CHAPTER THREE
TECHNOLOGY TRANSFER & TECHNOLOGY MANAGEMENT: AN OVERVIEW
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CHAPTER THREE
TECHNOLOGY TRANSFER AND TECHNOLOGY MANAGEMENT: AN OVERVIEW

"The only competitive advantage of the developed countries is in the supply of knowledge workers .... Knowledge constantly makes itself obsolete, with the result that today’s advanced knowledge is tomorrow’s ignorance."

Peter F. Drucker

"National prosperity is created, not inherited. It does not grow out of a country’s natural endowments, its labour pool, its interest rates or its currency’s values, as classical economics insists.” ...“A nation’s competitiveness depends on the capacity of its industry to innovate and upgrade. Companies gain advantage against the world’s best competitors because of pressure and challenge. They benefit from having strong domestic rivals, aggressive home-based suppliers, and demanding local customers.” ...“In a world of increasing global competition, nations have become more, not less, important. As the basis of competition has shifted more and more to the creation and assimilation of knowledge, the role of the nation has grown. Competitive advantage is created and sustained through a highly localized process. Differences in national values, culture, economic structures, institutions and histories, all contribute to competitive success. They are striking differences in the patterns of competitiveness in every country; no nation can or will be competitive in every or even most industries. Ultimately, nations succeed in particular industries, because their home environment is the most forward – looking, dynamic and challenging....

Michael E. Porter
3.1 Introduction

The venerable doyen of Management Gurus, Peter F, Drucker, was the first, prescient observer to comment on the emergence of "knowledge" as the prime source of an industrialised nation’s competitive advantage, and the power of “knowledge-workers”, in the Post – Industrial, borderless, global economy that is evolving since mid-1980s. “The Second Industrial Revolution”, as some observers have termed the current, knowledge-based rapid advances in Information Technology, Genetic Engineering / Bio-Technology and allied fields, would be dominated by those nations that posses the highest quality work force of “knowledge workers”: Peter Drucker goes to the extent of insisting that “the only competitive advantage of the Developed Countries is the supply of knowledge workers”, a stand supported by other experts in the field like Prof Michael E.Porter.

In such a scenario of a “knowledge-based” economy, the issues of Technology Transfer and Management of Technology, especially in sensitive strategic industries, are of major concern, not only in the context of national competitiveness but also in the context of national sovereignty and security interests. The field of “Technology Transfer” is a complex multi-disciplinary area of Technology Management involving Technology Transfers from overseas Developing Agencies (DAs) and internal Technology Transfers from indigenous DAs to local, and in some rare cases in the Indian context, foreign clients.

3.2 Definitions of Technology and Technology Transfer

Technology transfer means different things to different people. First, to an engineer the term technology does not refer to a “thing.” Try one may,
we cannot point to an animate or inanimate object and call it technology. Knowledge is the state of knowing through study or experience. Therefore, transfer of technology really means the transfer of knowledge. Knowledge can be stored and conveyed in many ways: The written word is knowledge, the spoken word is knowledge; computerized data banks are knowledge.

Second, the term transfer does not mean movement or delivery. Transfer, as we define it, means the use of technology. Therefore, our definition of technology transfer is the use of knowledge. The argument has been made that if technical knowledge is sent and the receiver acknowledges that it has been received, then technology has been transferred. What is really meant by the argument is that something has been delivered. If this something is never used, then, by the above definition, nothing has been transferred. **There is no transfer of technology unless, and until, the technical knowledge has been put to use.** Even if the use does not meet the expectations of the user, technology transfer has still occurred. The success or failure of its use does not determine the state of transfer – its use does!

Technology means specialized knowledge applied to achieving a practical purpose. In current parlance, we use the term know-how. Know-how is defined by Webster (Seventh Collegiate Edition) as the knowledge of how to do something smoothly and efficiently. That “something” is the practical purpose that we identify with technology. **Fig. 3.1** through **3.4** illustrate models for technology transfer and are self-explanatory.
Fig 3.1 Bridging Agencies

Fig 3.2 Research and Development Diffusion model
3.2.1 Yet, technology transfer is not the mere transfer of know-how from one person to another, although know-how transfer is a very important step in the technology transfer process. And, in a very real sense, when one teaches another the specialized knowledge necessary and sufficient for achieving a practical purpose, knowledge transfer has been achieved. We will indeed use the words technology transfer to mean not only knowledge transfer but also its social use. Dr Frank Press defines technology transfer as “the moving of
research and development (R&D) results out into the communities, in the country of origin and abroad.” There is a need to find ways to bring unmet needs and available science and engineering and much existing technology together.

