

TECHNOLOGY TRANSFER IN INTERNATIONAL JOINT VENTURE PROJECTS IN CHINA

Richard Lihua and David Greenwood

University of Northumbria, Newcastle upon Tyne, NE1 8ST, UK

China's rapid economic expansion has resulted in a demand for resources that cannot be satisfied by current local capacity. Its major infrastructure projects are often supported by international funding agencies whose favoured method of delivery is by joint-venture between foreign and local organisations. In the interest of promoting sustainable local technical development, the funding agreements often include a contractual requirement for technology transfer.

This paper describes the first part of a PhD research project which examines a particular aspect of technology transfer within Sino-foreign joint ventures. The study will concentrate on the more 'tacit' forms of management knowledge, and how these can be transferred through the vehicle of joint ventures between multinational foreign contractors and new generation Chinese construction companies. Based upon the premise that tacit management knowledge is transferred through human interaction, the first objective was to develop a basic benchmark model for the transfer process of management know-how. A pilot case study was carried out to observe the interaction of a number of 'dyads', comprising one foreign and one local manager. The results will be incorporated into a model, which will be developed and tested on a number of current international joint venture projects in China.

Keywords: China, joint venture, tacit knowledge, technology transfer, human interaction, international market.

INTRODUCTION

Since the start of economic reforms in 1978, China has become the world's fastest growing economy with an average annual growth rate of 9% in real terms over the past 18 years. (Chen, 1997) A result of this rapid economic expansion has been the creation of the largest construction market in the world (Bon, 1997), a fact which has been noted by prospectors from the construction industries of developed countries (Li, 1997). The rise in construction output in China has been dramatic. Before 1983 construction was not officially recognised as a separate sector, previously being subsumed in the general category of Government Investment; by 1988 it accounted for 13.9% of GNP, which had increased to 23.7% by 1994.

Many of the resources required to meet this demand were not readily available in sufficient quantities. In particular, there was a lack of project funding. Furthermore, the indigenous industry was simply not capable of meeting demand. The two are inter-related, as will be seen, but this paper concentrates on policies aimed at increasing the supply-side potential of the indigenous construction sector through what can be broadly categorised as technology transfer.

An initial response to both shortfalls was to import from abroad. Since economic reform opened China to the outside world, it has absorbed a large amount of direct foreign investment. By the end of 1996, there were 283,793 foreign investment

projects approved in China, with a total contract value of \$ 469.325 billion. Many of these have been formal joint-ventures, more than 140,000 of which (employing 17 million people) are currently in operation (Ma, 1997). In construction, an increasing number of projects have been promoted for international competitive bidding, prompting 238 foreign contractors from 49 countries (e.g. Japan, USA, UK, France, Germany, South Korea, Australia, Malaysia) to enter the Chinese construction market (Wu, 1998).

A feature of the expansion of China's infrastructure has been the number of externally-financed projects, in particular projects funded by the World Bank and the Asian Development Bank. The number has been increasing since the World Bank recommenced the provision of loans to China at the beginning of 1980's. So far, the total amount of loans provided by the World Bank to China has exceeded \$US 20 billion (Sun, 1997). There are currently about 200 projects in construction, agriculture, transportation, communication, energy, social and educational development. Notable examples include the Lubuge and Ertian Hydro-electric Power Stations, Jing-Jin-Tang Express Way, and Xiaolangdi Hydro-electric Network.

In addition to providing project finance, international funding agencies are keen to address the second of the issues highlighted above, namely increasing the future capacity of the indigenous industry to meet the demands placed upon it. The principal vehicle for achieving this is technology transfer.

TECHNOLOGY TRANSFER

It is generally accepted that the ability to develop and cultivate new technical capabilities is vital to the construction sectors of newly industrialised countries with rapidly growing economies (Simkoko, 1989). China is no exception.

What is being transferred?

It is clear that technology can no longer be regarded as being generally applicable and easy to reproduce but as 'a highly differentiated range of techniques' (Tsang, 1997). Neither can technical knowledge only be interpreted in terms of production technology, as Kogut and Zander (1992) point out. People and organisations 'possess .. socially oriented as well as technologically oriented know-how' (Menzler-Hokkanen, 1995) and a firm's technologies are embodied in its human and organisational resources as well as its physical resources. Successful transfer of hard technologies often has to be accompanied by the transfer of soft technologies like management know-how (Hendryx, 1986). These are particularly critical since they are sensitive to local cultural and environmental conditions (Bakuli, 1994).

Thus Tsang (1997) characterises technical knowledge as consisting of two components: 'explicit' (codified in blueprints, designs, drawings and specifications) and 'tacit' (kept in human brains). The greater the extent to which a technology exists in the form of the softer, less physical resources, the greater the proportion of tacit knowledge it contains. Tacit knowledge, due to its non-codifiable nature has to be transferred through 'intimate human interactions' (Tsang, 1997). It is worth noting that this form of transfer in particular may well be a 'two-way process' between multinational and local partners.

