse, A. and Voordijk, H, 2005). The major focus in construction currently however is towards information technology (IT). This is evident from the case of the UK having set up the Construct IT Centre for Excellence at Salford (<http://www.construct-it.org.uk/>) in order to develop opportunities for the strategic use of IT by construction organizations in the UK, and the ongoing research at Loughborough University, the CoBrITe project which is a LINK/IDAC UK funded project (Rezgui, Y. *et al.*, 2004) and has been

¹ cpgomez@kuittho.edu.my

recognized for 'outstanding contribution to the advancement of the practice of IT in the UK construction industry'. In the Malaysian context, although there does not seem to be a comparable high focus on IT in construction, there is however an increasing focus on international collaborative construction projects involving Malaysian construction contractors. This is being pursued with increasing intent and is reflected by the policy expressed by the Construction Industry Development Board (CIDB) of Malaysia in terms of "maintaining the Malaysian Construction Sector as an 'open' market to encourage transfer of relevant construction and materials technology" (<http://www.cidb.gov.my/>).

There is an increasing awareness that whilst the science based knowledge is often regarded as critical for competitiveness and prosperity, research-based knowledge has, thus far, played only a minor role in guiding management policy and practice (Department of Trade and Industry, 2001). It is noted by Tranfield, D. *et al.*, (2004) that "within the knowledge economy, it is becoming increasingly important to develop management knowledge and learning from this wealth of information [science based knowledge], and use it to inform, if not transform, management practice" (p. 376).

However, it is evident that the current dominant perspectives relating to the issue of technology transfer is being limited by a discipline-based monopoly by communities of practice (CoP) over such phenomena. This can be described as the dominance of particular forms of rationality based on an objectifying posture (see Chio, 2005) that is identified as modern knowledge. It is noted by Choi (2005), that in the field of international management, that research on 'transfers', tend to focus on a variety of technically-oriented issues relating to the mechanics and form of transfer.

For Kunda (1992) it is clear that engineering managers possess a technical background and it is apparent that technical sophistication is indeed the sine qua non of management in Engineering. This 'scientific' and expert views become crucial in the decision making process in construction companies that are very discipline oriented. Within this context, an 'engineering culture' becomes prevalent that has the contextual norms of engineering development in terms of having 'value added', measurable 'deliverables', and a clear schedule. However, it is suggested here, that this prescriptive management style, that is founded on positivist perspective of identifying an 'objective reality' is not consistent with managing the complex issue of *technology transfer*.

TECHNOLOGICAL CAPABILITIES

It is noted by Awny (2005), that the indigenous technological capabilities of developing countries are weak, and this is identified as a decisive factor in successfully transferring and absorbing particular technologies. He focuses on the prevailing agreements on the transfer of technology from an industrialised country to a developing country, which is seen as being mainly distributive in nature and in conflict with the developing countries interests. This downward distributive push on the part of industrialised countries is seen as being very much at the lower end of the capacity for transferability of technology. It is argued here, that such arrangements are founded on markets and hierarchies mode of conceptualizing the coordinating forms of economic exchange. The implication is that the notion of 'social embeddedness' in economic exchange has been ignored.

From a socio-economic view, network forms of coordination can provide a third dimension as proposed by Granovetter (1985), and it is proposed in this paper not only

to reduce the conflicting interests between collaborative parties as in the case of a developed and industrialised country, but also analogously amongst organizations involved in projects. Founding coordinating mechanisms along the notion of networks makes it possible to structure and sustain value-chain relationships situated within the inter-organizational structures that can accommodate the links for multi-disciplinary analysis and synthesis of issues relating to technology transfer and related technological knowledge management issues.

TECHNOLOGY TRANSFER THROUGH INNOVATION

Technology transfer is defined by Anuwar Ali (1996), to mean “the acquisition and adaptation of production techniques from one country or firm to another and its application in the production process” (p. 211).

It is argued by Alderman (2001) that there is currently an overwhelming trend towards externalization and the outsourcing of technology and other expertise, and hence the value is no more an exclusive concern of the ‘producer’. The vertically integrated company producing everything necessary to deliver a specific product has almost completely been replaced and there is a greater focus on the entire value-creating system. It is this value creating system that requires detailed attention for purposes of ‘stimulating’ technology transfer, and it is proposed that these systems and sub-systems be viewed as networks.

It is in this sense, that the notion of technology transfer and innovation is analysed within the framework of technology management, and related to the existing work of Sexton and Barret (The role of technology transfer in innovation within small construction firms, 2004), that is seen to be relevant for the objectives of this paper. Primarily, this paper seeks to deconstruct present dominant practices and forward new possibilities for action.

