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Contemporary Issues in Technology Transfer

Theories and Practice: From a management perspective

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Table 1.1. *Description of the Categories of Inforware*

Categories of Inforware and Their Description
1. Technoware-Specific Inforware (TSI) • Technoware attribute inforware (tai): Information pertaining to the technical specifications of the technoware. • Technoware operating inforware (toi): Information pertaining to standard operating procedures and software needed to activate the technoware. • Technoware maintenance inforware (tmi): Information needed to maintain technoware and the software needed to operate the technoware. • Technoware performance-enhancing inforware (tpi): Technoware performance-enhancing heuristic knowledge developed in-house by the firm's humanware. • Technoware design inforware (tdi): Engineering drawings, design specifications, and designcalculations needed for manufacturing the technoware.
2. Humanware-Specific Inforware (HSI) • Humanware foundation inforware (hfi): Information that provides insights into the functional requirements of a manufacturing system; the knowledge of the possibilities, limitations and manipulability of various natural processes and structures which might be used in technical practice; and a range of design concepts through which such processes and structures are harnessed to the performance of various functions. • Humanware back-up inforware (hbi): Information such as tables of engineering data and functions; documentary standards; state-of-the-art measurements; standardized measurement and calibration methods; and national and international standards of physical, chemical and engineering measurements.
3. Orgaware-Specific Inforware (OSI) • Orgaware back-up inforware (obi): Information such as: demand forecasts and customer specifications needed to determine the master production schedule (mps); bills of materials, on-hand inventories, order status of production items, replenishment rules and lead times needed for materials requirement planning (mrp); technoware and labor contact humanware capacity information for order scheduling, for planning overtime and/or subcontracting, if necessary, and for revising mps and mrp if needed; and supplementary details on costs, technoware downtime, yields, rejects etc. • Orgaware enhancing inforware (oei): Information needed for enhancing the planning and control of technoware and humanware. This includes algorithms, heuristics and rules such as those provided by operations research and statistical techniques, and also computer software that facilitate the scope of application of these.

Chapter 2
ROLE OF R&D IN TECHNOLOGY TRANSFER

Zong-Tae BAE

Abstract

The technology base and capability of any company are essentially its sources of competitive advantage. This can be acquired in two ways: internally ("make" such as R&D and imitation) and externally ("buy" such as technology transfer and joint venture). Technology transfer and R&D are often treated as separate alternatives and substitutes for each other. On the contrary, they should support each other, particularly at the company level. In acquiring needed technologies, companies in developing countries rely on technology transfer to supplement R&D, and vice versa. In implementing these, they should have an R&D that is capable of assimilating and adapting the transferred technologies in local circumstances. This chapter focuses on the following issues:

- *Is technology transfer enough as a technology acquisition strategy?*
- *Why is R&D needed in the transfer of technology?*
- *How can R&D support technology transfer?: Case Study and Guidelines*
- *What are its implications at the firm and national levels?*

Also, it expounds on how R&D can contribute to the successful choice of the mixture of technology acquisition methods needed by any firm.

About the author

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INTRODUCTION

Recent business and technological changes have made "technology" a key attribute to both success and failure in world competition. Although less developed countries (LDCs) did not pay proper attention to the importance of technological innovation until about the mid-sixties, attitudes on science and technology (S&T) in LDCs have changed drastically during the last three decades. As a result, technological advancement has been recognized as a major contributor to economic growth and a dominant factor for business success both to LDCs and DCs (developed countries). Policy makers in LDCs particularly in Asia now refer to technology as the "master-key" or "competitive weapon" for development (Frohman, 1982). The higher the level of technology is, the greater is its strategic importance.

Technology as an Asset: Not Free Nor Fully Transferable

Scientific knowledge can be widely available in some cases. Technology, on the other hand, cannot be acquired freely (Ramanathan, 1991). Although one may have enough resources to acquire technology, some companies in DCs are reluctant to transfer strategically-important and key technologies. And even if technologies could be transferred through machineries and documents, the know-how cannot be transferred completely.