A second usage of technology transfer reflects our perception that know-how may comprise an element of a series of steps, the culmination of which is achievement of a practical purpose. If one combines know-how from one or more such series to achieve a new practical purpose, technology transfer is accomplished no less than in the teaching of a body of know-how to achieve a single practical purpose.

Some people might call the combination of know-how elements to achieve a new practical purpose as invention. It may be pointed out that United States courts have held that a result that is based on a combination of previously known elements of knowledge and that is predictable or obvious to anyone skilled in the art is not an invention. This is true even though the achievement of the result had not previously occurred. However, it may very well be called engineering.

3.2.2 The achievement of a practical purpose by one who has not previously been able to accomplish that purpose is the hallmark of technology transfer. It is recognized through two modes: the teaching of a body of knowledge, and the teaching of a group of elements, the combination of which permits the achievement of a practical purpose, whether or not previously achieved.

Technology transfer is not restricted here to only a scientific or engineering sense. It is recognized that the use of knowledge as its application to achieve a purpose that can be rewarded in the marketplace. (This does not imply that it will be rewarded in the marketplace). Therefore, manufacturing, marketing, distribution, and customer service are among the factors that can be included in technology transfer. The purpose is a very
INDUSTRY GRADUATION
FROM FABRICATOR TO DESIGN, DEVELOPMENT & MANUFACTURING AGENCY
practical one. An attempt is made to show how one can enrich oneself by using the ore of contemporary society.

3.2.3 As Kleiman and Jamieson in a discussion of international technology transfer point out: “Technology transfer is a chameleon like process for differing applications, environments, participants, and problem areas. It rewards many human endeavors, easily crossing internal and cultural boundaries.” Dr. Harvey Brooks of Harvard University, who was also Chairman of the (US) National Research Council Commission on Sociotechnical Systems, had observed: “Technology transfer is the process by which science and technology are diffused through human activity. Wherever systematic rational knowledge developed by one group or institution is embodied in a way of doing things by other institutions or groups, we have technology transfer.”

Kleiman and Jamieson note several key factors in technology transfer:

(i) Transplantation of technology from within one set of well-defined conditions to another set in which at least one key variable may differ and how the recipient applies the technology may vary greatly from the donor’s mode.

(ii) A sense of opportunism prevails in technology transfer, whether justified or not.

(iii) The transfer process embraces a rich variety of mechanisms and relationships between recipient and donor. The process can vary from a routine, people less passive transfer to a turnkey contract where the donor takes full responsibility for all phases of the contract. The more active and usually more successful instances call for frequent and intense personal interactions between both parties.

(iv) It follows that the nature of the transferred technology and how it is transferred are critical to the success of the technology transfer process. Technology transfer may begin as a solution to someone else’s
problems. Adaptation of such “outside” solutions to solve “inside” problems is technology transfer. The advantage lies in avoiding “reinventing the wheel”.

3.3 Technology Transfer Modes

Technology transfer modes have been categorized basically as being passive or active, which refers to the transferring activity’s role in the application of technology to the solution of the user’s problem. If the transferring mechanism presents the technology to the potential user without assisting the user in its application, e.g., by a report or oral presentation, then the technology transfer mode is said to be passive. This is actually knowledge transfer. If, on the other hand, the transferring activity assists the potential user in the application or technology, then the technology transfer mode is said to be active. If the transfer activity presents the technical information in the form of written or spoken data, i.e., knowledge transfer, and the user is left alone to decide how he or she will apply the knowledge to the problem, we consider that the user has not been assisted and therefore the mode is passive.

According to studies presented to NASA, the degree, and nature of use of technology distributed by the passive mode can be related to three variables. These are: the size of companies within specific industrial sectors, the job position of the information user, and the nature of the technological disclosure. Among other things, it was found that published technology is generally not so much a source of new product ideas as it is used for improving existing products and processes.

If, on the other hand, the transferring activity goes beyond mere interpretation of the transmitted data and advises the potential user on how to apply the technology, or demonstrates the applicability of the technology to
CHANGE OF FOCUS
R & D INDUSTRY INTERFACE

TECHNOLOGY TRANSFER
* INDUSTRY ROLE IS LIMITED TO PRODUCTION

TECHNOLOGY ABSORPTION
* INDUSTRY IS AN ACTIVE PARTNER IN THE DEVELOPMENT
* CONCURRENT ENGINEERING

TECHNOLOGY DIFFUSION
* INDUSTRY LEADERSHIP WITH R&D CAPABILITIES
* SPIN-OFF BENEFITS
* COMMERCIALISATION

80'S 90'S BEYOND 2000

Fig. 3.6 65A
the perceived need, then the user is considered to have been "assisted" in an active mode.

