# KNOWLEDGE TRANSFER MANAGEMENT: STUDYING THE ACTUAL PROCESS

Giannis Tselekidis[a]
Apostolos Rafailidis[b]

[a]Department of Business Administration,
University of Patras, Greece
tselekid@in.gr

[b]Department of Business Planning and Information Systems,
Technological Education Institute of Patras, Greece
arafail@ath.forthnet.gr

**Session I-4**

## Abstract

Intangible components like knowledge, technological capabilities and skills, constitute a major determinant of a firm's competitiveness and can be viewed as production factors. While keeping – up in technological capabilities presents a challenge for any firm, in cases of firms that are technologically less developed this lack of capabilities presents a major problem. When self – sufficient development of capabilities is not enough to keep – up or catch – up with the competition, firms have to resort to external technology. A main characteristic of technology is that it is based on knowledge. The latter, however, is notoriously hard to transfer; rather, knowledge is a result of learning. This paper empirically studies variables that enhance the probability for successful technological learning through cooperation of Greek firms with foreign partners.

**Keywords:** technology, transfer, knowledge, capabilities, Greece.

# Knowledge Transfer Management: studying the actual process

Tselekidis Giannis[a]
Rafailidis Apostolos[b]

[a]Department of Business Administration
University of Patras, Greece
tselekid@in.gr
[b]Department of Business Planning and Information Systems
Technological Education Institute of Patras, Greece
arafail@ath.forthnet.gr

## Abstract

Intangible components like knowledge, technological capabilities and skills, constitute a major determinant of a firm's competitiveness and can be viewed as production factors. While keeping – up in technological capabilities presents a challenge for any firm, in cases of firms that are technologically less developed this lack of capabilities presents a major problem. When self – sufficient development of capabilities is not enough to keep – up or catch – up with the competition, firms have to resort to external technology. A main characteristic of technology is that it is based on knowledge. The latter, however, is notoriously hard to transfer; rather, knowledge is a result of learning. This paper empirically studies variables that enhance the probability for successful technological learning through cooperation of Greek firms with foreign partners.

**Keywords:** technology; transfer; knowledge; capabilities; Greece

## 1. Introduction

Nowadays, firms' long – term competitiveness is believed to be mainly based on intangible components like knowledge, technological capabilities and skills. This led to the theoretical discussions on knowledge – based economies. In order to create this knowledge, that will eventually be transformed into new products and services, firms have internationally began to form increasing numbers of knowledge-based strategic

alliances, thus creating a new form of competition; competition between constellations of firms.

Nevertheless, the creation and transfer of knowledge and best practice through inter – firm cooperation have proven to be quite difficult. Knowledge transfer is neither an easy nor a costless task. Unlike information, capabilities and knowledge simply cannot be bought in market, arms' – length, transactions. Instead, they have to be gradually built through strenuous and systematic learning efforts.

The issue of knowledge management and knowledge transfer is all the more important for firms lacking, or lagging behind, in technological capabilities; firms that have to rely more on extra – firm knowledge sources. Thus, there emerges the question of how firms with no particularly strong technological capabilities can manage knowledge transfer, in the context of newly industrializing countries. Is there a best practice process that can contribute to the ultimate goal, on the part of such firms, which is the maximum possible improvement of their technological capabilities?

For the technology – receiving firms, the technology (and knowledge) transfer cooperation arrangement usually takes place in the context of a broader investment plan undertaken on their part. This investment plan normally incorporates the goal of introducing a new product, or a new production process. What frequently escapes the attention of firms is that this form of investment (in technology transfer) creates two kinds of flows. On the one hand, there is the physical flow of technology, as incorporated in the new product or production process. On the other hand, there is also the intangible flow of new knowledge, skills and capabilities. Firms very frequently tend to place emphasis upon planning and implementing the physical aspects of their cooperation arrangements. However, it is these precisely intangible aspects of knowledge transfer that can, in our view, be the most important.

Thus, in this paper it is argued that in technology transfer cooperation arrangements, explicit emphasis for the maximisation of these intangible knowledge flows can have a greater overall positive impact on the part of the technology – receiving firm. More specifically, the creation of a technology transfer cooperation arrangement can be seen as a process that can be broken down in closely related stages or phases. Here, this process is distinguished in two separate phases. The first is the phase that precedes the creation of the cooperative arrangement (the pre – formation phase). This phase is about the motives that drive the firm to cooperate, the firm's partner selection criteria and, finally, the partner search procedure. The second phase is about the formation and implementation of the arrangement. It concerns the kind of knowledge being transferred, the actual transfer mechanisms, the duration of the arrangement and,

finally, the kind of management required on the part of the recipient for better assimilating new knowledge.

An important remark regarding the whole knowledge transfer process is that the planning and implementation of the first phase will have a major bearing in the outcome that can be achieved during the second. The authors believe, for example, that the motives of the recipient will determine their partner selection criteria, which in turn will determine the profile and characteristics of the desired partner. The kind of partner eventually selected will in turn greatly determine the kind of knowledge that will be acquired, the kind of relationship between partners, as well as the rate at which the recipient will improve their technological capabilities. Empirical evidence is presented, in the form of several in – depth case studies, which seems to strongly support the above line of thought.

The empirical evidence presented suggests that the theoretical model used is a valid one. Thus, it seems that there is indeed a clear need for a detailed and explicit planning of the transfer, assimilation and in – house improvement of the most complex and critical asset that a firm can possess and manage: knowledge.