Industrial technology is sometimes misunderstood as being thoroughly documented in codified form - in "blue prints," as one metaphor puts it. If this simplistic view were valid, technologies could be transferred and assimilated effortlessly, and a narrow conception of technological effort would be appropriate. But the same underlying technological knowledge is not widely used with equal effectiveness (Dahlman & Westphal, 1981). This is clearly evident in the fact that ostensibly identical technologies are employed with vastly unequal levels of technological efficiency (or productivity) by firms within and across economies. Obviously, learning to make effective use of knowledge also requires resources (Bell, 1984). Therefore, technological effort must be defined more appropriately as the employment of resources not only to create but also to master technological knowledge. It is erroneous to say "transfer of technology", because "technologies are in fact transferred." Capital goods can be transferred, but capital goods alone do not constitute a technology. They represent only that part of the technology which is embodied in hardware. The other part is comprised of disembodied technological knowledge. Although this knowledge can be transferred, the ability to make effective use of it cannot. Therefore, technology mastery can only be acquired through indigenous R&D or other technological efforts leading to human capital formation.

Technology Transfer and R&D: Not Substituting But Supporting Each Other

In acquiring needed technologies, companies in LDCs rely on technology transfer in order to supplement R&D, and vice versa. In implementing these, they should have an R&D that is capable of assimilating and adapting the transferred technologies in local circumstances. Therefore, technology transfer and R&D are not substitutes of each other but are complementing in order to acquire new technologies. This chapter discusses the

various roles of R&D in the process of technology transfer and focuses on the following issues:

- Is technology transfer enough as a technology acquisition strategy?
- Why is R&D needed in the transfer of technology?
- How can R&D support technology transfer?
- What are its implications at the firm and national levels?

TECHNOLOGY TRANSFER AS A TECHNOLOGY ACQUISITION STRATEGY

Technology Acquisition Strategies in LDCs

There is a large amount of literature on different technology acquisition strategies and their determinants (Brockhoff & Chakrabarti, 1988; Ford, 1988; Sen & Rubenstein, 1989, 1990; Granstand et al., 1992). Some empirical studies suggest that a firm acquires a license for a new product when appropriate internal capabilities for its development are insufficient (Caves et al., 1983; Crawford, 1985). Atuahene-Gima (1992) suggests that a lack of internal new product development capability in a particular product area more likely leads to the choice of inward technology licensing over internal R&D. These findings suggest that a firm's internal technological capability in a particular project area is a prime factor for the selection of technology acquisition strategy. The technology base of a company is essentially the asset of the technological competence or capability that the company possesses. As an asset, the technology base can be acquired in two ways - internally ("make") and externally ("buy"). A firm may acquire skills and know-how for its own use through in-house R&D. Alternatively, it may purchase technology in various stages of development. Cooperative R&D is another method that lies in the middle of the make-buy spectrum (Lee et al., 1994). In spite of the growing concerns on technology acquisition methods however, few studies have empirically analyzed their complementary roles among several technology acquisition methods in promoting successful implementation and commercialization of adopted technologies and R&D results. Readings on this topic suggest that R&D activities combined with other technology acquisition methods may aid in the rapid development of new technologies. In-house development efforts in addition to technology transfer are usually needed to assimilate transferred technologies and to transform them into commercially relevant products or processes, efficiently and effectively.

Changing Patterns of Technology Acquisition in LCDs

Lee et. al. (1988) presented a conceptual model as a new framework of the technology development processes in LDCs on a global perspective. This consists of three development stages such as initiation, internalization and generation, as well as some propositions related to the levels of transferred technology, technology acquisition modes, technology elements mastered, and major contributors of technology development in each development stage.