The notion of technology transfer in innovation is seen as key for countries like Malaysia that have a low level of technological capabilities and the lack of research and developing facilities compared to industrialised countries (see Awny, 2005). The idea of playing ‘catch-up’ along the same developmental phases as industrialised countries in terms of technology acquisition is tantamount to duplication. Sexton and Barret (2004) argue that technology transfer will only be effective if the three elements of: strategic direction and capability, interorganizational networks and the knowledge characteristics of technology, are appropriately focused and integrated to achieve a specific aim. An organizational factors of innovation model is proposed by them for understanding and managing technology transfer.

In undertaking generalizations and modelling, it is crucial however to take into account the epistemological underpinnings relating to the conceptual models that constitute different dimensions of knowledge production and acquisition. This paper thus takes issue with the propositions and founding knowledge that forms the basis of such propositions and models that are not analysed to ‘reveal’ their essential nature in order to make them amenable to insightful understanding and hence action and generation (innovation). It is in this sense that it is suggested here that the phenomena of technology transfer be approached for analysis based on the socio-technical systems (STS) framework of understanding based on a constructivist epistemology of knowledge as a form of active construction that is consistent with active engagement within legitimate networks that are recognized as part of clusters that are among other

possibilities, delegated with the responsibility for pursuing technology transfer and innovation.

Additionally, it is recommended that the 'capture' and 'value acquired' from such knowledge be structured and sustained through the added mechanism of STS analyst/s. It is necessary that such individuals be able to understand the fundamentals of the technology in use and the fundamentals of the work processes involved in the projects. This obviously will require individuals who have expertise in applying the principles of STS and are currently actively engaged in research relating to the relevant industrial field, so as to be able to provide a reliable analysis for the specific purpose of technology transfer and innovation. The appreciation for such a characterization of roles for the STS analyst warrants engagement in the situated practice through focused legitimate peripheral participation (see Wenger, 2000) amongst the dynamic networks. This form of participation provides a reasonable chance of achieving transfer of technology based on value-chain relationships that is located within a framework for joint value maximization rather than single firm cost minimization (Gomez, 2005). Thus promoting a socio-technical perspective rather than a socio-economic or a purely technicist one. These analysts can be engaged in a form of situated ethnography, providing value-chain relationship accounts based on a case writing method that is subjected to further participative generation as can be suitably structured. This approach can even serve as a database for knowledge management and knowledge production. The generative capabilities can be further developed.

Currently there is an increasing focus on international collaborative construction projects involving Malaysian construction contractors. However, based on current practice in Malaysia, a major concern is with respect to the dominant reductionist thinking generated within a framework of bounded rationality that persists amongst practitioners in the construction industry that is aligned towards the traditional approach in construction of understanding and analyzing via an 'engineering culture oriented' lens that is structured around technocratic interests.

THE MALAYSIAN CONTEXT

Malaysia allows the entry of foreign contractors through the establishment of legal entities in the form of Representative Offices, Regional Offices or Joint Ventures. Joint Ventures will have to be incorporated in Malaysia with either Malaysians or with other Malaysian controlled institutions/corporations or a combination of both with foreign equity no exceeding 30%. A joint venture company with more than 30% foreign participation is categorised as a "Foreign Contractor", whilst those incorporated overseas are considered as foreign as well. The liberalisation of the is seen to pose both threats and opportunities to local contractors. There has been an increased participation of foreign contractors in Malaysia. From 104 foreign contractors registered in 2001, there was a 18.3% increase in 2002 to 132. Most of these contractors were from Japan, Singapore and Germany. The percentage breakdown is provided in Table 1 below.

Table 1: Registered Foreign Contractors by Percentage for 2001-2002.

Country of Origin	2001	2002
Japan	33.7%	31.1%
Singapore	20.2%	22.7%
Germany	12.5%	9.8%
Others	33.6%	36.4%

(sourced from CIDB News 2004)

At the same time Malaysian contractors have begun to make significant inroads into overseas markets. As of December 2003, a total of 154 projects have been undertaken by Malaysian contractors overseas (CIDB News, 2004).

It is mandatory for all construction contractors, whether local or foreign, to register with CIDB before undertaking or implementing any construction works. However foreign contractors have to apply for provisional registration before tendering any projects and this is effective on a per project basis. Foreign contractors have been operating in Malaysia long before the General Agreement on Trade in Services (GATS) was signed in 1995 under the ambit of the World Trade Organization (WTO). Amongst the areas covered under the GATS agreement is The Construction and Related Engineering Services Sector, which can be subdivided into:

- Pre-erection work at construction sites;
- Construction work for buildings;
- Construction work for civil engineering;
- Assembly and erection of prefabricated constructions;
- Special trade construction work;
- Installation work;
- Building completion and finishing work; and
- Renting services related to equipment for construction or demolition of buildings or civil engineering works, with operator

The Malaysian government is placing great interest at a policy level for the acquisition and development of expertise through the process of technology transfer. This initiative is being led by several key organizations, namely the Ministry of International Trade and Industry (MITI), the Ministry of Science Technology and Innovation (MOSTI), National Council for Scientific Research and Development (NCSRD) and the Construction Industry Development Board (CIDB). The importance of technology for development in construction is widely recognized. One of the major areas of focus in the construction industry is on information technology. However, it is identified in the Egan Report (1998) that technology on its own cannot provide the answer to the need for greater efficiency and quality in construction, noting that there has been well publicized cases of new technology being used which does not work.

