

# The Theoretical Perspectives Underlying Technology Transfer: A Literature Review

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## Abstract

The main objective of this paper is to contribute to the existing technology transfer literature by comprehensively reviewing and outlining the theories underpinning technology transfer. This review could stimulate and generate dynamic ideas for future researchers i.e. to further identify, conceptualize and understand the theories and perspectives underlying technology transfer. Such strong understanding is necessary to enable the interested parties (such as private sectors, government departments, academics, researchers and students) to relate these theories with the practical and empirical aspects of various technology transfer models, mechanism, issues and challenges. This is due to the fact that different perspectives/theories underlying technology transfer will have different theoretical arguments and insights, research problems, constructs, variables, and measurements. The literatures on technology transfer and international technology transfer are extensive, varied in perspective and from many disciplines; which include political science, economics, sociology, public policy, marketing and management. Since technology transfer literatures cover wide research areas, therefore this paper sets its perimeter by focusing only on the theories and perspectives underlying intra and inter-firm technology transfer.

**Keywords:** Underlying theories, Intra and Inter firm technology transfer, Malaysia

## 1. Introduction

In the 1970s studies on technology transfer have adopted “the economic international trade approach” in developing a linear technology transfer (TT) model (Bessant and Francis, 2005). In the 1980s research on TT emphasized on the effectiveness of specific technologies that are being transferred; which in general is within a broader context of economic development (Hope, 1983). The 1990s approach emphasizes on the significance of learning at the organization level as a key element in facilitating technology transfer (Figuereido, 2001). In late 1980s and early 1990s TT models have started to absorb the principles of organization development movement (French and Bell, 1995). Strategic management researchers have further contributed to the development of TT frameworks based on knowledge-based view of the firm (KBV) and organizational learning (OL) perspectives since these perspectives have been found to have quite similar dimensions in terms of the outcomes, processes, barriers and facilitators (Daghfous, 2004). These perspectives have significantly contributed to the expansion of TT models because the literatures from both KBV and OL perspectives appear to subsume most of the contributions of the TT literatures (Daghfous, 2004).

From a review of literature, the relevant theories which are found to be related to intra and inter-firm technology transfer are the international trade theory, foreign direct investment (FDI) theory, resource-based theory, knowledge-based view of the firm perspective and organizational learning perspective. For example, the international trade theories, which consist of the classical trade theory (Ricardo, 1817; Smith, 1776), the factor proportion theory (Heckscher and Ohlin, 1933) and the product life cycle theory (Vernon, 1966, 1971; Wells, 1968, 1969), are related to TT studies as these theories provide plausible explanations on how trades between countries contribute to the flow of production or goods and services which have brought along the technology embedded in them. The FDI theories are related to TT studies as these theories provide explanations on how FDIs by MNCs become the main channel for intra-firm technology transfer; where technology is transferred to MNCs' subsidiary or affiliates in the host countries. FDI theories consist of the market imperfection theory (Hymer, 1960, 1970; Kindleberger, 1969; Caves, 1971), international production theory (Dunning, 1980), internationalization theory (Buckley, 1982, 1985; Buckley and Casson, 1976), and transaction cost theory (Williamson, 1975; Ouchi, 1980; Williamson and Ouchi, 1981). This paper follows a number of scholars who apply the terms 'technology' and 'knowledge' interchangeably to establish a close association between technology transfer and knowledge transfer (Sazali and Raduan, 2011; Sahal, 1981, 1982; Kogut and Zander, 1992, 1993; Simonin, 1999b; Bozeman, 2000; Sinani and Meyer, 2004)