The model explains several dynamic changes in LDCs' development processes with global perspectives focusing on the linkages between DCs and LDCs. Through the technology development and learning processes, the firms in LDCs can select and utilize several technology acquisition methods suitable for the internal and external circumstances. According to the model, old and mature technologies are transferred mainly via non-formal channels such as imitation and purchasing of capital good [in initiation stage]. On the other hand, new and high technologies are transferred mainly via formal channels such as licensing and purchasing of technology [in internalization stage]. Finally, generation stage can be reached when development of new products or the mastery of the state-of-the-art core technology are realized. This model implies that patterns of main and supplementary roles among technology acquisition methods in LDCs are subject to change dynamically according to the stages of technology development.

"Make-some-and-buy-some" Strategy

The most pragmatic strategy for any country is to follow the "make-some-and-buy-some" path with careful specialization - and R&D is necessary for both options. Also, the "embodiment forms of technology" approach - technoware, humanware, inforware, and orgaware - is very useful in identifying future directions for technology transfer (Sharif, 1988). For example, the nature of technology transfer can be examined from the "embodiment forms of technology" perspectives:

(a) Technoware. Other than the state-of-the-art, Technoware can normally be bought for a price determined by the relative bargaining position of transferors and transferees. Less sophisticated imported Technoware may often require quite sophisticated Humanware to operate and maintain it.

(b) Humanware. Humanware can be imported temporarily, and success in acquiring this ability depends primarily on local learning capabilities. When Humanware is well developed, importing Technoware can be very effective in reducing technology gaps.

(c) Inforware. Beyond the level of simple operating instructions, Inforware is not usually given to ordinary Technoware importers. Since Technoware involves risks and money, critical information (particularly comprehending, generalizing and assessing facts) is closely guarded for cost recovery and profit-making. Thus, importing Inforware can be more expensive than even state-of-the-art Technoware.

(d) Orgaware. Imported Orgaware cannot be easily transferred and needs considerable adaptation to local working conditions.

The above discussions imply that only some parts of a technology can be transferred. The rest should be realized through the transferee's own efforts.

Is Technology Transfer Sufficient?

It was emphasized that assimilation and adaptation of technologies are even more important than just acquiring them. Therefore, it can be concluded that technology transfer alone is not sufficient because :

1. Emerging technology which can give competitive edge in the international market cannot be bought in the open market.

2. Neither closed door policy nor achievement of self-sufficiency is economical and possible.

3. The path of seeking aid to "transfer" and now "cooperation" can only increase the gap and dependence unless there is emphasis on self-reliance (not self-sufficiency) in the long-run.

4. Technology can never be transferred completely. Because only some parts of the technology can be transferred, in-house R&D efforts should be undertaken to maximize the use of the transferred technology vis-à-vis to fully acquire the other parts of technology.

5. Even "reverse engineering" - digestion, imitation and creation - may become difficult without capability in some areas.

6. Transferred technology should be assimilated to suit local circumstances because the economic and social contexts where the transferor and the transferee operate usually differ from each other.

7. Indigenous technological efforts, in addition to technology transfer, can enhance efficiency and effectiveness in utilizing transferred technology.

Also, in the technology transfer contract, firms in LDCs face several problems because of (a) low bargaining power, (b) lack of technology capability - especially in the technology choice and absorptive capabilities, (c) unclear S&T development strategy, and so on. Enhanced technological capability through indigenous R&D efforts can contribute in strengthening the bargaining power.

ROLES OF R&D IN TECHNOLOGY TRANSFER

Considering these points, three issues relevant to supplementing the roles of R&D in technology transfer can be identified from the viewpoint of LDCs. In this chapter, roles of R&D are explained along the process of technology transfer, such as (1) before, (2) in, and (3) after the technology transfer contract.

Before Technology Transfer: R&D as a Source of Choice Capability

The first issue deals with choosing the appropriate technologies and acquiring them. This involves technical, marketing and socio-economic considerations (Dahlman & Westphal, 1981). The level of technological gap between the transferor and the transferee should be analyzed. The technology that creates a reasonable and appropriate gap, neither too big nor too small, should be selected (Sharif & Haq, 1980). Indigenous technological capability accumulated through in-house R&D can provide useful information in analyzing alternatives and making right decisions that lead to better choice of appropriate technologies.