This submission is expected to add to the theoretical development of the field in the following ways. First, this is a longitudinal study covering two distinct phases of the inter – firm knowledge transfer process. This presents the opportunity to study the technological and knowledge level of firms (along with their goals and expectations) before they entered a transfer agreement, with their actual achievements during the transfer process. This allows for a clear identification of cause and effect, and presents insights into the actual knowledge transfer process. Second, this study specifically concerns knowledge transfer flows between firms of different technological capabilities and levels. That is, the study is about knowledge flows from technologically more advanced to technologically less advanced firms. The implications, however, are wider and have a bearing on any firm planning to transfer and assimilate knowledge. It is believed this is a major issue, as knowledge is widely accepted to present increasing returns. Firms or countries that will continue to rely on natural resources, labor and financial capital will remain limited by the economic laws of diminishing returns. Such firms or countries will see cost rise and prices decline. Such factors will manifest themselves as ever – declining productivity compared to firms and countries investing in the creation and management of knowledge.

Third, the study can be potentially applied in an organizational setting, as it provides several guidelines concerning (a) the firm motives that usually lead to successful learning, (b) the setting of knowledge transfer goals and expectations, (c) the partner

selection criteria and (d) the nature, content and mechanisms the transfer process should present, so as to enhance the probability for successful learning.

The paper is structured the following way. In section 2 the pre – formation stage of cooperation is studied, and divided in two sub – sections: one presenting the motives for cooperation and the second studying the partner selection criteria and the search process. Section 3 deals with the formation and implementation stage of a cooperation agreement and is divided in three subsections: one studying knowledge and the content of knowledge transferred, the second regarding issues of cross – functional learning and transfer of knowledge and the third regarding issues of the association between the duration of cooperation and the transfer of knowledge. In Section 4 the research methodology is presented, again divided in two sub – sections: the first sub – section present the sample and variables used, while the second is the actual presentation of the results. The 5$^{th}$ and last Section contains the conclusions.

## 2. Pre – Formation Stage

### 2.1 Motives for Cooperation

There exist a variety of motives for firms to enter a cooperation agreement, the most common of which shall be mentioned here. Meyer et al. (1985) suggest that expectation of increased revenue through the production of a new product, made possible through a cooperation agreement, is an important factor inducing firms to enter technological cooperation. When this product is protected by patents, the prospective revenues stemming from this “territorial monopoly” can be a very important factor indeed (McDonald et al., 1985).

Other motives for entering a technology transfer cooperation agreement are quick access to a new technology, the lower cost for developing a new product, as well as the lower cost for introducing the product to the market (Teece, 1988; Lowe and Crawford, 1983). Despite the fact that technology transfer can be quite expensive (Teece, 1977), this cost is usually lower than having to develop a product in – house. In addition, there is no technological or commercial risk, since a completed product is usually also tested in the markets of the technology supplying firm (Shahrokhi, 1987). Moreover, through technological cooperation the technology recipient can: (a) fill possible gaps in their line of products, (b) quickly respond to moves and offerings of competitors (Patsalos – Fox, 1983) and (c) exploit possible spare capacity (Lowe and Crawford, 1983).

The last, but by no means least, reason for cooperating is the potential for gaining access to the knowledge and capabilities of the partner and thus increasing the possibility of achieving organizational learning (Hamel, 1991; Kogut, 1988; Khanna et al, 1998; Wathne et al, 1996; Rivera et al, 2001).

As far as knowledge transfer and creation is concerned, these motives can be classified in two categories: (a) cooperation seen as a mechanism for substituting missing knowledge that can not be created internally and (b) cooperation seen as a laboratory for learning on a spectrum of technological issues (Vicari et al., 1996). In the first case, knowledge creation / acquisition is not top priority for the receiving firm that can accept continuing technological dependence on the partner. In the second case, knowledge is of strategic importance to the firm that pursues its internalization through learning. The firm's goal is the development of its own technological capabilities and, ultimately, the improvement of its competitive position (Inkpen, 2000).

A firm's motives for cooperation are very important, as they will greatly determine the kind of relationship that will be developed with the partner, as well as its evolution and final outcome (Nielsen, 2003). For example, when entering a cooperation agreement, the motives of a firm aiming at exploiting surplus capacity will be quite different from those of a firm aiming at widening the breadth and depth of firm knowledge and competences. Since the present paper is focused on technological learning and knowledge transfer through inter – firm cooperation:

*H1: The more a firm aims at gaining knowledge and competences through cooperation, the more probable it is for the firm to (a) find a partner that will provide these and, (b) actually achieve learning*.

## 2.2 Partner Selection Criteria and Search Process

Once a firm manages to clearly define its motives for seeking and entering a cooperative arrangement, the next step to be taken is the formulation of partner selection criteria. A large percentage of cooperative arrangements fails to realize expected results because of the, sometimes hasty, partner selection process. Prior research has shown the importance of partner selection for the viability of cooperation (Dodgson, 1992). The choice of the right partner can yield important benefits, whereas failure to do so can entail considerable cost in time and money.

Hakanson and Lorange (1991) have found that compatible organizational cultures, which they view as encompassing similar perception of the environment and organizational value systems, are important. In addition, the partner's willingness and ability to supply technical, managerial and other resources are also found to be

important (Forrest and Martin, 1992). Furthermore, Bailey et al. (1998) suggest that besides having the required technical capabilities, the speed with which a partner can fulfill their contractual obligations (in this paper's case, technology transfer) is an especially important factor for the partner selection process.