## 2. Intra-Firm Technology Transfer

As an intangible firm resource, technology and knowledge are viewed as the most strategically important resource of the firm (Grant, 1996). The ability to create and transfer knowledge internally is one of the main competitive advantages of MNCs. Several studies have argued that MNC is considered to be a 'differentiated network' where knowledge is created in various parts of MNC and later transferred to several inter-related units (Hedlund, 1986; Bartlett and Ghosal, 1989; Gupta and Govindarajan, 1991). Baum and Ingram (1998) argue that organizations whose are capable of transferring knowledge effectively from one unit to another within the organizations are more productive and more likely to survive than organizations that are less adept at knowledge transfer. MNCs are seen as the mechanism to transfer knowledge because of their ability to transfer and exploit knowledge more effectively and efficiently in the intra-corporate context than through external market mechanism (Hymer, 1960). Holm and Pedersen (2000) view MNCs as no longer as repositories of their knowledge as put forward by Kogut and Zander (1993) but more as instruments where knowledge is transferred across subsidiaries and contribute to knowledge development. Knowledge is transferred internally from MNCs to the subsidiaries when knowledge is developed in one location but exploit in other location. The MNCs' ability to facilitate and manage inter-subsidiary transfer of knowledge thus creates a competitive advantage to MNCs (Minbaeva et al., 2003). Wang et al. (2004) describe intra-firm knowledge transfer as a process of a systematically organized exchange of information and skills between entities in the organization. Argote (1999) examines how characteristics of the relationship between organizations, the organization's characteristics, the features of the knowledge being transferred and the dimensions of the transfer process affect the actual knowledge transfer. Szulanski (1996, 2003) suggests that the movement of knowledge within the organization is a distinct experience, not a gradual process of dissemination. Szulanski (1996, 2000, 2003) defines intra-firm knowledge transfer as a process of a dyadic exchanges of knowledge between the sender and the receiver where the effectiveness of transfer depends to some extent on the disposition and ability of the source and recipient, on the strength of the relationship between source and recipient, and on the characteristics of the object that is being created. Minbaeva et al. (2003) propose that knowledge transfer between organizational units as a process that covers several stages starting from identifying the knowledge over the actual process of transferring the knowledge to its final utilization by the receiving units.

Minbaeva et al. (2003) also argue that the knowledge transfer from the source to the recipient has little value if the recipient, due to lack of absorptive capacity, does not use and utilize the new knowledge transferred. Other studies on intra-firm knowledge transfer affirm that the effective internal knowledge transfer i.e. to disseminate knowledge from one division to another division within the same firm is not an easy task or automatic (Hedlund, 1994; Nonaka and Takeuchi, 1995; Szulanski, 1996). The effective dissemination of valuable organizational knowledge is likely to be difficult within the diversified and multidivisional firms that have been such prominent foreign investors in a variety of markets around the world (Barlett and Ghoshal, 1992; Hedlund, 1994). Past studies have indicated that the success of knowledge inflows into a subsidiary are positively associated with the richness of transmission channels, motivation to acquire knowledge and the recipient's absorptive capacity to absorb knowledge (Gupta and Govindaraj, 2000). Szulanski (1996) identifies that other than the causal ambiguity and relationships between the source and the recipient units, lack of absorptive capacity on the recipient's part is one of the most important factors that impede intra-firm knowledge transfer.

## 3. Inter-Firm Technology Transfer

Inter-firm technology and knowledge transfer have been viewed as a process of inter-organizational learning (Liao and Hu, 2007). This view is consistent with organizational learning perspective which emphasizes on knowledge

acquisition by the organizations (Huber, 1991). Inkpen (2000) argues that, based on knowledge-based view perspective, organizations gain competitive advantage when they are able to acquire and transfer new knowledge from outside their boundaries. Knowledge acquisition of new capabilities through organization learning has been recognized as conferring a sustainable competitive advantage on the firms (Bontis, et al., 2002). Past studies have also affirmed that the important tool for organization learning is through strategic alliance formed between different organizations (Eisenhardt and Schoohaven, 1996; Harrigan, 1988). From a review of literature, the formation of strategic alliances is motivated by variety of objectives including the need to spread the costs and risk of innovation, economies of scale, access to new markets, the search for legitimacy and the acquisition of new technical skills or technological capabilities from alliance partners (Contractor and Lorange, 1998; Harigan, 1986; Henhart, 1998; Mowery, 1998; Marity and Smiley, 1993; Hamel et al., 1989; Hamel, 1991). Researchers have argued that strategic alliance provides an ideal platform for organizational learning, giving access to the knowledge, skills and competencies of their partners when two or more organizations are brought together because of their different skills, knowledge and strategic complementarities (Grant, 1996; Hamel, 1991; Khanna, et al, 1998; Kogut, 1988). Huber (1991) proposes that inter-organizational learning process occurs through vicarious learning and grafting. Vicarious learning occurs when organizations acquire knowledge through learning from the experience of other organizations. On the other hand, grafting process enables the organizations to increase their store of knowledge by acquiring knowledge not previously available within the organization through mergers, acquisition and alliance (Huber, 1991).