3.3.1 The Passive Mode

The passive mode (dissemination mode) is illustrated in Fig. 3.7. Perhaps the most familiar and widely used form of passive technology transfer, i.e. knowledge transfer, is the "cookbook." No other communication is made from the originator of the technology to the maker of the end-consumer item. Yet millions of products a day are made and consumed from this form of knowledge transfer. Similar forms of passive technology transfer are self-teaching manuals of all kinds, e.g., automobile repair manuals and how-to-do-it guides for home repair. It should be noted that all of these modes of technology transfer have one thing in common: they presume an elementary familiarity with and competence in the subject. This same presumption is made in a U.S. patent which is another no less important passive mode of knowledge transfer.

![Fig. 3.7 - Technology Transfer - Passive Mode](image)

There is no disputing that passive technology transfer does exist where a single body of knowledge is used to achieve a practical purpose. Just as
OBSERVATIONS

- LARGE SYSTEM TECHNOLOGY TRANSFER ISSUES
  - MULTI-ORGANISATIONAL INTERFACE
  - ABSENCE OF STRONG INTEGRATOR
  - EXPECTATION OF QUICK RESULTS LEADING TO PARTIALLY MATURED TECHNOLOGY
  - DIFFERING LEVEL OF MOTIVATION AND TECHNOLOGY ABSORPTION CAPABILITY OF PRODUCTION PARTNERS

- DRDO NOT GEARED UP TO OFFER TECHNOLOGY TRANSFER PACKAGE SIMILAR TO LICENSE PRODN.

- ISOLATING PSU (DEF) MAY LEAD TO THEIR RESORTING TO TECHNOLOGY IMPORT
reading and computation can be self-taught – indeed all knowledge embodies in a printed word is available to one who has learned to read – so can any existing know-how be transferred theoretically. But we have left out an important element: the skill learned by hands-on practice. Undoubtedly, there are cooks who can bake a perfect cake and home mechanics who can rebuild a carburetor perfectly the first time from printed instructions, but the same cannot be said of glass-blowers, woodworkers, sheet metal workers, blacksmiths, and workers in ceramics. Skill comes from practice under instructions. The role of the teacher or knowledge transfer agent (also loosely called technology transfer agent) is important here and this is the semi active mode of technology transfer. It should be obvious that there must be a whole spectrum of modes from passive to active. There is a need to define three, but it should be recognized that the midpoint must be flexible. For example, some inventors sell their rights with a retainer for “consultation if needed”. This fits somewhere in the spectrum.

3.3.2 The Semi-Active Mode

In the semiactive mode of technology transfer (Fig. 3.9) involves moving from self-education and self-retrieval of the elements of the technology to the intervention of a knowledge or technology transfer agent.

![Fig. 3.9 – Technology Transfer – Semi-Active mode](image)
The technology transfer agent, as defined earlier, screens available pertinent information to eliminate redundancy and superfluous information. Hopefully, he or she will detect and eliminate erroneous information, as well as material that has only superficial pertinence. What the transfer agent transmits is a body of manageable data that is within the ken of the recipient, i.e., the user of the information (not to be confused with the ultimate user of the product of the technology whom we call the client of the data bank). However, the transfer agent, in the case of the semiactive mode, has not gone beyond the role of a communicator. He or she has not actively participated in the application of the technology. When the agent does this, it is the next mode of technology communication.

3.3.3 The Active Mode

The active mode of technology transfer carries the process through to an actual demonstration as shown in Fig. 3.10. This form of technology communication recognizes that words alone may not sufficiently communicate and pictures may be unavailing: only a model actually demonstrating the technology that is being transferred will suffice. Moreover, the finished working model may not be enough: it may be necessary to show the various steps of the construction of the model from procurement of materials to fabrication and assembly of the parts that embody the technology being transferred.

The technology transfer agent plays a key role in this mode. He or she dons the problem solver's mantle and approaches the problem of a nontechnologist with the hope of applying existing technology to the solution of a vital problem.
The first and most important single step is the accurate enunciation of the problem. To do this, the technology transfer agent must listen carefully and critically to the problem (or opportunity) as its presenter perceives it. With such resources as are available, the technology transfer agent must restate the problem in such terms as facilitate search for available technology. In doing this, it may turn out that the original statement of the problem did not state the real problem. The perceived problem may be totally at variance with the real problem, the solution of which will give the desired result.