A factor that is especially important for firms in technologically less developed countries that are also probably lacking financial resources, is the cost associated with cooperation and technology transfer (Hitt et al., 2000). For example, in the case of technology licensing there is transaction cost relating to lump sum and or royalty payments, travels, negotiations e.t.c. (Ford, 1985). In cases of such firms, then, cost is a factor that can prove important for the selection of a particular partner instead of another.

Geringer (1988) found that important factors in the partner selection process is also a firm's cooperative experience, its size and structure, the knowledge the firm possesses and the access to markets it enjoys, the partner's national culture, technical know – how, financial assets and managerial experience. Al – Khalifa and Pererson (1999) empirically found that crucial partner related critera in their sample of international joint ventures were the partner's reputation, experience, knowledge, as well as the personal qualities of the executive officer.

Finally, Hitt et al. (2000) and Dacin et al. (1997) found that an especially important factor for the selection of a particular partner is their willingness to share expertise. As the authors suggest, selection of a partner possessing strong managerial and technical capabilities is a necessary but not sufficient condition for successful knowledge transfer. In addition to being technologically competent, the partner also has to be willing to share. A similar remark was made by Scott – Kemmis and Bell (1985), who studied technological cooperation between UK and Indian firms. They found that a reason for the limited success of knowledge transfer was the emphasis put by Indian firms on the financial aspects of the cooperation, instead of evaluating the potential partner's willingness to share knowledge and help with the development of the recipient's technological capabilities.

As seen from the literature, then, the partner selection criteria are many and diverse. The desired cooperation partner's profile is to a large degree determined by the emphasis a firm will put on each of those. Thus it is assumed that:

*H2: The more emphasis a firm puts on finding a partner technologically capable and willing to share knowledge and know – how, the more probable it is that the firm will eventually find a partner that will provide these competencies. Thus, successful learning also becomes more probable.*

Furthermore, the importance of the process of identification of the potentially most suitable type of partner has been stressed by several authors (Dacin et al, 1997; Dodgson, 1992). “Finding the right partner requires careful screening and can be a time – consuming process. Developing an understanding of partner’s expectations and objectives can also take time. However, many alliances are formed by chance meetings, or through previous experience with the partner” (Dacin et al, 1997:4). Whenever the goal of the cooperation is the transfer and subsequent development of the technological capabilities of the recipient, a long – term cooperative relationship is crucial, as is the shaping of conditions that facilitate efficient communication, encourage the building of trust and of a shared language (Dodgson, 1992).

All the remarks and findings mentioned point towards the same direction: a firm pursuing the development of their technological capabilities should plan for an active partner search process. Active here means taking initiative for the search of the suitable partner. Such a process can increase the chances for eventually finding a partner that meets the company’s criteria (Hart and Diamantopoulos, 1992).

Firstly, the desired partner’s profile is determined by the significance attributed to each selection criterion; this is actually a potential partner pre – selection process that greatly helps the actual subsequent partner selection. Secondly, the identification of potentially suitable partners can be useful in the pre – negotiation and partner evaluation stages. In other words, since the criteria for the selection of potential partners have been set (and the necessary data collected), the firm can contact the firms in the list of potential partners.

However, gathering information and creating a list of potential partners is not enough. The firm will have to contact as many of these potential partners as possible, face to face when feasible. This contact is especially important in cases where the firm seeks to build cooperation in order to transfer complex and firm – specific knowledge. At this stage, which can be characterized as a preliminary negotiation, the potential partners will have the opportunity to set forth their respective goals, expectations and demands. Thus, it is assumed that:

*H3: The more potential partners a firm contacts, the more probable it is that the firm will eventually find a partner that will suit the desired partner profile best. Thus, successful learning also becomes more probable.*

## 3. Formation and Implementation Stage

### 3.1 Knowledge and the Content of Knowledge Transferred

A firm wishing to use a technological cooperation in order to improve its own technological capabilities is bound to try to transfer and assimilate as much useful knowledge as possible.

Even though the two last decades have seen a dramatic increase in the number of cooperation agreements, many of these fail to accomplish their set goals (Park and Russo, 1996; Harrigan, 1988). One of the main reasons for this failure rate, if not the most important, is the great difficulty of inter – organizational knowledge transfer (Szulanski, 1996; Inkpen, 1998;). Knowledge transfer is even more complicated when the cooperation involves partners with very dissimilar initial levels of technological capabilities and / or coming from countries with dissimilar levels of such capabilities (Freeman and Hagedoorn, 1994).

In order to comprehend where the problem lies, one has to examine knowledge itself. Facets of knowledge are uniquely interpreted by researchers and practicioners. For example, information and knowledge are sometimes taken as identical concepts. In reality, they are not. More generally, one needs to distinguish between data, information and knowledge. Data are what come directly from sensors or other sources, reporting on the measured level of some variable. Information is structured data that is placed in a context (Bohn, 1994). Hence, information is generated only after an appropriate processing of the data. Loosely speaking, data can be viewed as “raw material” that needs further processing before it can acquire meaning and added value. Knowledge is different in that is is the element that allows “distinction making and distinctions, in turn, enable the development of new knowledge” (Von Krogh, 1996:423). The only way to gain knowledge is to create own experience in a specific field, through practice.

Thus, acquiring knowledge requires action and practice. In turn, knowledge will allow the creation of new distinctions and enable the development of new knowledge. A person can be said to have knowledge of a specific field not when they possess data and information, but when they are able to predict, to detect causal associations and to make decisions based on their existing beliefs and underlying theories (Tselekidis et al, 2003).