Strategic alliance offers organizations learning opportunity to the partners through several organizational arrangements such as JVs, licensing agreements, distribution and supply agreements, research and development partnerships and technical exchanges (Inkpen, 1998). Inkpen (1998) categorizes the organizational arrangements into two broad categories: 1) equity alliances; where it involves the transfer or creation of equity ownership either through direct investment or the creation of an equity JV, and 2) non-equity alliances; where no equity transfer or creation of new organization is involved. Based on organizational theory, Kogut (1988) argues that strategic alliance through the inherent long term partnering provides the partners opportunities to transfer embedded knowledge between them. Strategic alliances create a cooperative, shared and mutual learning environment and effective transfer of knowledge. A strategic alliance acts as a mechanism for competitive advantage where partners mutually aspire to meeting the individual and collective objective of the relationship (Inkpen, 2000).

Past studies have suggested that inter-firm knowledge and capabilities transfer depends on the choice of alliance structure such as joint venture (JV), licensing agreements, R & D partnerships, distribution and supply agreement or technical exchanges (Inkpen, 1998). Kogut (1988) argues that equity-based joint ventures, as compared to licensing agreements, are more effective vehicles for transferring tacit knowledge between partners. This is because knowledge that is being transferred is organizationally embedded; which cannot be easily blueprinted or packaged through licensing or market transactions. In support of this argument Inkpen and Dinur (1998) assert that if the alliance replicates the partners' experience knowledge in a jointly owned organization, one or all partners may have access to knowledge that would not have been available in the absence of collaboration. Inkpen and Dinur (1998) and Inkpen (2000) further argue that the inter-firm organizational learning mainly depends on the alliance knowledge accessibility and firm learning effectiveness. In support of Kogut (1988), several empirical studies have shown that equity-based joint ventures are more effective than licensing agreement in transferring knowledge and capabilities between partners in strategic alliances. Mowery et al. (1996) find that equity joint ventures appear to be more effective conduits for complex knowledge and capabilities in the inter-firm knowledge transfer within strategic alliance than contract-based alliances such as licensing agreements. Pak and Park (2004), in their empirical study on cross border knowledge transfer in the international joint ventures and Korean partners, find positive relationship between equally shared JV and knowledge transfer. Lin (2005) finds positive impact of the U.S management control in JV and the acquisition of managerial knowledge by Chinese partners.

#### **4. International Trade Theories**

The international trade theories are relevant to technology transfer as they provide explanations on how trades between countries have contributed to the flow of productions of goods and services; which have brought along the technology embedded in them. This is consistent with the earlier literatures' arguments which argue that technology embodied in people, product and processes is expected to be transferred during the trades between countries (Hall and Johnson, 1979; Das, 1987). The focus of the discussion below is on how international trade theories facilitate the transfer of technology embodied in product and services to another country through trades between countries.

##### *4.1 Classical Trade Theory*

The classical trade theory is first developed by Ricardo (1817) and Smith (1776). The theory holds that there are gains from trade if each nation specializes completely in the production of the goods and services in which it has a

comparative cost advantage in producing and later trades with the other nation for the other goods. Morgan and Katsikeas (1997) in their extensive work on international trade, foreign direct investment and internationalization literatures state that the classical trade theory effectively describes the scenario where a country generates goods and services in which it has an advantage for the consumption indigenously. According to Morgan and Katsikeas (1997), based on the classical trade theory, the countries will have to import goods and services that they have an economic disadvantage. The economic advantages or disadvantages of a country may arise from the country differences in factors like resources endowments, labor, capital, technology and entrepreneurship. The classical trade theory provide an explanation that the basis for international trade can be sourced to differences in production characteristics and resource endowments which are founded on domestic differences in natural and acquired economic advantages (Morgan and Katsikeas, 1997).