There are many channels of technology transfer. Rapoport (1985) lists 15 which broadly fit into five categories:

Direct foreign investments;

Export, including turnkey plants, commercial visits, trade shows and exhibits;

Consultancy;

Co-operative joint ventures, research arrangements and exchange of personnel;

Education and training, including conferences publications and literature.

Ofori (1994) proposes a similar list which includes: subsidiary companies; joint ventures, strategic alliances and subcontracting; supply of plant and equipment; licensing; counterpart training; contract research and development; government level technical aid; conferences and seminars; and publications.

It should be noted that these categories are not mutually exclusive: thus, for example, technology transfer could be effected through *counterpart training* within a *joint venture*.

TECHNOLOGY TRANSFER WITHIN INTERNATIONAL JOINT-VENTURES

The importance of human interactions in the transfer of tacit knowledge or know-how has already been noted, and it is perhaps because of their potential in this respect that joint ventures are accepted by many as the preferred vehicle for transfer. In the construction industries of developing countries, joint ventures between foreign multinationals and local contractors are widely recognised as a means of enhancing local expertise (Glass and Saggi, 1999). Joint ventures are, according to Tsang (1995), the preferred method of technology transfer in China.

This is confirmed by a survey of joint venture construction companies carried out for the International Section of the Chinese Construction Ministry (Wu, 1998). The most regularly-cited aims of local Chinese partners (after 'increasing the profits of the enterprise') were:

Learning more advanced construction technology;

Obtaining project management skills; and

Obtaining channels to the international construction market.

Elements of technology transfer also figured among the aims of the foreign partners, with expressions such as 'learning how to operate projects in China' rating relatively high after 'promoting increased business for the enterprise' and 'obtaining profit'.

The potential is recognised by the World Bank (Carrillo, 1996). In 1993 the Bank adopted an explicit policy of requiring a commitment to technology transfer from its contractors to the construction industries of the host country (Langford, 1995).

According to Abbott (1985), an essential condition for effecting such technology transfer is the clear specification of the requirement in a contract. The World Bank's policy in principle was that organisations should not be awarded contracts without forming meaningful partnerships with local companies (Carrillo, 1993).

Despite the existence of the policy, there appear to be few, if any mechanisms for ensuring that technology transfer has taken place, or to measure its effectiveness (Carrillo, 1993). The World Bank has itself already recognised the difficulties in monitoring such a policy (World Bank, 1986). There is even evidence to suggest that some efforts may have been counter-productive. The Chinese construction industry is not uniform and in fact presents quite a complex picture. There are state-owned units,

nominally collective-owned units which are in fact also owned by the state and true collective-owned units run by rural construction teams. Overlaid upon these, are a new generation of construction companies which can be wholly Chinese, owned by a foreign organisation, or a joint-venture between the two. The irony of the situation is that the traditional rural construction teams often out-perform the supposedly technically-superior companies. Significant inefficiencies appear to have developed where these new enterprises have attempted to embrace new technology without the capacity to fully implement or even understand it (Chen, 1997).

CURRENT RESEARCH PROJECT: AIMS AND OBJECTIVES

The aims of the research were to:

model the transfer of management know-how in a Sino-foreign joint venture;

To refine the model and to test its validity on further case studies.

The intention of the present research is to construct a detailed and robust model of tacit knowledge transfer, which has now moved into the forefront of current academic investigations into technology transfer.

In the process of reforming many loss-making state enterprises, it has been recognized that China must draw upon the world's advanced methods of management (The 12th Central Committee, 1984) so that effective productivity can be achieved. In fact, China has been one of the largest importers of technology in the world. Tsang (1995) argues that joint ventures, which offer a good environment for the Chinese to acquire up-to-date management skills from the foreign partners, seem to be the best option for China in terms of transfer of management know-how. It is clear that joint ventures between domestic companies in developing countries and multi-national firms have become a popular means of satisfying the mutual objectives of both partners. Both local partners and foreign partners have mutuality in terms of advantages and disadvantages in international joint ventures as Miller (1997) points out. Foreign partners offer advanced process and product technologies, management know-how and access to export markets. The proposition is that the transfer of management know-how is an indispensable pre-requisite for proper technology transfer. The literature search has confirmed that whereas the transfer of hard technology in joint venture is usually evaluated and paid for, the transfer of management know-how is never evaluated in practice, nor has it been specifically researched.

Frappaolo and Toms (1997) define knowledge management as a tool set for the automation of deductive or inherent relationships between information objects, users and processes while Takeuchi (1998) believes that knowledge management is about capturing knowledge gained by individuals and spreading it to others in the organisation. Knowledge management is vast not only because of its potential for organisational value but also because of the solutions and technologies that can be applied to it. It is the role of knowledge management, therefore, to connect two nodes, knowledge owners and knowledge seekers. The knowledge of one is transferred to the mind of another, so that a new decision can be made or situation handled.