Moreover, many researchers and practitioners classify knowledge in two basic categories, explicit and tacit. Some of these researchers believe that tacit knowledge can be transformed into explicit (Nonaka and Takeuchi, 1995), but this argument has convincingly been refuted by others who believe that the two kinds of knowledge are

actually two sides of the same coin (Tsoukas and Vladimirou, 2001; Cook and Brown, 1999; Von Krogh and Grand, 2002).

A less widespread classification is the one distinguishing knowledge in three categories: (a) know – what (what a technology or system can be used for, or the description of something), (b) know – how (how a technology or system is built or used) and, (c) know – why (the underlying principles and mechanisms behind a technology's or system's function) (Garud, 1997). Essentially, this classification is complementary to the distinction between explicit and tacit knowledge and refers to three different levels of knowledge. Each level comprises of explicit and tacit knowledge. For example, know – how on the operation of a machine encompasses a tacit and explicit component. In consequence, also with this classification a necessary condition for improving one's own technological capabilities is practice and experience.

How is this part on knowledge related to the efforts of technologically less developed firms for knowledge and capabilities transfer? This question can be answered with the help of Bell and Pavitt (1993) who found that the main problem in technology transfer to firms coming from technologically less developed countries was that, even when technology was successfully transferred, local firms were very rarely able to adapt and improve it, and eventually innovate on the base of it. A basic cause of this weakness was the kind of knowledge and capabilities that the recipient firms created. More specifically, the researchers distinguish between production capacity and technological capabilities. The former refers to the capability of a firm to efficiently produce, while the latter refer to the capability to develop technological improvements and innovate.

In addition, Scott – Kemmis and Bell (1985) argue that technology as a term is normally used to embody quite different things. It is methodologically useful to distinguish between three components of technology. First, there are the technical services and capital goods necessary to operate the technology transferred. Second, there are the know – how and operating skills, that include information on specifications and procedures, as well as skills and knowledge required so as to use information extracted from the production processes. Know – how and skills may actually concern a spectrum of production functions (such as products, processes, raw materials, etc.). The relevant information is codified in manuals and documentation, while skills and knowledge are transferred through training. Finally, third, there is the knowledge required to pursuit and achieve technological change. This component of technology includes knowledge and experience that range beyond what is required for normal everyday production and it contributes to the successful development and improvement of the initial product or production process. To achieve this improvement the firm needs

to possess the knowledge and have a clear understanding of the underlying principles (know – why) regarding the product or process, as well as the experience and skills required for implementing these principles for the planning and realization of technological change.

Continuing with the research of Scott – Kemmis and Bell, in most cases of technological cooperation between British and Indian firms the latter were not able to create capabilities that would enable them to locally improve upon the technology transferred. This was because the training offered and the content of knowledge transferred did not go beyond the level of know – how transfer, that is, the lowest level possible for the simple operation of the technology. In many cases technology transfer was limited to manuals, documentation and blueprints all of which, on the basis of the distinctions made earlier, can be characterized as information and not knowledge. In addition, training usually only concerned one or two individuals who were sent to the United Kingdom for a limited time – span, while the training itself was limited to the very confined framework of standard operating procedures. This kind of training process and transfer practice resulted only in the assimilation (interiorization) of the functioning of the production process, that is, only production capacity was created.

What would have been actually required for developing design skills and capabilities (know – why) that would allow the improvement of existing products and production processes? Individuals from the recipient firms reported that “Good design capabilities require specialized knowledge and great experience. Probably the best means of transferring this knowledge would be to have a number of U.K. engineers spend an extended period in India…beyond a certain point, they can only accumulate design expertise by doing design. We could continue to help by commenting on their planned developments” (Scott – Kemmis and Bell, 1985: p.1995). Thus, in order to create such skills and capabilities it is extremely important to acquire knowledge through direct experience on design activities, through strong connections between staff of the technology recipient and the supplier.

A similar remark was made by Inkpen in his empirical studies on cooperation between U.S. and Japanese firms: “When the American firms formed alliances with an objective of learning from their Japanese partners, the learning expectations revolved around “what” the Japanese knew, rather than “how” and “why” the Japanese firm knew what they knew” (Inkpen, 1998:226).

Concluding, in order to acquire new production capacity (know – how) and / or technological capabilities (know – why) there is need for information and explicit knowledge transfer, but also for own action and practice so as to develop knowledge

(distinction – making) and capabilities. What differs between acquiring know – how and know – why is the level of complexity (breadth and depth) of the knowledge required. Thus, it is assumed that:

*H4: The greater the depth and breadth of knowledge transferred from the transferor to the recipient through practice-action, the more probable it is for the latter to improve upon their existing technological capabilities.*

### 3.2 Cross – functional Learning and Transfer of Knowledge

In the literature studying innovation and the development of organizational capabilities, it is widely held that cross – functional teams are very effective and creative in their effort to develop new products. This is because such teams have better capabilities to assemble and integrate information coming from all over the firm, as well as from outside the firm. For example, Wong et al. (1998) in their empirical study on factors that helped Taiwanese firms assimilate technology through technological cooperation agreements found that the firms that created and deployed cross – functional and / or multidisciplinary teams managed to better develop their technological capabilities than firms that did not form such teams.