Given an accurate enunciation of the real problem, the next step is retrieval of pertinent technology. This is a form of technology in itself. It may be done by the technology transfer agent, or it may be done by specialists under the agent’s direction. In any event, the collection of applicable information is now in the hands of specialists. Steady interaction of non technical user and technology transfer agent is required from this point on.

It must be recognized that the technology transfer agent is no longer merely feeding information as in the semiactive mode. He or she is a technologist who is actively searching for the solution to the problem. The agent must have a clear understanding of what it takes to satisfy the needs of the user. It is with this solution that the entrepreneur can proceed to
fabricate a prototype, test it, manufacture the product, and sell it. This is the general statement of technology transfer. Although a successful technology transfer can be accomplished when the entire market demand is for a single manufactured unit, it is more usually the case that successful technology transfer is marked by the steady entrance of a manufactured product into the marketplace.

Experience has shown that certain elements in the demonstration process must, at a minimum, be present during the transfer cycle. These are:

(i) first statement of user need
(ii) clearly stated and understood boundary of solutions
(iii) firm commitment by the user to remain actively associated during and after the transfer
(iv) Participation of representatives of influential interested organisations
(v) market analysis
(vi) A manufacturer
(vii) A champion and an entrepreneur (who may also be the champion) the most important elements.

3.4 Transition from Research to Product Development: IBM Case Studies

Cohen et al. (1979), focusing on the transfer of technology from research to a profitable commercial enterprise, describe a study of 18 IBM projects; some of them were successful while others failed. They produced valuable guidelines for moving technology from research to product development. This study can form on archetype for the development of guidelines for technology transfers that are responsive to the unique requirement of a given organization.
"BUY" OPTION

* SHORT INVESTMENT OR RISK
* EMBODIED COMPONENTS  - M/C, EQUIPMENT, MANUFACTURING PROCESS
* DISEMBODIED FORM     - SOFTWARE, KNOWLEDGE BASE FOR INNOVATION (KNOW ONLY)

* EMBODIED PART SUITABLE FOR LOW LEVEL TECHNOLOGY
* FOLLOW "DISEMBODIED" TECHNOLOGY AS PURCHASE OPTION
* PURCHASE TECHNOLOGY THROUGH R&D LABS or CONSORTIA OF R&D AND INDUSTRY
3.4.1 This study identified factors that affect technology transfer. These are discussed in the order of their relative importance:

A. **Technical Understanding**
   
   (i) It is necessary that research personnel fully understand the main technology before passing it on. Though this may seem obvious, it is not always the case.
   
   (ii) It is necessary to evaluate the benefits of new technology in comparison to what is already available and to other competitive advancements.
   
   (iii) One must identify where it will fit in the product line and what requirements must be met to reach the fit.
   
   (iv) One possible means of manufacturing needs to be exhibited.

B. **Feasibility**

   (i) Both the research and the receiver unit must reach an agreement on what constitutes feasibility and then what should be established.
   
   (ii) Some estimate of cost effectiveness should be made.
   
   (iii) In some cases, feasibility implies acceptability by the end user. This would recognize some kind of joint study with real users to establish feasibility.

C. **Advanced Development Overlap**: For projects being transferred out, some overlap of research activities may be needed either to support development or to explore advanced or related technologies. For systems work (computer software), creation of special advanced development effort is often the answer to problems of scaling-up or to answer questions of economic feasibility.

D. **Growth Potential**: When projects are narrowly focused on a specific need and do not have paths to technical growth and product applicability, technology transfer may suffer. This is because existing
technologies “stretch” themselves and the limited advantage offered by
the new technology may not be sufficient to warrant change.

E. **Existence of an Advocate**: A strong proponent activity is needed to
help overcome many hurdles during the technology transfer process.

F. **Advanced Technology Activities in a Development Laboratory**: In
moving technology from research to manufacturing, advanced
technology programs in the development laboratories are often
necessary.

G. **External Pressures**: In some cases, parallel activity by a competitor
may help provide the push for technology transfer. In others,
regulatory requirements may necessitate adoption of new technologies,
for example, advanced waste treatment technologies.

H. **Joint Programs**: It was concluded that joint programs with receiver
groups are good to have, but they do not ensure success.

Other secondary factors affecting technology transfer relate to
timeliness, internal users, government contracts, high level involvement,
individual corporate responsibility, and proximity. There was an interesting
comment about proximity. For the IBM project studies, in no case was the
proximity of a development laboratory to a research laboratory an important
factor for technology transfer. Being close was convenient, and saved
money, but no transfer failed because of distance.  