#### *4.2 Factor Proportion Theory*

The second international trade theory is factor proportion theory which was developed by Hecksher and Ohlin (1933). This theory builds on the classical theory of comparative advantage by Ricardo (1776). This theory extends the classical trade theory by taking into account the endowment and costs of factors of production by predicting patterns of trade and production based on the factors endowments of a trading region. The theory holds that countries will tend to generate and export goods and services that harness large amounts of abundant production factors that they possess and import goods and services that require large amounts of production factors which may be relatively scarce (Hecksher and Ohlin, 1933). This theory has offered an explanation as to what causes differences in relative advantage by the trading countries in the classical theory (Morgan and Katsikeas, 1997). However, Morgan and Katsikeas (1997) argue that both classical and factor proportion theories are shown to be deficient in explaining more recent patterns of international trade due to technological progress and the increase in trades by MNCs.

#### *4.3 Product Life Cycle Theory*

The product life cycle theory is an economic theory that was developed by Vernon (1966, 1971) and later expanded by Wells (1968, 1969) in response to the failure of the Heckscher-Ohlin's (1933) model of factor proportion theory. The theory was found to be a useful framework in explaining and predicting international trade patterns as well as MNCs's expansion (Morgan and Katsikeas, 1997). Vernon (1966) has categorized the product life cycle into three stages: 1) During the first stage or new product stage the theory suggests that a trade cycle emerges where a product is produced by a parent firm in the home country and introduce into foreign markets through exports; 2) In the mature product stage, as technology becomes sufficiently routine to be transferred, the firm's export position becomes threatened and firm is induced to produce goods in the host country through its foreign subsidiaries; and 3) Finally, as the product becomes completely standardized it will be produced anywhere in the world especially in the developing countries where costs are at their lowest possible (Morgan and Katsikeas (1997). This theory also explains how a product may emerge as a country's export and works through the life cycle and ultimately becomes an import. Morgan and Katsikeas (1997) argue that globalization has weakened the power of the product life cycle theory and consequently MNCs whose have heavily invested in research and development (R & D) with the objective of creating competitive advantage will opt to export goods that have high technology contents. They also postulate that new technologies may be positively related to foreign direct investment (FDI) and mature technology is positively related to licensing and as a result the product life cycle standardized technology is obtained by the developing countries through licensing agreement. Thus, in the context of FDI, the product life cycle appears to be a defensive strategy of MNCs when they go abroad to protect their product innovations once technology becomes standardized and competitors from the developed countries can adopt and copy the new product (Niosi and Rivard, 1990). Based on the international trade theories, the early economist tend to treat technology as given that embodied in products (goods) and processes such as technology resembles blueprints, machines, or materials which is easily replicated and transferred (Lin, 2003).

### **5. Foreign Direct Investment Theories**

The foreign direct investment theories are relevant to technology transfer particularly in explaining how FDI by MNCs becomes the main channel for inter-firm technology transfer to developing countries or local firms when technology is transferred to MNCs' subsidiary or affiliates in the host countries (Kogut and Zander, 1992, 1993; Zander and Kogut, 1995). FDI theories consist of market imperfection theory, international production theory, internationalization theory and transaction cost theory.

#### *5.1 Market Imperfection Theory*

The market imperfection theory by Hymer (1970) was introduced, among others, to address limitation of international trade theories and also to provide explanations on why MNCs may prefer FDI than exporting, licensing or joint venture. The theory holds that firms constantly seek market opportunities and their decision to

invest abroad is explained as a strategy to capitalize on certain capabilities not shared by competitors in foreign countries (Hymer, 1970). Hymer (1970), Kindleberger (1969) and Caves (1971) suggest that the MNCs exist because of the 'market imperfections'. These imperfections were 'structural' in nature and led to a divergence from perfect competition in the final product market. This divergence resulted from the control of ownership advantages of factors such as proprietary technology, privileged access to inputs, scale economies, control of distribution systems, and product differentiation (Bain, 1956). Hymer (1970) further argue that on the basis of these imperfections, MNCs would seek to consolidate and internalize the relationship between licensor and licensee by establishing monopolist type advantages through the vertical integration of a potential licensee. Kalfadellis and Gray (2002) argue that despite significant gains to be made in international production by internalizing operations, in terms of cost reduction, improving product quality, and fostering innovation the fact that the firm internalizes or supersedes the market highlights the issue that economic activity organized internally by MNCs is an opportunity for the MNCs to further advance its monopoly power.