In Technology Transfer Contract: R&D as a Source of Bargaining Power

The second issue pertains to the bargaining and the negotiation process transpiring in the technology transfer deal. The bargaining power of any transferee in technology transfer contracts can be strengthened by (a) providing sufficient information, (b) legal support, and (c) intensive R&D. Also, absorptive capabilities can be increased by (a) building up competent manpower (intensive training), (b) providing sufficient support to build sound S&T infrastructures, and modern laboratories and S&T information, and (c) strong support by political leaders and management team. Therefore, extensive R&D activities and enhanced technological capabilities can contribute to increased bargaining power in negotiating technology transfer contracts.

After Technology Transfer: R&D as a Source of Learning Capability

The third issue is concerned with utilizing and mastering adopted technologies efficiently and effectively. Active and explicit technological efforts to assimilate and improve them should follow, based on accumulated technological capabilities, strong learning motivation, top management support and clear goal setting.

HOW CAN R&D SUPPORT TECHNOLOGY TRANSFER?

Principles for Integrating R&D and Technology Transfer

There are several areas where R&D can support technology transfer. First, R&D can increase the effectiveness of the external technology acquisition and implementation process. According to Kohler et. al. (1973), the activities in the acquisition and implementation of external technology can be classified into ten distinct stages, as shown in Table 2.1. Sen and Rubenstein (1990) described the extent of in-house R&D involvement in each stage of the external technology acquisition and implementation processes as a function of inter-organizational, intra-organizational and personal factors. It was also identified that the firm's R&D involvement is higher in the external technology acquisition process when the perceived adequacy of its R&D capability is high. They also wrote that formal procedures that include in-house R&D in the process has an impact in the acquisition phase, while R&D's involvement in the implementation phase seems more influenced by the possession of appropriate in-house capabilities. In Stage 7 especially (construct), strong transfer capabilities in R&D and the existence of "people with specialized skills" increases R&D's involvement and enhances the effectiveness of the process. Table 1 summarizes the roles and effects of R&D in each external technology acquisition and implementation stage.

Secondly, R&D can enhance the bargaining power of the transferee in technology transfer negotiations. Apparent in the Korean experience (Lee et al., 1991), some firms participate in cooperative R&D projects to enhance their bargaining power in purchasing foreign technologies from DCs, as DC firms sell their proprietary technology at a lower price if developed locally in Korea. Specifically, Shepherd (1976) provided some

strategies and constraints in technology transfer agreements from the viewpoint of LDCs, based on the examination of relevant policy tradeoffs. Although some of them are difficult to implement in the new rules of the game effected under the Uruguay Round, the strategic directions are still useful. These are:

(1) attempts to unbundle technologies from the traditional package of foreign investments;

(2) restructuring the method of payment, duration of agreements and pricing of technology;

(3) reducing the control of the transferor over the transferee's decision-making;

(4) removing restrictions on marketing, exportation or further use of technologies;

(5) limiting the proprietary rights of the source of technology;

(6) the demand for relocating R&D facilities in LDCs;

(7) increasing the capability of local governments to intervene directly in the sale, use and adaptation of foreign-sourced technologies; and

(8) rejecting contractual obligations and demanding greater flexibility to adapt or change agreements.

Thirdly, R&D can promote the assimilation and adaptation of technologies acquired through technology transfer. Without indigenous R&D efforts, however, these can not be utilized efficiently. Moreover, studies on cooperative R&D emphasize the supplementary role of additional technology acquisition strategies for the commercial utilization of the results of cooperative R&D (Alic, 1990). Generally, DC firms participating in cooperative R&D need complementary in-house R&D efforts for the effective utilization of cooperative R&D results. On the other hand, LDC firms in cooperative R&D prefer licensing or purchasing external technologies available from DCs to supplement cooperative R&D (Lee et al., 1994).