Takeuchi (1998) identifies in his study that European companies have been international leaders in measuring knowledge, while American companies have taken the lead in managing knowledge effectively. According to Nonaka (1995), Japanese companies are organisations which do not merely manage knowledge, but create it as well. Every one in the organisation is involved in creating knowledge.

METHODS, PILOT STUDY AND FINDINGS

The nature of the present research programme has resulted in the adoption of a combined research style integrating case studies and assessment inventories. The latter requires the researcher to have a good understanding of construction processes in order to identify and evaluate problems and potential solutions, while case studies involve in-depth study of particular instances within the research subject (Fellows, 1997). Therefore both semi-structured and structured interviews were designed to be an integral part of methodology of the research. By using semi-structured interviews in the pilot study, valuable data were collected for the design and formulation of the research model. The research model will be further developed and refined by incorporating the data to be collected by using an assessment inventory (Melvin, 1979) in the main study.

Pilot Study

The Xiaolangdi Hydro-electric Network across the Yellow River in Henan Province, PRC was chosen as the pilot study, not only because it is one of the largest joint venture projects in China, but also because it is quoted by the Chinese government as a demonstration project for Sino-foreign joint ventures. Following research into the current state of knowledge about the topic, 3 study visits were undertaken in 1999 to the Xiaolangdi Project and the International Co-operation Division, Construction Management Department, Ministry of Construction, PRC. Data were collected primarily by individual interviews with the managers (foreign and local) of the relevant construction organisations. This has enabled the researcher to track the development of collaborative relationships over time. The interviews were conducted in Chinese and English and were recorded. The Xiaolangdi project is funded by the World Bank and the Central Government of PRC and undertaken by three major joint-venture companies. The local partners are the companies from Hydro-electric Engineering Bureaux of the Hydro-electric Ministry, PRC, while the foreign partners are multinationals from France, Germany and Italy. There are more than 10, 000 people working on the construction site, 700 of which are foreigners from 51 countries. However, the intention was to use the project to validate a systematic model for the transfer of tacit knowledge. This Pilot Study has indeed identified and the typical management structure of Sino-Foreign joint venture in Xiaolangdi by examining the existing resources and interviewing the management staff of the project, with which significant insight into the investigation of the "dyadic interaction" could be approached. Furthermore, the study has established a platform for a more in-depth analysis of transfer of management know-how between foreign and local partners, in terms of explicit and tacit knowledge transfer, dyadic interaction, channel of transfer and the influence factors.

The primary interest of this research is in how tacit management knowledge is transferred through human interaction. The unit of analysis will therefore be a dyad with one foreign member and the other local, and whose roles demand that they work together. Evidence from the pilot study has shown that tacit knowledge transfer occurs from time to time during the execution of the project between members of management dyads composed a foreign (F) and a local (L) element. The pilot study permitted the identification of the various 'dyads' or pairs of individuals who interact with each other as part of their managerial role. In fact these dyads are numerous, and made up of foreign-foreign (F-F), foreign-local (F-L), local-local (L-L) but for the immediate purposes of the current research, only the foreign-local (F-L) dyads are of interest.



Figure 1: Work pattern of dyadic interaction

Factors Influencing the transfer of knowledge

Many factors are cited as potential barriers to the success of technology transfer. Samli (1985) considered six dimensions: culture, economy, people, business, and government. Walsh suggests that the typical approach of the foreign organisation is to attempt to use familiar technologies rather than develop production process skills of the existing labour force (Walsh, 1987). This approach provides only short-term solutions to shortfalls in indigenous capacity. According to Chen (1994) only a minimal level of transfer is achieved. Lam (1997) argues that the difficulties in the transfer of knowledge arise not simply from the tacit nature of knowledge itself, but from differences in the degree of tacitness of knowledge and the way in which it formed, structured and utilized in different countries. Within the context of Hofstede (1980) and Hofstede and Bond's (1988) five dimensions of culture and based on the model of technology transfer developed by Tung (1994), the pilot study considered the following influencing factors:

Cultural difference

Language barriers

Social values

Different objectives

Technical development level

These factors will be incorporated into the research model for the main study. The next stage is to undertake the main study by using assessment inventories on projects in Henan and Jiangsu provinces. Finally the model will be tested by the case study projects selected from those taking place in the same provinces.

A Basic Model of Knowledge Transfer

Explicit and tacit knowledge have different channels of transfer. Figure 2 represents the channels of transfer generated from the literature (Polanyi, 1967; Woherem, 1991; Tsang, 1995, 1997, 1998; Mcaulay, 1997; Maitland, 1999) and refined using data from the pilot study.