### *5.2 The International Production Theory*

The eclectic theory of international production which was developed by Dunning (1980) is in response to the failure of market imperfection theory to explain why foreign production is considered the most desirable means of harnessing the firm's advantage. Dunning (1980) suggests that the propensity of a firm to initiate foreign production will depend on the specific attractions of its home country compared with resource implications and advantages of locating in another country. Following this theory there are three conditions that have to be satisfied for FDI to occur: 1) The MNCs must possess ownership specific advantage and be competitive; 2) MNCs must choose FDI over trading and licensing due to market imperfections that create additional transaction cost associated with trade and licensing; and 3) the location advantages of certain foreign countries should make FDI into these countries preferable to making direct investments. The international production theory makes it explicit that not only do resources differentials and advantages of the firm play a part in determining overseas investment activities but foreign government actions may significantly influence the piece-meal attractiveness and entry conditions for firms (Morgan and Katsikeas, 1997).

### *5.3 Internalization Theory*

The concept of internalization has been extensively examined by Buckley (1982, 1985) and Buckley and Casson (1976, 1985). Internalization theory holds that when penetrating foreign markets to exploit technological advantages, MNCs have to choose whether to set up subsidiaries in the host country or by way of licensing. Morgan and Katsikeas (1997) suggest that internationalization concerns about extending the direct operation of MNCs, bringing under common ownership and control activities conducted by intermediate market that links the MNCs to customers. Firms will gain by creating their own internal market in such that transaction can be carried out at a lower cost within the firm. Buckley and Casson (1976) argue that internalization theory is the acknowledgement of imperfection within the market which prevents the efficient operation of the international market in trade and investment. These market imperfections occur as a result of externalities (exogenous variables) in the goods or factor markets (Kalfadellis and Gray, 2002). Building on Buckley and Casson (1976), Kalfadellis and Gray (2002) argue that these externalities may exist in the form of government induced regulations and controls or it can be attributed to other types of natural externalities (market failure) such as lack of information and knowledge. In overcoming these externalities MNCs will have to internalize their operations.

### *5.4 Transaction Cost Theory*

The transaction cost theory was developed to search for an answer to question why organization exists; and helps to provide an understanding as to the establishment and development of MNCs (Coase, 1937). Since transaction cost economics underpins internalization theory, it is necessary to consider and understand transaction cost theory (Buckley and Casson, 1976). In the context of this paper, the conceptual underpinnings transaction cost provides an understanding of the expected behaviors of both technology-supplier and technology-recipient during the technology transfer process; especially when dealing with the tacit knowledge embedded in the technology. Rugman (1981) suggests that internalization theory is very closely related to transaction cost theory. Internalization considers the internal operation of an MNC and takes into account the international arena, while transaction cost economics considers the growth of any firm regardless of operating domain (Madhok, 1998). Both theories are interconnected and compatible because internalization is the transaction cost theory of the multinational (Rugman, 1986). The conceptual underpinning transaction cost theory is best illustrated in the works by Williamson (1975), Ouchi (1980) and Williamson and Ouchi (1981). Williamson (1975) argues that transaction costs are those which favor hierarchical organization (internalization) instead of markets and the transaction costs exist when agents (economic actors) have bounded rationality and are opportunistic. Bounded rationality of transaction cost theory suggests that the agents (economic actors) may have a desire to be rational but their attempts to be rational are bounded by their cognitive limits. Simon (1955) postulates market failure occurs due to