3.4.2 In thinking about the transfer of technology we must be careful not to
give sole weight to technical and rational criteria. The following true
story makes the point. In India, an agricultural team convinced a
farmer to use some new seeds. The results were dramatic. Production
was 10 times as great. In evaluating the event, the farmer was asked
for comments. To the amazement of the questioner, he indicated he
was not planning to use the seed again. “Why?” Asked the city-raised
Indian agricultural engineer “Because I have no room to store that
much extra production, my cows can’t eat the plants that are left on the field after the crop is harvested and I have no way to get that much production to market.” In other words, the engineer had used productivity as the only criterion, not taking into account social and collateral activities associated with the crop.

3.5 Technology Transfer Strategy for Large/Complex Products/Systems

A generalized technology transfer strategy development plan is depicted in Fig. 3.12 and a description of major activities of this plan follows. To understand this approach clearly and to operationalize the concept, real research project execution and actual organizational experiences are needed. Hypothetical examples cannot easily convey the organisational and individual behavior contexts that effect technology transfer.

Figure 3.12 – Technology Transfer Strategy Development Plan

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3.6 Technology Absorption, Adaptation and Transfer Mechanisms

"Man’s will transforms rocky dry land into a blooming garden"

Dr. APJ Abdul Kalam

During the sixth Plan period, the government issued the comprehensive Technology Policy Statement (1983), stating its objectives with regard to the development of indigenous technology and the efficient absorption and adaptation of imported technology appropriate to national priorities and resources. Its aims, inter alia, were making maximum use of indigenous resources, providing a maximum of gainful and satisfying employment, minimizing capital outlay, and promoting modernization, fuller capacity utilization, and energy efficiency. The Policy Statement noted the need for a system of efficient monitoring, review, and guidance, and a scheme of incentives and disincentives.

The Seventh Plan (1985-1990) was formulated at a time when there was widespread concern about raising productivity in the country to meet the need for faster growth and a “resource crunch”. The Plan emphasized the consolidation and modernization of the S&T infrastructure and the promotion of certain “thrust areas.” and also the undertaking of work in frontline areas of new technology that had emerged. The Plan pointed to the need for S&T missions and linkages of S&T with the rest of the economy.

3.7 Factors in Technological Development

From the analysis of S&T self-reliance at the overall level and the industry studies, a number of policy and structural factors in technological development emerge.
3.7.1 Policy factors

(i) Import substitution: Industrialization itself is an important source of accumulation of technological learning. In the sense, the import strategy of the government, which fostered the development of a wide range of industries, is particularly important, because the presence of these industries facilitated the unpackaging of technology imports, and hence helped absorption.

(ii) Human Resource Development and S&T Infrastructure: The expansion of infrastructure for technical and higher education under the Scientific Policy Resolution, 1958, which ensured an adequate supply of qualified S&T personnel, has been of great value for S&T self-reliance. It has facilitated the quick replacement of foreign personnel and absorption of imported technology. In addition, the network of national laboratories has proved to be a major source of expertise and of other technical services such as testing, standards, and technical information. The more extensive the laboratory-industry linkage (as in petroleum refining), the greater is the likelihood that the laboratory will be an important source of innovation, the greater the market orientation of the .

(iii) Direct intervention: In all the industries studied, the public sector enterprises-i.e. HMT and BHEL in the engineering industries and CEDOs such as EIL, PDIL and FEDO in process industries - emerge as the nuclei for technological development. This is particularly significant, because in all these areas, except machine tools, there were
high entry barriers for innovation, as a result of large minimum scale of R&D activity.

(iv) **Protection of indigenous technology:** The industry studies uphold the view that local technology development is like rearing an infant: the industry requires protection and support in the initial period, but finally grows up. In these areas, effective protection of local technology, at least until the late 1970s, facilitated the local ownership of user industries, as in power generation, petroleum refining, and fertilizers; and in the case of machine tools, this was achieved by quantitative controls over imports. The existing technology import regulations alone could not guarantee protection to local technology in general.

(v) **Technological maturity and pace of technological change:** S&T self-reliance is achieved more easily in industries with relatively mature and stable technologies, such as the process industries, than in those undergoing rapid technological change.

(vi) **Nature of International Technologies Markets:** The nature of international markets, in respect of the seller concentration and the degree of vertical integration in an industry, affects national attempts to achieve S&T self-reliance. If the market for a particular technology is particularly oligopolistic, the technology may not be available in the desired mode, such as on a licensing basis. The choice of the mode of technology import has been found to influence local technological capability-building. Secondly, the degree of vertical integration of the technology suppliers of the nature of links between process (or design) suppliers and equipment suppliers also effects the attempt to achieve S&T self-reliance.
The need to develop or adapt the existing technology to suit local conditions or requirements turns out to be an important factor facilitating self-reliance.