Technology Transfer and Infrastructure: The Korean Experience

The Korean experience in international technology transfer has been generally regarded as a successful case concerning these issues. When Korea started her economic development in the early 1960's, her level of technology development was very low. Korea then actively imitated even mature foreign technologies. Reverse engineering was one of the typical methods that Korea utilized at that time. During these processes, Korean firms accumulated some technical capabilities, as well as some capabilities to choose appropriate technologies. The Korean government was very strict in approving transfer of technology to prevent local companies from unfair contracts. Stringent government regulations increased the bargaining powers of many local companies in technology transfer negotiations. In the 60's, only 270 technology contractual agreements were approved.

As the level of required technologies rose in the early 1970's, Korean firms tried to induce foreign technologies through formal channels because higher technologies were difficult to imitate. As a result, many technologies were transferred from DCs. For

Table 2.1: Involvement of R&D in External Technology Acquisition Process

STAGE	DESCRIPTION	EFFECT OF R&D's INVOLVEMENT ON THE EFFECTIVENESS OF THE STAGE
1. NEED	Awareness of needs for new technology	HIRD will improve the information available to make decisions[1].
2. FOCUS	Identification of Alternatives	(Depending on the Situation)
3. EVALUATE	Evaluation of Alternatives	HIRD will bring better satisfaction with solution to problems, better information to make decisions, higher ability to predict problems and overall satisfaction with the stage.
4. MAKE/BUY	Make or Buy Decision[2]	HIRD will improve the ability to predict problems in this stage.
5. NEGOTIATE	Negotiation for Acquisition	HIRD will provide better availability of information to make decisions.
6. RECEIVE	Preparing to Receive New Technology	HIRD will support the activity and increase the effectiveness of this stage.
7. CONSTRUCT	Installation of New Technology	HIRD will provide better information to make decisions and a better ability to predict problems in this stage.
8. START-UP	Actual Start-Up	HIRD will support the activity and increase the effectiveness of this stage.
9. IMPROVE	Improving Acquired Technology	R&D is highly involved in this stage.
10. RETOOL	Keeping Acquired Technology Work	R&D is highly involved in this stage.

NOTE: 1. HIRD stands for "High Involvement of R&D".
2. A decision is taken to do in-house R&D or to acquire it externally or to unpack the technology and produce some parts in-house and acquire the rest externally.

Source: Sen & Rubenstein (1990), "An Exploration of Factors Affecting the Integration of In-House R&D with External Technology Acquisition Strategies in a Firm".

example, technology contractual agreements approved by the government increased from 99 in 1975, 222 in 1980, 454 in 1985, to 751 in 1988 (Since 1989, however, the number of technology transfer contracts has decreased gradually and was reduced to 533 in 1992). The transferred technologies were assimilated and improved based on the accumulated technological capabilities and continuous technological efforts. In almost all industries, the localization rate has increased sharply. Also, whenever new products were developed by local firms, the government would restrict imports of competing foreign products to enhance growth of local companies. Korea's successful economic and technological development were caused by many factors, such as (1) promotion of planned development under government initiative, (2) fostering talented human potential and educated manpower, (3) selection of an appropriate development strategy and its phased promotion, (4) timely construction of infrastructure for industrialization, and (5) appropriate

introduction of technology development strategies with focus on industrialization (Choi, 1983). All of these are ascribed to (1) deliberate government policy, (2) well-educated, motivated and diligent manpower, and (3) strong entrepreneurship of top management. Also, transferred technologies from abroad played the critical role in enhancing Korea's economic and technological levels.