bounded rationality when agents cannot foresee all possible circumstances to incorporate in the contract because of lack of perfect knowledge. In other words they do not have the capacity to process all the information about the context within which they operate in a limited time that is normally available to them (Ojha, 2004). Opportunism suggests that the agents cannot be trusted because they tend to make decisions based on self-interest, thus making the contract difficult to enforce (Williamson, 1975). The agents, in seeking their self-interest with guile, have the tendency to commit behaviors which may include lying and stealing, where in the context of this perspective: the incomplete disclosure of information, mislead, distort, disguise, obfuscate or otherwise confuse a partner in an exchange or contract (Williamson, 1975). Although this might not always be the case but individuals or firms can sometimes be expected to make calculated efforts to cheat or mislead other parties in a transaction especially when it is hard to differentiate opportunistic behaviors from expected behaviors (Ohja, 2004).

## 6. The Resource-Based View

The resource-based view of the firm emphasizes the importance of internal firm resources for sustainable competitive advantage. This theory stresses the role of internal capabilities; which are developed historically in the firm, to explain business performance or competitiveness (Barney, 1991; Peteraf, 1993; Wernerfelt, 1984). Prahalad and Hamel (1990) broadly define firm resources to include physical assets, knowledge, technology, organizational capabilities and operations procedures. This definition is consistent with the early definition by Daft (1983) who defines firm resources as all assets, capabilities, organizational processes, firm attributes, and knowledge that are controlled by a firm to enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness. Barney (1991) categorizes firm resources into physical resources, human resources and organizational resources. A firm is said to have a sustainable competitive advantage when it implements a value creating strategy not simultaneously being implemented by any current or potential competitors which renders other firms unable to duplicate the benefits of this strategy (Barney, 1991). The resource-based view also suggests that firms compete on the basis of unique resources that are valuable, rare, imperfect imitability and non-substitutable (Barney, 1991). A resource is said to be valuable when it enables strategies that improve efficiency and effectiveness (i.e. when it can exploit opportunities and neutralize threats). Barney (1991) argue that uniqueness of the firm resources derives from being rare where only a few firms have the resources, having imperfectly imitability when other firms difficult to imitate or acquire the resources, and non-substitutable when there are no other strategically equivalent resources available to other firms. Spender and Grant (1996) stated that the firm resources inimitability is central to understanding the sustainability of competitive advantage of a firm. According to Barney (1991), firms strategic resources are inimitable by the competitors and act as barriers to imitation when: 1) the resources are dependent on unique historical conditions; 2) the ambiguity of the firm resources; and 3) the resources are socially complex. Lippman and Rumelt (1982) argue that causal ambiguity acts as a powerful on both imitation and factor mobility.

Barney (1991) posits that causal ambiguity of the firm resources occurs when the link between the resources controlled by the firm and a firm's sustained competitive advantage is difficult to understand or unclear. In the context of strategic alliance and inter-firm relationship, causal ambiguity as the source of firm's competitive advantage acts as barriers to imitation and lessens the propensity to learn from a partner (Simonin, 1999). The resource-based view implicitly poses a question on how knowledge and technology as the firm strategic resources can be perfectly transferred to form competitive advantage (Lin, 2003). Lin (2003) suggests that one of the ways to overcome the problem is to increase the technological capabilities of the recipient firms. Previous studies have observed that in the current era of technologically driven, technology as the strategic resources of the firm have intrinsically high value. Therefore, the technology resources that are regarded as having high intrinsic value are difficult to imitate due to high content of tacit knowledge (Bettis and Hitt, 1995; Teece, 1977). Eventually, firms that possess technology resources which are valuable and imitable will enjoy sustainable competitive advantage.