Another factor that amplifies the importance of cross – functional and/or multidisciplinary teams is the existence of collective knowledge. This is knowledge created by, and embedded in, teams of individuals. Collective knowledge is by definition tacit (Spender, 1996; Cook and Brown, 1999) and lies behind and successful organizational efforts for innovation and technological change. Thus, effective transfer of capabilities from the technology supplier to the recipient also requires the transfer of collective knowledge, a very demanding undertaking.

Whatsmore, the introduction of a new technology or practice usually also requires changes in the firm's existing organizational and managerial structure. Thus, it is assumed that:

*H5: The transfer of knowledge involving cross – functional and / or multidisciplinary teams increases the probability for successful assimilation of knowledge required to improve the technological capabilities of the recipient.*

### 3.3 Duration of Cooperation

Substantial knowledge transfer and assimilation of knowledge and skills from the recipient requires a long – term relationship between partners, frequent communication and familiarization. These allow the establishment of good working relationships and

the creation of trust and a common communication language, which all help the enhancement and/or creation of recipient's technological capabilities. Marcotte and Niosi (2000), studying technological cooperation between Canadian and Chinese firms, found that even in cases both partners pursued the creation of real technological capabilities within Chinese firms, this took quite a long time. In other words, the process of technological capabilities and skills development is evolutionary and there are no shortcuts.

Similarly, Lane et al. (2001) studied a number of international joint ventures created in Hungary in two separate time periods. They found that the more complex and socially embedded forms of knowledge and capabilities such as managerial and new product development capabilities were transferred and assimilated during the second time period, while training and close connections with the foreign partners were continuous and of crucial importance for the duration of cooperation. Thus, it is assumed that:

*H6: The greater the duration of a relationship, the greater the probability of transferring knowledge so wide and deep, so as to enhance the technological capabilities of the recipient.*

## 4. Research Methodology

### 4.1 Sample Data and Variables Description

The data used in the sample of the empirical research were drawn from the Ministry for National Economy of Greece, where the authors found that technological cooperation contracts signed between Greek and foreign firms are kept. Unfortunately, only contracts up to the year 1992 could be found. This is due to the fact that up to 1992 all firms wishing to transfer technology through licensing had to report this transaction to the Ministry, for purposes of foreign exchange outflows control. In 1992 the flow of capital and exchange was liberated and no such data were kept since. The contracts that were studies were signed between 1985 and 1992.

For the purposes of this paper, from the total of 169 firms (the technology transfer contracts of which were thoroughly studied), a sample of 62 firms (37% of the total) was selected. The cases that were excluded concerned: (a) relationships between parent and subsidiary firms, (b) public firms, because of their monopolistic nature and because they operate under an idiosyncratic logic that has led their profitability to plummet and (c) firms for which no data could be found (essentially, firms that changed name or merged, or firms that went under).

From this initial sample, 20 firms were visited for interviews with personnel that had played a part in the technology transfer process. This way the authors had the opportunity to perform a reality check of the variables that were formed with the use of the literature, and to add or modify some on the basis of remarks of personnel with hands – on experience in the whole transfer process.

The interviews took 2 to 4 hours, while the respondents answered open – ended questions. Not all firms had more than one cooperation cases. When there were more cases of cooperation per firm, the respondents were asked to describe the one international technological cooperation case that was the most successful for their firm, in terms of total benefits and technological capabilities created.

After analyzing the open – ended questions, a questionnaire with closed questions was sent to the same set of 20 firms. The previous contact with the firms and their contribution to the laying – out of the questionnaire helped iron out most chances for misinterpretation. This process concluded the first part of the research, and is presented here. For the next part, the authors plan to increase the sample size, so as to obtain more robust results and have more freedom as to the choice of statistical method to be used.

For the statistical analysis the non – parametric tests of Mann – Whitney U and of Kolmogorov – Smirnov were used. This choice was due to the fact of the small number of observations available that increased the probability of violating some of the assumptions for using parametric techniques. Mann – Whitney U test is suitable for ordinal variables and was used accordingly, while for the continuous variables Kolmogorov – Smirnov was used.

Regarding the variables, the one related to the motives for cooperation and the one related to partner selection criteria were in a 5 – point Likert scale (1: not true, 5: very much so). These variables are presented in the first two tables that contain the statistical results and thus do not need to be described here. For the third variable, on how active the partner search process was, the respondents were asked to state the number of potential partners the contacted before working out the final agreement with one of them.

These three were used as test variables for the testing of the first three hypotheses. The grouping variable was the degree to which staff from the recipient was trained in the fields of maintenance of technology and quality control, product and process design, product and process R&D. Again, the 5 – point Likert scale was used (1: not true, 5: very much so). Internal consistency of the indicators was satisfactory (Cronbach Alpha: 0.73).

The grouping variable of the first three hypotheses was used for the testing of the fourth hypothesis, while the grouping variable for the fourth hypothesis (as well as for the two that follow) was the degree to which the recipient developed their technological capabilities. Respondents were asked to rate, on a 5 – point Likert scale, four measures: (a) the degree to which they had acquired knowledge that generally caused them to develop new insights, (b) the degree to which the cooperation enabled them to perform new tasks as a result of the generation of new knowledge – perceptions, (c) the degree to which they developed capabilities that allowed them to improve upon the technology transferred and, finally, (d) the degree to whish the cooperation allowed the recipient to autonomously develop product or process innovation. Internal consistency was again satisfactory (Cronbach Alpha: 0.79).