SUMMARY

Because of the inability to meet the demands of economic growth out of current indigenous resources, the Chinese construction industry relies on foreign investment in its various forms. This is a short-term measure, but in the long term China seeks the additional benefit of sustainable technology transfer. There are various modes of international activity which could have an effect. Of these, international joint ventures

appear to be the preferred vehicle for both the recipients in question – China – and of its major external funder of construction activity– the World Bank.

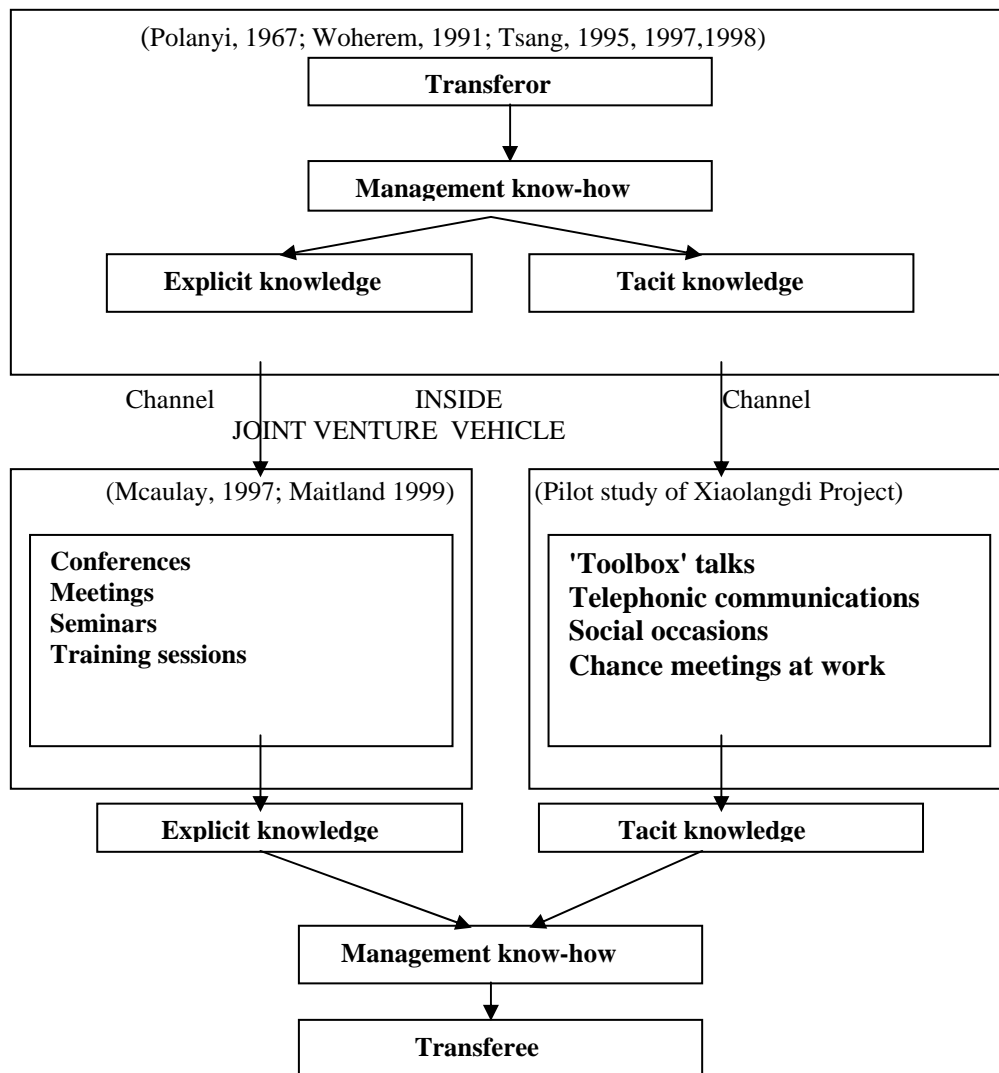


Figure 2: Knowledge transfer modes

The original research topic indicated an investigation of the current mechanisms of technology transfer between developed and developing countries. However an investigation into the current state of knowledge and the most recent research on the subject has shifted the focus towards the investigation of explicit and tacit knowledge transfer in international joint venture projects. Building on a distinction between explicit and tacit knowledge (Tsang, 1997), the research focus has further moved to the investigation of the transfer of tacit management know-how.

The ultimate objective is to produce and validate a model of the transfer of management know-how through human interaction. The results may ultimately assist in assessing the efficacy of technology-transfer in Sino-foreign and other joint venture projects. It may inform decision-makers within the governments, sponsors of projects and the executives of the companies involved to address the existing deficiencies in the process of technology transfer and assist in development of more appropriate arrangement for the transfer of management knowledge.

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