## 7. Knowledge-Based View of the Firm

Knowledge-based view suggests that firms, as a bundle of knowledge, emphasize that firm-specific, intangible, non-tradable and inimitable knowledge as the only durable sources of sustainable competitive advantage of the firm (Spender, 1996). Past studies on knowledge-based view have focused on knowledge as a key competitive asset and many studies focus on the capacity of the firm to integrate tacit knowledge (Grant and Baden-Fuller, 1995; Conner and Prahalad, 1996). Knowledge-based view concentrates more on human resource than other physical resources of the firm. The reason is that human resource is seen to have important role in the process of knowledge creation, knowledge transfer and knowledge acquisition within the organization (Conner and Prahalad, 1996; Kogut and Zander, 1996). The main focus of knowledge-based view is to explain how firms gradually grow and achieve sustainable competitive advantage through knowledge creation and learning (Kogut and Zander, 1992, 1993; Spender, 1996). Kogut and Zander (1993) argue that firms, as the repository of knowledge, builds their

firm-specific knowledge and accumulated it over time; which makes the firms specialize in specific product or service (Dierick and Cool, 1989).

Hymer (1976) asserts that firms expanding abroad transfer to their foreign subsidiaries firm-specific ownership advantage such as superior production, marketing and technical knowledge because of the inherent disadvantage of operating in host country environments. The intra-firm knowledge transfer of superior knowledge is seen as an effective mean of replication and exploitation of the ownership advantage for economic rents (Kogut and Zander, 1993). Recent studies argue that firms are no longer seen as the knowledge repository but rather as instruments where knowledge is transferred across subsidiaries and contribute to knowledge development (Gupta and Govindaraj, 2000; Holm and Pederson, 2000). As firm-specific, knowledge is the important resource of the firm, knowledge-based view suggests that tacit knowledge is more difficult to replicate and transfer than explicit knowledge (Mowery and Rosenberg, 1989). Nonaka (1994) states that the firm's tacit knowledge is not easily communicated and shared because it is highly personal deeply rooted in action and in an individual's involvement within a specific context. The individual's insights and skills that form tacit knowledge in human resource, which are gained through personal experience, is difficult or impossible to articulate or transfer (Kogut and Zander, 1993; Nelson and Winter, 1992; Nonaka, 1994; Polanyi, 1967, Simonin, 1999). Tacit knowledge acts as the glue that integrates mechanism in organizational learning (Dhanaraj et al., 2004). Whereas on the other hand, explicit knowledge, which is highly codified and transmittable in formal and systematic language, acts as the building blocks (Polanyi, 1967; Nonaka and Takeuchi, 1995).

## 8. Organizational Learning

Organizational learning refers to the environment adjustment process for achieving the specific goals of an organization and it is the common learning method of procedure of the organization (Lin, 2007). Past studies have different views on organizational learning for example based on system theories, Meyers (1990) believes that organizational learning is the firm's ability of evolution and action in response to the stimulation from the internal and external environment. From the knowledge-based view, Grant (1996b) views organizational learning as the process of promoting organizational activities with better knowledge and understanding. From the network system perspective Khanna et al. (1998) describes organizational learning as the process of acquiring or internalizing the skills or know-how of the partners. Build on Huber's (1991) work on organizational learning, Miner and Mezias (1996) suggest that organizational learning involves three key questions (issues): 1) what are the learning processes? 2) who or what is doing the learning? and 3) when is learning valuable?

The first question is closely related to the constructs and processes of organizational learning developed by Huber (1991). Huber (1991) proposes four constructs that integrally linked to explain the organizational process. The first construct is knowledge acquisition. This construct refer to the process of how knowledge is acquired or obtained. Huber (1991) categorizes knowledge acquisition into five categories: 1) congenital learning the a process where knowledge is acquired or inherited from its creator; 2) experiential learning the a process where knowledge is acquired through direct experience; 3) vicarious learning the a process where knowledge is acquired through observation and copying of successful routines from other firms; 4) grafting is the process where knowledge is acquired from new members with new knowledge from other firms; and 5) searching and noticing, the process where knowledge is acquired through scanning, focused research and performance monitoring. Information distribution as the second construct refers to the process by which information from different sources is shared and thereby leads to new information or understanding. The third construct is information interpretation is the process by which distributed information is given one or more commonly understood interpretations. The last construct, organizational memory refers to the means by which knowledge is stored for future use.