The test variable for the fifth hypothesis was one that was formulated from the responses on four measures: the degree to which the recipient's (a) management, (b) marketing, (c) manufacturing and, (d) R&D staff were involved in the transfer process. Again, the 5 – point Likert scale was used and internal consistency was satisfactory (Cronbach Alpha: 0.72).

Finally, the test variable for the sixth hypothesis was one in which the respondents had to state the duration (in years) of training of the recipient's staff by the supplier. It was also possible to find whether this training was one – off or continuous, or whether it took place at different points in time.

### 4.2 Empirical Results

Table 1 presents the results of the Mann – Whitney U test regarding the relationship between recipient's motives to create a cooperation agreement and the degree to which the technology supplier aids the former to develop their technological capabilities. Statistically significant variables, with a positive sign, are the degree to which the recipient has future access to future technological know – how (variable 4), the upgrading of the recipient's technological capabilities (variable 8) and the recipient's efforts to keep – up with competition (variable 11).

All these motives are more or less related to the intent and efforts of the recipients to acquire knowledge and capabilities in the face of competitive pressure. It is worth noting that the strongest motive appears to be that of upgrading one's own technological capabilities. Thus, the first hypothesis *H1* is accepted.

**Table 1** Motives for Cooperation

| | Grouping Variable[a] | Mean Rank | Asymp. Sig. (2-tailed) | Exact Sig. (2-tailed) |
|---|---|---|---|---|
| (1) use of excess production capacity | .00 | 9.68 | .127 | .140 |
| | 1.00 | 12.42 | | |
| (2) low cost of technology | .00 | 11.57 | .189 | .217 |
| | 1.00 | 8.00 | | |
| (3) tried and tested product / production process | .00 | 12.00 | .076 | .082 |
| | 1.00 | 7.00 | | |
| (4) future access to technology and know – how | .00 | 8.46 | .016 | .017 |
| | 1.00 | 15.25 | | |
| (5) access to supplier's patents | .00 | 11.43 | .236 | .269 |
| | 1.00 | 8.33 | | |
| (6) saving own resources by not developing technology in – house | .00 | 11.11 | .458 | .549 |
| | 1.00 | 9.08 | | |
| (7) quick acquisition of advanced knowledge | .00 | 11.54 | .213 | .229 |
| | 1.00 | 8.08 | | |
| (8) upgrading of technological capabilities | .00 | 8.36 | .012 | .011 |
| | 1.00 | 15.50 | | |
| (9) increasing sales and market share | .00 | 10.75 | .746 | .811 |
| | 1.00 | 9.92 | | |
| (10) securing a geographically defined market | .00 | 10.75 | .760 | .773 |
| | 1.00 | 9.92 | | |
| (11) keeping – up with the competition | .00 | 8.68 | .028 | .039 |
| | 1.00 | 14.75 | | |
| (12) acquisition of competitive advantage | .00 | 9.68 | .325 | .291 |
| | 1.00 | 12.42 | | |
| (13) increase of the range of products offerred | .00 | 10.43 | .928 | .973 |
| | 1.00 | 10.67 | | |
| (14) quick return on investment | .00 | 12.64 | .010 | .009 |
| | 1.00 | 5.50 | | |
| (15) speed of entry to a market | .00 | 11.32 | .308 | .361 |
| | 1.00 | 8.58 | | |

a: training fields provided by the technology supplier

Table 2 presents the results of the Mann – Whitney U test regarding the relationship between partner selection criteria and the degree to which the technology supplier aids the former to develop their technological capabilities.

**Table 2** Partner Selection Criteria

| | Grouping Variable[a] | Mean Rank | Asymp. Sig. (2-tailed) | Exact Sig. (2-tailed) |
|---|---|---|---|---|
| (1) high technological capabilities | .00 | 9.43 | .199 | .227 |
| | 1.00 | 13.00 | | |
| (2) common goals | .00 | 9.64 | .284 | .377 |
| | 1.00 | 12.50 | | |
| (3) common culture | .00 | 10.00 | .524 | .575 |
| | 1.00 | 11.67 | | |
| (4) speed of transfer and development of know – how | .00 | 10.96 | .579 | .613 |
| | 1.00 | 9.42 | | |
| (5) supplier's strategic marker position | .00 | 9.50 | .228 | .279 |
| | 1.00 | 12.83 | | |
| (6) supplier's low financial demands | .00 | 12.29 | .033 | .038 |
| | 1.00 | 6.33 | | |
| (7) willingness to offer access to future improvements of technology | .00 | 9.07 | .088 | .095 |
| | 1.00 | 13.83 | | |
| (8) supplier's international reputation | .00 | 11.79 | .119 | .120 |
| | 1.00 | 7.50 | | |
| (9) supplier's experience in technology transfer | .00 | 10.21 | .728 | .776 |
| | 1.00 | 11.17 | | |
| (10) willingness to share know – how | .00 | 8.64 | .026 | .029 |
| | 1.00 | 14.83 | | |
| (11) willingness to cooperate and share on issues beyond those of the agreement | .00 | 8.64 | .024 | .029 |
| | 1.00 | 14.83 | | |

[a] training fields provided by the technology supplier

Statistically significant variables, with a positive sign, are the willingness of the supplier to reveal and transfer knowledge to the recipient (variable 10), the potential for recipient's access to future improvements to the technology brought by the supplier (variable 7) and supplier's willingness for close cooperation on a range of issues beyond those strictly specified in the agreement (variable 11). These criteria can be said to be related, or driven, by the corresponding motives for entering a particular cooperation, while the results confirm the second hypothesis *H2*.