TECHNOLOGY TRANSFER AND INNOVATION

It is argued in this paper that the resort to a wholly functionalist/technical orientation can have a crippling effect on creativity and the decision making process of working

alliances that are fundamental to construction projects, and to the phenomena of technology transfer. The complex phenomena of technology transfer in the construction industry that encompasses several dimensions, most importantly the transfer and innovation of knowledge within a multidisciplinary context requires a different conceptualization of related issues from the traditional and dominant technocratic discipline-based approach as is evident in the Malaysian context. This approach is evident from the studies being undertaken on the uptake of Industrialized Building Systems (IBS) in Malaysia. The dominant policy driven approach is based on the notion of a buy-in for IBS systems based on the notion of cost savings (labour costs and material costs). However, there is still a low take-up amongst construction contractors, one reason being that the construction activities are highly capital intensive (Badir *et al.*, 2002). The government is providing some impetus for further take-up of IBS by implementing a rise from 30% to 50% in IBS building components for government building projects commencing 2005, and additionally housing developers that utilise greater than 50% of IBS building components are now given full exemption on the levy imposed on them by CIDB. As noted by Choi (2005: p. 127), the emphasis for development in Malaysia in terms of knowledge is that which is practical and market-oriented.

In this paper, there is a genuine attempt to address the phenomena of technology transfer and technological innovation within the framework of acquisition of practice. The approach described in the IBS case is considered to be pertaining to the phenomena of technology transfer and innovation. This case clearly indicates an approach based on viewing phenomena within the realm of modern knowledge. Modern knowledge referred to here, is with respect to practice that is seen as being rule-governed, relying on the process that involves activities like problem identification, analysis and sense making as a series of progressive activities (see Chio, 2005). However, phenomena such as technology transfer and technological innovation is identified here as postmodernist forms that are not amenable to positivist description and analysis for insightful understanding. Hence, it is important to consider the use of a socio-technical systems (STS) framework based on a constructivist-constructionist epistemology of knowledge emphasizing the social construction and generation of knowledge (see Gomez, 2005) that has the potential to fully 'capture' relevant issues.

For the specific purpose of providing consistent analysis, it is not sufficient to view complex phenomena through a singular gaze. Hence, by resorting to the singular position of the radical constructivist, such as Ernst Von Glasersfeld (1991), knowledge is a 'success' term, this is seen as being essentially of an instrumentalist nature. This approach is then found to be wanting as it is systemically fraught with problems conflicting with the conceptual framework of *collaborative* networks based on the notion of social embeddedness.

CONCLUSION

It is argued in this paper that the complex phenomena of technology transfer in the construction industry that encompasses several dimensions, most importantly the transfer and innovation of knowledge within a multidisciplinary context requires a different conceptualization of related issues from the traditional and dominant technocratic discipline-based approach as is evident in the Malaysian context. This is the modernist perspective. It is in this sense that there is a rationale for less market-led methods and discourses as well as technocratic or technical expert dominance in

the management of technology, vis a vis the phenomena of technology transfer and innovation. There is a need for articulating the social dimension, of social 'embeddedness', in the form of networks that can sustain and provide an avenue for more insightful and meaningful forms of collaborative working relationships that can enable technology transfer and innovation. Thus it is not just passive recipients and active providers of technology that become the focus, but the acquisition and development of knowledge as a form of co-production based on the understanding that there are multiple interpretations and that objects and subjects of interest are multi-focal in nature in terms of being context-bound and not fixed within the scope of a bounded rationality for knowledge acquisition.

The industrialised West (the big players) need to reassess their traditional approaches in forging working relationships with the developing nations of the East, particularly Malaysia, which is well on its way towards achieving its industrialised status in the year 2020.

As noted by Stephens and Greer (1995, cited in Choi, 2005),

"[The] management literature is unequivocal about the difficulty of establishing joint venturescross-national alliances almost certainly lead to conflicts when deeply held cultural assumptions initiate or compound differences in organizational processes, technology, and other factors" (p. 57-58).

This statement is indicative of the complexity of the issue of collaboration on joint venture projects between countries and in the globalized economy these issues can no longer be ignored or treated with polite indifference, as the players are aplenty.

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