On the second question, Miner and Mezias (1996) suggest three levels of learning. During the individual level, individuals acquire and interpret information based on their personal cognitive maps and frameworks. At the group level, the group decision-making of the firm will respond to performance feed-back with shared understanding and coordinated behavior. Lastly at the population of organizations level, groups of organizations acquire knowledge through sharing of experience. The focus of the present study relates to the organizational learning level on how organizations in the inter-firm relationship acquire and transfer knowledge. With regard to the third question on when is learning valuable, Miner and Mezias (1996) identify factors that affect the learning impact to include learning rate, level of noise in the feedback process, numbers of the independent learning sub-units and the timing of learning. In the context of inter-firm knowledge and technology transfer, organizational learning framework developed by Huber (1991) provides explanation as to how knowledge is acquired and transferred by organizations from outside their boundaries through the grafting process (Inkpen, 2000). Huber (1991) proposes that grafting is the sub-process of knowledge acquisition by which organizations increases their store of knowledge by acquiring new knowledge not previously available within the organization either through mergers, acquisition or alliance. Knowledge acquisition through alliance with other partners may occurs in various

organizational arrangements of strategic alliance such as joint ventures (JVs), licensing agreements, distribution and supply agreements, research and development partnerships and technical exchanges (Inkpen, 1998). From joint venture context, Inkpen and Dinur (1998) describe knowledge acquisition by organization through JVs as a multi-stage process. According to Inkpen and Dinur (1998) the first stage begins with the formation of the JV; where interaction between the individuals from the two or more partner of the JV partners occurs. The second stage is the grafting process; where the knowledge is transferred from the JV to the partners. Inkpen and Dinur (1998) also argue that, for the internalization to occur, the parents must first attempt to transfer the partner's skill-related knowledge from the JV to themselves.

Past studies on learning through alliance have affirmed two main factors that affect knowledge acquisition in an alliance by the partner (Inkpen, 1998, 2000). According to Inkpen (1998, 2000), the accessibility of knowledge and the firm's effectiveness at learning are the two critical factors that influence knowledge acquisition and learning in an alliance. The accessibility to alliance knowledge mainly depends on knowledge tacitness and partner protectiveness (Inkpen, 1998). Knowledge tacitness limits knowledge accessibility when knowledge, which is embedded in personal beliefs, experiences and values, is hard to formalize, not easily visible and difficult to be communicated and shared (Inkpen, 2000). Partner protectiveness inhibits alliance knowledge acquisition when a high competitive overlap exist between the partners, the transferring firms in the alliance will be reluctant to share or transfer knowledge because of the risk of knowledge spillover to the learning partner (Inkpen, 1998). Huber's (1991) work on organizational learning provides a useful framework in understanding how knowledge is acquired and transferred by organizations in the inter-firm relationship. Consistent with Huber (1991), Bapuji and Crossan (2004) suggest that external learning by the organization occurs in the form of congenital learning (where a new firm learns from the past experience of other firm in the industry), vicarious learning (firms learning from the experience of other firms), and inter-organizational learning. They argue that in the inter-organizational learning organizational learning occurs through vicarious learning for example when organizations interact with each other in alliances or joint ventures. Several studies on technology transfer have suggested that organizational learning perspective provides much needed rigor in the conceptualization of the technology transfer process in term of its depth and breadth. Daghfous (2004) views organizational learning literature as necessary and a complementary component of the complete view of 1) technology transfer as a learning process; and 2) technology-recipient organizations as learning system (Levin, 1993; Daghfous, 2004; Bapuji and Crossan, 2004).

## 9. Conclusion

Based on the above theories and perspectives underpinning intra and inter-firm technology transfer; which are gathered from various literatures, the area of technology transfer is wide and dynamic (Sazali and Raduan, 2011). The numbers of literatures on the subject are voluminous, extensive and varied in perspectives (Kumar et al., 1999; Zhao and Reisman, 1992). A strong understanding on the theories underlying technology transfer is necessary to enable the interested parties (such as private sectors, government departments, academics, researchers and students) to relate with the practical and empirical aspects of various technology transfer models, mechanism, issues and challenges. This review could help to stimulate and generate ideas for future researchers to further identify, conceptualize and understand the underlying theories and perspectives which strongly influence the previous, current, and future technology transfer's models and framework.

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