Table 3 contains the results of the Kolmogorov – Smirnov Z test and show a statistically significant (using exact significance) relationship between the degree to which the recipient pursued an active search process before selecting a particular partner and the degree to which they actually got support and help. However, the relationship is not significant using asymptotic significance. By taking into account the small sample of firms, it is believed that exact significance in this case better captures the total picture. Thus, the third hypothesis *H3* appears to be also confirmed.

**Table 3** Active Partner Search

| | Kolmogorov-Smirnov Z | Asymp. Sig. (2-tailed) | Exact Sig. (2-tailed) |
|---|---|---|---|
| Number of contacts with potential technology suppliers | 1.122 | .161 | .062 |

Grouping Variable: training fields provided by the technology supplier

The last three hypotheses are checked in Table 4, again with the use of the Kolmogorov – Smirnov Z test. As shown, the breadth of training provided by the supplier, the involvement of cross – functional teams in the transfer process, as well as the duration of cooperation in training all contribute statistically significantly in the development of the recipient's technological capabilities.

**Table 4** Degree to which the Recipient's Technological Capabilities were Developed[a]

| | Kolmogorov-Smirnov Z | Asymp. Sig. (2-tailed) | Exact Sig. (2-tailed) |
|---|---|---|---|
| (1) number and fields of training provided by the supplier | 1.528 | .019 | .005 |
| (2) cross – functional teams involved and knowledge tranferred | 1.236 | .094 | .031 |
| (3) duration of cooperation and of training | 1.326 | .059 | .024 |

[a]Grouping Variable: Degree to which the recipient's technological capabilities were developed

## 5. Conclusions

The purpose of this paper has been to empirically investigate the creation of technological cooperation between firms lacking in technological capabilities and aiming at the transfer of technology from their technology – supplying partner.

A main conclusion that can be drawn from the findings is that the development of technological capabilities through inter – firm cooperation can be fruitful as a supplement of intra – firm efforts (Tselekidis et al., 2003). However, the transfer process has to be dealt with in an integrated way. This is because each stage of the process has an effect on the next, and each and every stage partially determines the final outcome.

Consequently, a firm aiming at developing their knowledge and technological capabilities has to take a thoughtful and integrated approach to the transfer process. The latter is extremely complicated and evolutionary in nature, requiring hands – on approach and strong connections between the cooperating partners.

The results of the empirical research should be treated with caution because of the limitations that follow. Firstly, the size of the sample was small and this presented considerable difficulties in the ways the data could be used and also adversely affects the robustness of the results. Secondly, all firms of the sample were not of the same size, neither did they belong to the same industry. Thus, the resources that they possessed as well and those that they needed may have been quite diverse and this might affect their cooperation aims and processes.

Future research could focus on addressing these limitations by increasing sample size and attempting to make it more homogenous. The authors are working towards these directions. Finally, perhaps structural equation modeling is the most suitable way to approach and statistically analyze a model as the one that was presented here.

## References


Bailey, W.J., Masson, R. & Raeside, R. (1998). Choosing successful Technology Development Partners: A Best Practice Model. *International Journal of Technology Management* 15(1/2): 124-138

Bell, M. & Pavitt, K. (1993). Technological Accumulation and Industrial Growth: Contrasts between Developed and Developing Countries. *Industrial and Corporate Change* 2(2): 157-210

Bohn, R.E. (1994). Measuring and Managing Technological Knowledge. *Sloan Management Review* 36(1): 61-73

Cook, S.D.N. & Brown, J.S. (1999). Bridging Epistemologies: The Generative Dance between Organizational Knowledge and Organizational Knowing. *Organization Science* 10(4): 381-400

Cooper, R.G. & Kleinschmidt, E.J. (1993). Major New Products: What Distinguishes the Winners in the Chemical Industry?. *Journal of Product Innovation Management* 10: 90-111

Dacin, M.T., Hitt, M.A. & Levitas, E. (1997). Selecting Partners for Successful International Alliances: Examination of U.S. and Korean Firms. *Journal of World Business* 32(1): 3-16

Dodgson, M. (1992). The Strategic Management of R&D Collaboration. *Technology Analysis & Strategic Management* 4(3): 227-244

Don Scott-Kemis & Bell, M. (1985). Technological Dynamism and Technological Content of Collaboration: Are Indian Firms Missing Opportunities?. *Economic and Political Weekly* XX(45/46/47): 1991-2004

Ford, D. (1985). The Management and Marketing of Technology. In R. Lamb, & P. Schrivastava (Eds.), *Advances in Strategic Management*. (pp. 103-134). Vol. 3, JAI Press: Greenwich

Forrest, J.E. & Martin, M.J.C. (1992). Strategic Alliances Between Large and Research Intensive Organizations. *R&D Management* 22(1): 41-53

Freeman, C. & Hagedoorn, J. (1994). Catching Up or Failing Behind: Patterns in International Inter-firm Technology Partnering. *World Development* 22: 771-781

Garud, R. (1997). On the Distinction between Know-How, Know-Why and Know-What in Technological Systems. In J. Walsh, & A. Huff (Eds.), Advances in Strategic Management (pp. 81-101). JAI Press.

Gerringer, J.M. (1988). *Joint Venture Partner Selection: Strategies for Developed Countries.* Westport: Quorum Books.