(vii) **Research in National Laboratories**: The impulse to innovate, originates either in the production process or in the market. The national laboratories receive no feedback from either of these sources. They operate in an environment isolated from production units, do not sell innovations directly to the industry, draw their resources almost entirely from the government, and have mostly officials and scientists on their boards.

The need for more intensive links with industry has been emphasized repeatedly, but such links have largely been limited to occasionally accepting industry-sponsored research. There are two possible ways of making their research more fruitful. First, they could work more closely with the public sector. National laboratories could help these public sector enterprises to assimilate and adapt imported know-how and to generate their own.

A second possibility is for national laboratories to be made to survive more and more on sponsored research from industry. This might exclude projects with high social externalities, such as those concerning rural industrialization, basic needs, etc.

(viii) **Technology Import**: The nature of the relationship between technology imports and local in-house R&D in the Indian context has been found to be dependent upon the mode of import i.e. whether by licensing agreement or foreign direct investment (FDI). A number of empirical studies, at both firm and industry level, have confirmed that firms importing technology through FDI are much less concerned with absorption, adaptation, and in-house R&D than their counterparts.
with technology imported under licensing agreements. Hence, from the
point of view of promoting indigenous technological capability
through faster absorption and innovation, the policy ought to restrict
technology imports.

(ix) **Cost-Effectiveness of Local Generation**: A rational firm’s decision
to “make” or to “buy” a technology abroad is expected to be based
upon the cost-effectiveness of local generation. The cost of imported
technology for the importer is likely to be lower than the cost of local
development. This is because the transfer of already developed
technology, which is a public good, does not entail many costs, while
fresh generation certainly does. However, there are externalities
involved in local generation; the benefits latent in generation, such as
skill formation, instant absorption overall technological capability-
building, are all available to the country.

(x) **Time, Capital Cost and Uncertainty**: The “productionizing” of a
standardized imported technology by experienced personnel may
require a considerably shorter time than the commercialization of an
indigenously developed technology from scratch. The former is also
subject to less uncertainly and risk of failure because it has been
proved and standardized. Furthermore, with imported technology, it is
possible to phase the project cost over a period of time. Normally,
such projects begin with the assembly of imported kits, and the
manufacturing process is indigenised gradually as markets are
developed with the product assembled from the kits. In contrast, an
entrepreneur using indigenous technology has no such option. The
choice of local technology in preference to foreign alternatives,
therefore, may prove to be time-consuming, more capital-requiring and
subject to greater risk.
(xi) **Finance-Technology Nexus**[^40]: The ability of technology and equipment suppliers to provide financing plays an important role in technology selection, particularly for large capital requiring projects. Technology suppliers from industrialized countries are usually willing to provide or arrange financing on soft terms from their respective country's export-import banks or other institutions. Their bids are often backed up by their home government's bilateral aid agreements. The local technology or equipment suppliers with no matching ability to provide credits are, therefore, easily outmatched, even with comparable prices and capability.

(xii) **Market Power of Foreign Technology**: The prospect of using an internationally reputed brand-or trade-name gives a tremendous edge to foreign technology over the local ones, particularly in consumer goods. Though the guidelines for foreign collaboration stipulate that no foreign brand-names will be allowed to be used in domestic sales, they are very much in use. In fact, a number of foreign collaborations are just "cover-ups" for the procurement of the right to use foreign brand-names, and are being signed even in low-priority industries such as cigarettes. In order to make sure that only genuine technology is transferred to the country and the local technology does not face unfair competition from the market power of foreign technology, foreign brand-names have to be eliminated altogether.

### 3.7.2 Globalization:

With the acceleration in the pace of globalization in the early 1990s came the expectation that growth and development based on global market forces would be more rapid, more sustainable and more widely shared than in the past, allowing developing countries to narrow the gap with...
COST

* ACQUISITION COST
* ASSIMILATION COST
* ASSIMILATION COST HIGHER THAN ACQUISITION COST
* LACK OF ASSIMILATION LEADS TO:
  * AGEING OF IMPORTED TECHNOLOGIES
  * INCREMENTAL INNOVATION NOT POSSIBLE
  * ALWAYS PURCHASE OF NEWER TECHNOLOGY

Fig. 3.13
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industrial countries and the poorest sections of society to close the income gap with the rich. However, the empirical record has until now fallen short of this expectation. Global economic growth in the 1990s has remained below the post-war average, the income gap between the developed and the developing countries has grown wider, and the prospect of marginalization is becoming increasingly real. This has been accompanied by increasing income inequality within countries, along with increased job and income insecurity and financial instability. These tendencies have been compounded by a series of unexpected financial crises which have affected the global economy with increasing frequency and intensity in the 1990s.

