

# The Critical Factors for the Successful Transformation of Technology from Developed to Developing Countries

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## Abstract

The importance of international technology transfer (ITT) for economic development can hardly be overstated. Both the acquirement of technology and its dissemination foster productivity growth. As invention and creation processes remain overwhelmingly the province of the OECD countries, most developing countries must rely largely on imported technologies as sources of new productive knowledge. However, considerable amounts of follow-on innovation and adaptation occur in such countries. This paper explores recent international technology transfer issues between developed and developing countries. The paper will investigate technology transfer from the perspective of innovation systems, and identify critical components for the successful transformation of technology. Based on literature, findings emphasize on the development of learning system to overcome the barriers and promote international technology transfer in the long run. The focus of this paper is to study government's technology policy and its influence on international technology transfer as well. Due to the ever changing environment of world politics and economy, there are numerous uncertainties in policy making for every country. It is not uncommon some policies cannot meet government's original requirement as they were legislated. The rapid development of high technology has made stable technology policy a difficult task. Therefore, it is necessary to study the causal factors and intrinsic relationship of issues involved.

*Keywords:* Technology transfer; barriers in technology transfer; success factors; technological competency

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## 1.0 INTRODUCTION

Technology transfer is a crucial and dynamic factor in social and economic development. Technology has been transferred intentionally or unintentionally (Pries, 2008). Sometimes, a generator of technology has acquired a competitive advantage by undertaking the dissemination of products, processes and maintenance systems (Bradbury, 1978). The two words "technology transfer" seem to convey different meanings to different people and different organisations. Technology transfer is defined in the Work Regulations of the United Nations, as the transfer of systematic knowledge for the manufacture of a product or provision of service (Yin, 2009). It has been defined in many other ways. According to Abbott (1985), it is the movement of science and technology from one group to another, such movement involving their use. Traditionally, technology transfer was conceptualised as the transfer of hardware objects, but today also often involves information (e.g. a computer software program or a new idea) that may be completely devoid of any hardware aspects (Bis, 2010). However, owing to rapid technological changes, short product life cycle and increasing global competition, acquiring new technology becomes crucial to

enable firms to develop new products more quickly (Samli, A. 1985, Cilingir, 1984). This development comes with costs and risks. Even firms with greater financial and technological capability cannot conduct independent R&D activities readily (Abeda, 2011). Thus, the ability to exploit external knowledge is a critical component of successful innovation. In addition to conducting internal R&D activities, firms can reinforce their technological competence by importing external technologies, and then diffusing, assimilating, communicating and absorbing them into their organizations (Hamel and Prahalad, 1990). The process is called technology transfer. This study compliments existing research by focusing critical components for successful technology transfer from developed to developing countries.

## 2.0 LITERATURE REVIEW

Technology transfer (TT) is usually the basis for technical innovation and often its after-effect in the form of innovation diffusion (Elijido, 2010). Innovation and TT now have a crucial role to play in modernizing the economies in transition. This, in turn, should facilitate their steps towards a knowledge-based

economy/society. External (international) and internal (domestic) transfers of technology are equally important. The development of TT processes in 1996-2005 is shown in Figure 1. The chart shows that, in a given year, international transfers show the same change (increase/decrease) in relation to the previous year as the

change in domestic transfers in the given year in relation to the previous year (Andrzej, 2009). However, the following observations can be made:

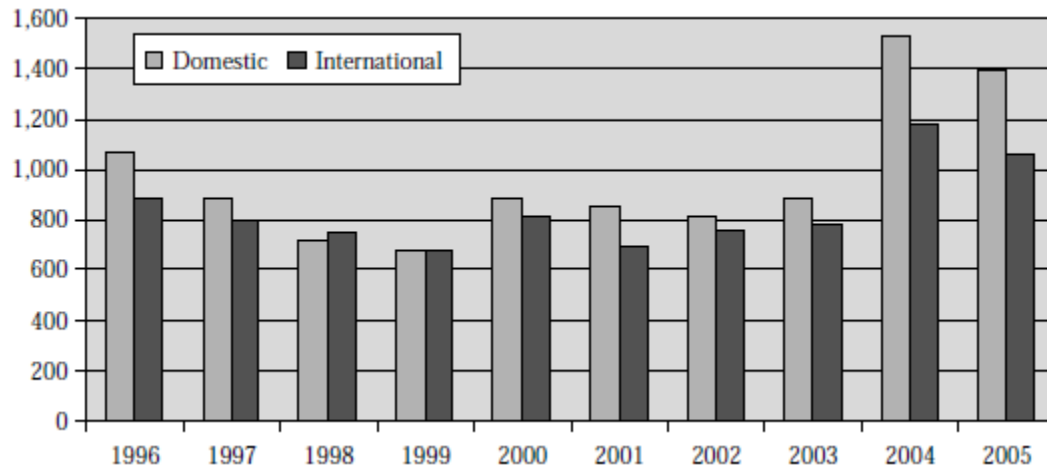


Figure 1 Development of TT processes (Source: Andrzej, 2009)

- The number of firms purchasing new technologies in the country fluctuated significantly: steady declines in 1997-1999; an increase in 2000, a decrease in 2001 and 2002; again an increase with a significant upturn in 2004, and a slight decline in the final year of the period analysed.
- The share of firms buying means of automation appears too high and the share of those purchasing domestic licences, although increasing, remains too small; this indicates a preference for embodied TT.
- Both the number and the share of companies buying results of R&D are, unfortunately, falling.
- The number of companies selling their technological achievements (in various forms) is very small, too small for evaluation.

In turn, the following conclusions can be drawn:

- The number of firms purchasing new technologies abroad showed similar fluctuations: there were three years (1997-1999) of steady decline, followed by an increase in 2000, a decrease in 2001 and three years (2002-2004) of continual growth with a considerable increase in 2004, and again a slight decline in the final year of the analysed period.
- The share of firms buying means of automation (over 50 per cent, which confirms the previous data) seems too high.
- The share of enterprises purchasing foreign R&D and licences is much too small.
- The number of firms selling their technical achievements abroad is extremely small.

Therefore, in 1996-2005, the population of enterprises participating in TT, both internally and externally, showed big fluctuations. During the latter portion of the period some improvement occurred with a significant increase in 2004. Reasons for this sudden jump are not entirely clear. No new legal

regulations were introduced in this field at that time. Data for 2006 and 2007 may confirm this positive trend.

The above findings confirm earlier observations (Jasinski, 2000):

- Polish firms show little interest in TT;
- The role of external TT is much too small;
- Polish firms are oriented to purchase rather than sell technology;
- The scale of transfers involving engineering-science achievements in a form of licenses is much too small; and
- The contribution of TT embodied in means of automation seems too high.

As results from the data, no clear improvement took place in TT processes in 1996-2005.

### ■3.0 CONSTRAINTS IN SUCCESSFUL TECHNOLOGY TRANSFER

- The fact that firms mention a lack of financing as the most significant barrier is fully understandable. This situation is largely due to a lack of partners for S&T cooperation.
- If this obvious barrier is omitted, then the most significant obstacle is the weaknesses of the R&D sector and its offer. Therefore, with a better offer from R&D units, firms would then take a more active role in TT processes.
- Although frequently blamed in the literature, firms cannot be held responsible for their passive attitudes to TTs.
- High costs as a barrier for TT can result both from large investment expenses and from high purchase prices of new technology (e.g. licensing fees).

- A lack of innovation culture as well as managerial and technical staff with the relevant skills is a very important limitation in regard to human capital. Human capital and the mobility of this capital is one key to solve the problem.
- Legal barriers also play a crucial role. However, while protection of IPRs is most emphasized as a legal barrier in HDCs, it is bureaucracy.
- One of the most significant obstacles is limited government aid, particularly for SMEs (e.g. the inefficient system supporting innovation and TT).
- A very persistent barrier is deficiencies in information systems, particularly the lack of S&T information for SMEs.
- Both firms and experts stress the difficulties firms have in acquiring outside financing, particularly from banks as a significant obstacle for transfers.