Hakanson, L. & P. Lorange (1991). R&D based Co-operative Ventures. In L.G. Matsson and B. Styme (Eds.), *Corporate and Industry Strategies for Europe* (pp. 235-263). Amsterdam: North-Holland

Hamel, G. (1991). Competition for Competence and Inter-partner Learning within International Strategic Alliances. *Strategic Management Journal* 12: 83-104

Harrigan, K.R. (1988). Strategic Alliances and Partner Assymetries. In F. contractor and P. Lorange (Eds.), *Cooperative Strategies in International Business* (pp. 205-226). Massachusetts: Lexington.

Hart, S. & Diamantopoulos, A. (1992). Marketing Research Activity and Company Performance: Evidence from Manufacturing Industry. *European Journal of Marketing* 27(5): 54-72

Hitt, M.A., Dacin, M.T., Levitas, E., Edhec, J.-L.A. & Borza, A. (2000). Partner Selection in Emerging and Developed Market Contexts: Resource-based and Organizational Learning Perspectives. *Academy of Management Journal* 43(3): 449-467

Inkpen, A.C. (1998). Learning, Knowledge Acquisitions, and Strategic Alliances. *European Management Journal* 16(2): 223-229

Inkpen, A.C. (2000). Learning Through Joint Ventures: A Framework of Knowledge Acquisition. *Journal of Management Studies* 37(7): 1019-1043

Khanna, T., Gulati. R. & Nohria, N. (1998). The Dynamics of Learning Alliances: Competition, Cooperation and Relative Scope. *Strategic Management Journal* 19: 193-210

Kogut, B. (1988). Joint Ventures: Theoritical and Empirical Perspectives. *Strategic Management Journal* 9: 319-332

Lane, P.J., Salk, J.E. & Lyles, M.A. (2001). Absorptive Capacity, Learning and Performance in International Joint Ventures. *Strategic Management Journal* 22: 1139-1161

Lowe, J. & Crawford, N.K. (1983). New Product Development and Technology Licensing for the Small Firm. *Industrial Management and Data Systems* September-October: 26-29

Marcotte, C. & Niosi, J. (200). Technology Transfer to China: The Issues of Knowledge and Learning. *Journal of Technology Transfer* 25: 43-57

McDonald, D.W. & Leahey, H.S. (1985). Licensing has a Role in Technology Strategic Planning. *Research Management* 28 (January-February): 35-40

Meyer, T.A., Tinney, C.H. & Tinney, T.J. (1985). Guidelines for Corporate Trademark Licensing. *Journal of Product Innovation Management* 3: 196-204

Nielsen, B. (2003). An Empirical Investigation of the Drivers of International Strategic Alliances Formation. *European Management Journal* 21(3): 301-322

Nonaka, I. & Takeuchi, H. (1995). The Knowledge-Creating Company. New York: Oxford University Press

Park, S.H. & Russo, M.V. (1996). When Competition Eclipses Cooperation: an Event History Analysis of Joint Venture Failure. *Management Science* 42: 875-890

Patsalos-Fox, M. (1983). How to Buy Technology. *Management Today* December: 78-81

Rivera, M, Dussauge P, & Mitchell, W. (2001). Coordination, Creation and protection: Micromechanisms for Learning from an Alliance. Working Paper University of Michigan Business School

Shahrokhi, M. (1987). *Reverse Licensing: International Transfer of Technology to the United States*. New York, Praeger.

Spender, J-C. (1996). Making Knowledge the Basis of a Dynamic Theory of the Firm. *Strategic Management Journal* 17(Special Issue Winter): 45-62

Szulanski, G. (1996). Exploring Internal Stickiness: Impediments to the Transfer of Best Practice within the Firm. *Strategic Management Journal* 17 (Winter Special Issue): 27-43

Teece, D.J. (1988). Capturing Value from Technological Innovation: Integration, Srrategic Partnering and Licensing Decisions. *Interfaces* 18(3): 46-61

Teece, D.J. (1977). Technology Transfer by Multinational Firms: The Resource Cost of Transferring Technological Know-How. *The Economic Journal* 87: 242-261

Tselekidis, G. (2002). Technology Transfer, Technological Accumulation and Firm Economic Performance: The Case for Ellas. *Global Business & Economics Review* 4(2): 243- 260

Tselekidis, G., Peppas, P. & Williams, M-A. (2003). Belief Revision and Organizational Knowledge Dynamics. *Journal of the Operational Research Society* 54: 914-923

Tsoukas, H. & Vladimirou, E. (2001). What is Organizational Knowledge?. *Journal of Management Studies* 38(7): 973-993

Wong, V., Shaw, V. & Sher, P.J.H. (1998). Effective Organization and Management of Technology Assimilation. *Industrial Marketing Management* 27: 213-227

Vicari, S., Von Krogh, G., Roos, J. & Mahnke, U. (1996). Knowledge Creation Through Cooperative Experimentation. In G. Von Krogh and J. Roos (Eds.), *Managing Knowledge* (pp.184-202). London: SAGE Publications.

Von Krogh, G. & Grand, S. (2002). From Economic Theory Toward a Knowledge-Based Theory of the Firm: Conceptual Building Blocks. In C.W. Choo and N. Bontis (Eds.), *The Strategic Management of Intellectual Capital and Organizational Knowledge* (pp. 163-184). New York: Oxford University Press

Wathne, K, Roos, J. & Von Krogh, G. (1996). Towards a Theory of Knowledge Transfer in a Cooperative Context. In G. Von Krogh and J. Roos (Eds.), *Managing Knowledge* (pp.55-81). London: SAGE Publications.