Cooperative R&D and Additional Technology Sourcing

LDC firms can rely on R&D to supplement technology transfer. Similarly, they can rely on technology transfer to support in-house or cooperative R&D. According to studies conducted by Lee et al. (1994) involving 162 cases of vertical cooperative R&D projects from a diverse group of industries in Korea, the direction of additional technology sourcing - in-house R&D (internal) versus licensing (external) - for commercial development of cooperative R&D is related to the type of innovation it aims to undertake. If a project is characterized as unrelated diversification (new business area) - less related to existing business - licensing foreign technology is more appropriate than in-house R&D as a complementary means for cooperative R&D. On the contrary, if a project is more related to the firm's existing business area, in-house R&D would be cheaper and the development period would be shorter compared with external acquisition, as a complementary means for cooperative R&D. Findings suggest that firms participating in cooperative R&D projects should try to utilize other supplementary technology acquisition methods in order to achieve commercial utilization of cooperative R&D results.

Roles of Government

Another issue concerns government roles and policies for technology transfer and R&D. Governments should prepare long-term and short-term science and technology policies that will support and coordinate transfer of technologies. It should not, however, be involved in selecting transferors. To facilitate the inflow of foreign technologies, governments should create a favorable climate. To prevent unfair negotiations in technology transfer due to weak bargaining power of local firms, governments in LDCs should play the critical role of being a coordinator based on clearly defined step-by-step guidelines. Also, to promote R&D and technology mastery efforts of local firms, governments should provide strong policy measures - indirectly rather than directly.

Effective national and international policies relating to technology transfer must address the differences in technologies, suppliers and receivers. For many LDCs, unpacking is unrealistic. For others, the local infrastructure may allow for the unpacked technologies to be used and integrated properly. In some cases, direct foreign investments may be the best method for importing technology and beginning more extensive stimulation of technical infrastructure. Therefore, a contingent view of this environment demands different policies for different countries with regard to different technologies. Thus, recipient countries must acknowledge the inadequacies of their technical infrastructure as a primary obstacle to effective technology receipt and mastery. It is also a more significant barrier to the transfer of more sophisticated technologies, no matter who the transferor may be. Equally important is identifying the legitimate concerns of the host firms and countries so that incentives can be developed to stimulate greater transfer rather than inhibiting the desire or capability of suppliers.

No matter how varied and contingent the policy instruments on the environment are, the objectives for technology transfer and development in LDCs should be similar, especially in the case of long-term technology base. They are (a) to increase technology flows at lower costs, (b) to establish active independent local technological capabilities, (c) to encourage more appropriate technology and associated products, exports, etc. and (d) to strengthen local technical infrastructure. Continuing dialogues and discussions between transferor firms and governments can alleviate some of the more critical bottlenecks which result from improper policy development and implementation. Informal policies and programs can guarantee that the prerogative and interests of all parties concerned are considered. Such policies can also help assure that the flow of needed technology to the LDCs will continue in the quantity and quality needed.

Recommendations for Effective Technology Transfer

Based on the above discussions, some implications for LDC firms are suggested.

First, they should establish an explicit technology strategy as well as business strategy, based on the analysis of the firm's capability and competitive position.

Second, they should utilize informal and formal technology transfer channels and make active technological efforts (in-house R&D) to assimilate and improve acquired technologies. This is the only way for LDCs to achieve technological self-reliance and avoid technological dependence on advanced countries. Also, some kinds of R&D activities can contribute to enhance a firm's bargaining power in technology transfer negotiations with foreign companies. R&D laboratories in LDCs should serve as one of the major sources of technological mastery and development.

Third, as mentioned earlier, high learning motivation is required for successful assimilation and improvement of transferred technologies. Top management should fully recognize the significant role of technical manpower and give proper attention to developing and motivating technological human resources. This is the reason why training and education for technical manpower are important in LDCs.

Fourth, appropriate mechanisms for technology transfer should be established. Edosomwan (1989) recommended the following mechanisms for the effective transfer of technology:

(1) the training of transfer agents and users of technology;

(2) the establishment of technology transfer and maintenance centers;

(3) the establishment of training and research centers for existing and emerging technologies;

(4) availability of capital to purchase tools, machinery embodying needed technologies, technology licenses, patents, and technology based system codes;

(5) the ongoing maintenance of suitable environment for technological innovation and adaptability; and

(6) the implementation of adequate procedures for assessing the real need, screening technologies, justifying and modifying technologies and diffusing appropriate technologies to the required sectors of the economy.