#### ■4.0 SUCCESS CRITERIA FOR TECHNOLOGY TRANSFER

The process of technology acquisition by developing countries is one of learning and improving their technological capability. This is a complex, long-term, process with various levels of technological competence such as the ability to use the technology, adapt it, stretch it, and eventually to become more independent by developing, designing and selling it (Etzkowitz, 2010). It very much relies on the effort of technology acquirers. China No. 1 Automotive Works is a good example. It created a joint venture company with Germany to produce Audi cars. At first the Chinese partner organised a team of experts who were

from universities and institutes as well as from its own organisation to translate and read all the technical documents provided by the foreign partner (Cilingir,1984). Then, the members of the team "learned by doing" how to use the technology. They used, adapted, and changed existing technologies, and finally they combined the newly acquired technology with their own experience to develop new products under the "Red Flag" brand (Callahan, 2008).

Technology transfer can be successful by combining the forces of institutions conducting scientific studies and R & D units of enterprises and universities through structural adjustment (McAdam, 2009). Some institutes with independent capabilities will be transformed into high-technology enterprises; others will be turned into scientific research units for public service, such as technical information consultancies. Hiring respected personnel in a host country with a markedly different culture than the home country is an effective human resource strategy. For example, some U.S. firms hired retired executives or professors in Japan to help guide strategy in the Japanese market (Egbu, 2000). These respected personnel add credibility to the effort. They can be trained in the firm's strategy, and most importantly, they truly understand the culture, markets, laws, etc. of the host country (Maitland, 1999). These personnel serve as a useful bond to the firm in transferring technology to the host country. To be successful, firms need careful strategic thought and planning, skilled and knowledgeable implementation, and the understanding that successful technology transfer can be greatly beneficial to both the firms and countries (Robert, 1990). However, in the long term, investment in human capital was more important for the advancement of the technology.

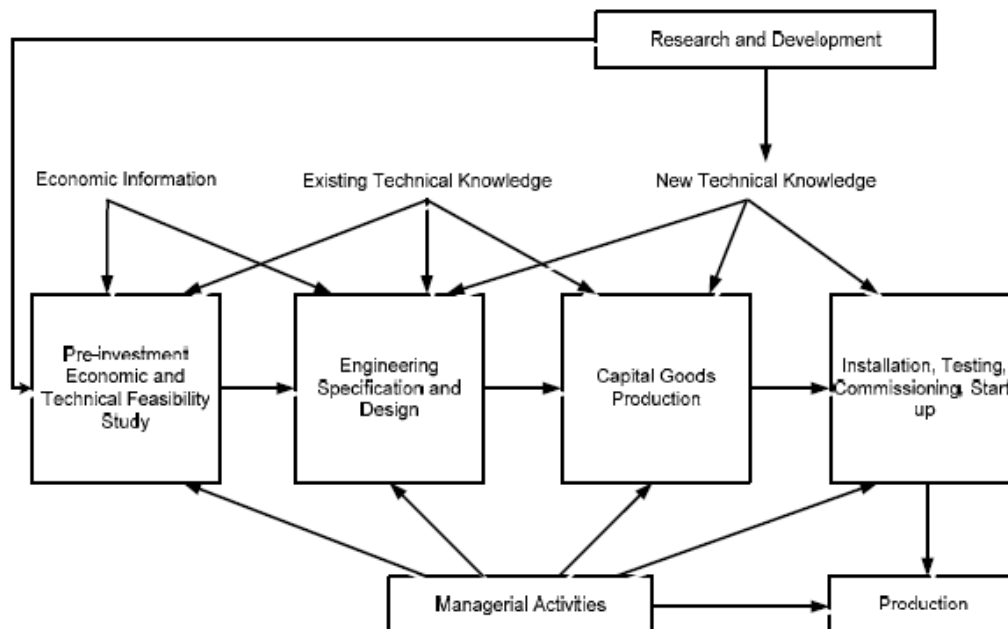


Figure 1 Model of successful technology transfer (Source: Andrzej, 2009)

#### ■5.0 CONCLUSION

The growing attention to the field of technology and knowledge transfer is primarily due to the sustainable competitive advantage that emanates from continuous capability development. In

technology transfer projects, the recipient country's organization is essentially a learning system and technology transfer is a learning process that results in intended as well as unintended benefits. Therefore, from the recipient firm's perspective, it is the manager's responsibility to lead the development of the requisite

absorptive capacity, prior related knowledge, and learning processes that would maximize both types of benefits to the firm from the technology transfer project. Apart from government, the two other actors (science and industry) should also take major steps to remove barriers for TT. Finally, there is an urgent need for a public system of supporting corporate activities in the field of innovation and TT.

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