There is a growing awareness that the Washington consensus, the yardstick by which development strategies have been conducted in the last decades at the instigation of the multilateral financial institutions, has severe limitations for the development process. It is, therefore, necessary for the international community to elaborate a new conceptual framework for development designed to overcome the negative effects of economic and financial globalisation and also to take full account of broader development goals.

Recent experience suggests that no simple economic law will make developing countries coverage automatically towards the income levels of developed countries. This is a result of the operation of market forces in a world of asymmetries and imbalances. The most striking asymmetry in the globalization process lies in the uneven distribution of economic power in the world economy. A second set of imbalances exists among the international economic forces themselves. The fast pace of financial liberalization had delinked finance from international trade and investment. A premium has been placed on liquidity and the speedy entry into the exit
from financial markets in search of quick gains. The growing volatility of capital flows follows from these developments.

Given these asymmetries in the world economy, the extent and the ordering of liberalization have also tended to have unbalanced outcomes. In trade, despite the liberalization process, many areas of export interest to developing countries remain heavily protected. Equally, labour markets have also remained protected in the developed countries, while capital markets have opened up in the developing countries. Moreover, skilled labour has become more mobile, whereas unskilled labour continues to face important constraints. If this continues, developing countries will be unable to build competitiveness in those sectors where real and sustainable growth opportunities are most likely.

Finally, orthodox approaches have helped developing countries to manage their integration into the world economy effectively. Liberalization of trade, domestic financial markets and the capital account have not yet delivered the anticipated recovery and growth. In the industrial countries, policy weaknesses have been one of the significant elements in these orthodox approaches. Tight macroeconomic policies have favoured capital against labour and finance against industry. Also, protectionist sentiment has emerged once again in some sectors, increasingly in the guise of technical standards and environmental and social concerns.

Globalization nevertheless remains a potentially powerful and dynamic force for growth and development. It is an evolving process which presents not only risks and challenges but also opportunities. In order to ensure that it can contribute to laying the foundations for enduring and coherent development, intensified international co-operation as well as the countries' own national and collective efforts will be essential to address
## POSSIBILITIES

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<th>REMARKS</th>
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<td>- EMPLOY CONSULTANT TO PREPARE TOT PACKAGE</td>
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<td>* INSIST ON INHOUSE TECHNOLOGY ABSORPTION CENTRE AT PSUS</td>
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<th>OPTION II</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>* ENLIST COMPETENT PRIVATE SECTOR FOR PRODUCTION</td>
<td>- LARGE SCALE SYSTEM PRODN NOT POSSIBLE (MBT, PRITHVI)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OPTION III</th>
<th>REMARKS</th>
</tr>
</thead>
</table>
| * DRDO TO BUILD DEFENCE PRODUCTION CORPORATION  
- SYSTEM INTEGRATOR  
- MARKETING | - GOOD PROSPECT * |

<table>
<thead>
<tr>
<th>OPTION IV</th>
<th>REMARKS</th>
</tr>
</thead>
</table>
| * INTEGRATE DEF R&D AND DEF PRODUCTION  
* INNOVATIVE TOT MECHANISM | - HIGH MAGNITUDE * OF CENTRALISATION  
- CONFLICT WITH DEF PRODN |
effectively shortcomings of the external environment and the constraints of underdevelopment.

It can be concluded from the above decision that the technology transfer impediments can be overcome by empowering of Indigenous Technology and fight finance & technology nexus. Approach globalisation with low cost quality products.

3.7.3 Transfer of Technology: The technology gap between developed and developing countries is wide and increasing to a significant extent as a result of the failure of existing market and non-market mechanisms that are supposed to lead to transfer of technology.

With the appearance of new technologies, productive activities can be segmented and spread around the world in different locations, and thus more countries have potential opportunities to participate in international production and trade. But these opportunities are not easily tapped by all countries. Only countries with a broad range of technological capabilities are able to host specialized activities in the various segments of goods and services production. Created technological assets, more than traditional factor endowments, determine comparative advantage in today's knowledge-based world economy.

In principle, the technological gap between developed and developing countries is bridgeable, as technology can be transferred from producers to users through the market and other mechanisms. At one stage, technological backwardness was even considered an asset, as developing countries could grow rapidly with catch-up strategies and leapfrog the slower-growth front runners. However, this has not happened on a large scale.
New technologies such as information technology and electronic commerce will revolutionize the way business is conducted. On the other hand, other technologies such as environmentally sound technologies, biotechnology and new materials development present opportunities for developing countries provided they have skills, absorptive capacity and finance to adopt and adapt.