Fifth, top managers should have a long-term perspective and philosophy on the future technological and business situations of their firm. Utilization of foreign technology without internalization can make profits for the time being, but it can not guarantee sustained business development in this rapidly changing environment. New ideas and strong entrepreneurship are essential for the successful, future-oriented manager.

National Guidelines for Technology Transfer in the 1990's and Beyond

In the midst of so many constraints, not every desirable thing must be done; and not everything which must be done should be done at once. The first priority is the development of institutions which will increase the capacity to transfer technology. The accelerated development of critical human resources is one such issue, and the management of technical standards is another. Helping organizations select the correct transfer mechanism is then a simpler task. Gilbert (1991) suggested national guidelines for technology transfer in the 1990's and beyond.

(1) **Defining and Implementing Technical Standards:** Industrial standards serve both explicit and implicit purposes. They should protect both the end users and equipment suppliers from competition. Good standards are difficult to develop. This is partly because modern technology is inherently complex, and complex systems incorporate components developed at various periods by different sources. Moreover, there are real conflicts in interests between suppliers, middlemen and end users in different national contexts. Rapid certification of new products and processes, based on a uniform international system, is essential. Even the poorest nation must shift its focus outward on the critical issue of industrial standards.

(2) **Building Human Resources:** In a global economy, no nation is self-sufficient. Even if manpower development were viewed as a critical goal, and each developing country began today, the manpower required to design, build, and operate high technologies needed over the next decade could not be internally sourced. Despite growth in the economy, employment opportunities for unskilled labor will recede as the pace of automation accelerates. This means that technological change must be carefully monitored. For example, as digital technology sweeps analog designs from the shelf, a pressing need will emerge for software designers (who will also be in heavy demand in other service sectors). Overseas-educated nationals now working in high technology industries in the West is one important source of advanced knowledge, and Korean successes in repatriating these skills should be carefully studied. Finally, investors must become directly involved in upgrading human resources. Aggressive steps must be taken now, or short supplies of semi-skilled and skilled workers will become a barrier to investments over the next decade.

(3) **Selecting Technology Transfer Mechanisms:** Many LDCs will attempt to employ all the available modes to transfer technology. Limited technological

absorption capacity argues against the use of pure licensing mechanisms, and investors should consider instead enhanced licensing, build-operate-transfer, or joint venture mechanisms in higher technology ventures. From the perspective of sources of technology (and their national trade offices), every effort must be made to balance incentives and disincentives intended to shift the preferences from the anti-competitive mode. While it is in the long-term national interest to avoid these inefficient mechanisms, they do in fact serve the useful purpose of accelerating enterprise learning over the short run. In many instances, technology which is in the public domain can be provided. In others, cooperative agreements can be tailored to reflect the economic reality of the specific situation.

(4) **Skill Transfer through Training:** Although international access to business services will be essential for many investors, skills transfer must not be neglected. Mandatory counterpart training schemes in business services will accelerate the building of local capacity.

CONCLUSION

The degree of success in transferring technology from one location to another depends on the type of technology involved, the techniques and methods employed for transfer, the transferor-transferee relationship, the organization of the work involved in the entire technology transfer projects, policy issues, and skills of the technical personnel involved in the transfer process.

LDCs are suffering from lack of needed technologies and heavy dependence on the DCs. LDCs can not avoid such kind of undesirable situation. What they can do is try to take off from their current situation as soon as possible. Without explicit technological efforts and top managers' strong commitment on technological strategy, a developing country will remain a developing country forever. Simultaneous utilization of technology transfer and indigenous R&D contribute to long-term technological self-reliance as well as short-term efficiency of technology implementation for entrepreneurs in LDCs.

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