Technological knowledge includes not only knowledge on which a product process or service is based but also the organisational knowledge necessary for production and distribution of goods and services. Transfer of technology is not only embodied in machinery, equipment, intellectual property rights and managerial skills, but also occurs through other means such as training and the provision of information. The transfer process should focus on a transfer of capability, which is of greater developmental value than the mere transfer of a piece of hardware.

The establishment of transfer of technology facilities will help developing countries in assessing their technology needs, identifying technology suppliers and concluding mutually beneficial technology deals and partnerships in areas such as information technology, biotechnology and environmentally sound technologies.

Similarly, measures are needed to prevent abuses by technology right holders or the resort to practices which impede the transfer and dissemination of technology. Control of such practices is quite common in developed countries, but there is a lack of legislative measures in this regard in many developing countries.

3.8 Changing model of involving people in research and development

When contemporary participatory approaches are eventually placed in a historical content they will undoubtedly be seen as part of an emerging
MANAGEMENT OF TT PROCESS

* MANAGEMENT OF THREE TYPES CULTURES SYMBOLISED BY
  - RESEARCH SCIENTIST
  - DESIGNER/DEVELOPER
  - INDUSTRIALISTS

* CRITICAL VARIABLES FOR BRINGING THEM TOGETHER
  - COMMUNICATION — PASSIVE & ACTIVE LINKS
  - DISTANCE — GEOGRAPHICAL AND CULTURAL
  - MOTIVATION — INCENTIVES
  - TECHNOLOGY EQUIVOCALITY — LEVEL OF CORRECTNESS
    LOW
    HIGH

Fig. 3.15
83A
discourse, with variations provided by the cultural, historical and institutional frameworks from which they emerged. This view is consistent with the contextual nature of learning—human minds develop in social situations and use tools and representational media that culture provides to support, extent, and reorganise mental functioning. In turn, as more people learn of successes from a particular way of doing things— and share this experience—so the wider social system itself learns. This suggests how development paradigms can be construed as proceeding in discontinuous ‘spurts’ or ‘waves’, leading to new eras which are characterised by wider social worldviews and methods of inquiry which differ from those of earlier years.

3.9 RECIPROCAL TECHNOLOGY TRANSFER

One promising type of partnership starts with the fact that both business and IHEs must learn to use merging technologies in order to remain competitive. The traditional client vendor relationship is replaced by a partnership in which the latest information and concepts about information technology flow in both directions. We call this “Reciprocal Technology Transfer.”

A reciprocal technology transfer partnership is an excellent way to facilitate growth in its technology capabilities. Of course, it’s often not quite that simple. The issues facing an IHE include matters of venture capital, personnel, cultural differences, and legal concerns.

3.9.1 Venture Capital. Very likely, central administration will have to provide substantial up-front capital to enable a department to respond to business needs. Indeed, the institution may have to develop its own internal sources of venture capital. There is a high probability that a department undertaking partnership or contract relationships will not break even for a
number of years. The university may not recoup its risk capital within any single year or biennial budgetary increment.

3.9.2 Personnel  University have to identify individuals who can provide businesses with products and services that meet their needs. These people have to be able to work in both business and academic environments, meeting the needs of both communities while translating the activities and intentions of one to the other. These individuals will likely represent a mix of talent (for example, administrators, faculty, creative staff personnel, programmers, student employees).

3.9.3 Cultural Differences. An important difference between corporate and collegiate cultures has to do with time and scheduling. Universities benefit from flexible time schedules but are challenged in finding financing. Corporations may have greater funding flexibility but are challenged by competitive time schedules. Beyond this general difference, there is a critical, up-front time during which the relationship between the business and the university develops. This is the time needed for the business to determine if the university indeed has the talent and skills it needs and during which a pilot or proof-of-concept project can be developed.

These early, critical steps may take months. From a university perspective, they consume valuable resources without return on investment. But from a business point of view, these activities are necessary to determine if a business relationship can follow. Then after this process, it is more than likely that the business will want a project completed in a time frame that may rock the university’s usual pace of work.

The international transfer of high technology to developing countries has to be examined country by country, since the level and structure of the industrial sector are, to a considerable extent, different among them. There are many means of transfer of high technology;
(i) the import of high technology by licensing agreement;
(ii) the import of high-technology-related commodities, machinery and equipment, and plants;
(iii) the establishment of multinational subsidiaries;
(iv) joint ventures with multinational corporations;
(v) subcontracting with multinational firms; and
(vi) the participation in international R&D projects.