Development and transfer of advanced technology

The paradigm of equal partnership

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Technology transfer has traditionally been viewed as a 'donor-recipient' relationship. But in a business scenario characterized by liberalization, privatization and globalization, a new paradigm based on equal partnership is emerging. In this article we examine two contrasting case studies - one a successful and the other an unsuccessful case of technology transfer - against the frameworks of the old and new paradigms. In so doing we identify a few factors that contribute to the successful implementation of a technology transfer initiative. Many of these factors belong to the 'equal partnership' paradigm. While technology flow need not always be in two directions, the benefit flow in successful transfer is most likely to be two-way.

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Introduction

Technology is increasingly being recognized as the main vehicle of growth, and hence the subject of international technology transfer has become the focal point of the socio-political and economic activities of nation states. International technology transfer, though traditionally seen as a 'donor-beneficiary' transaction, is now being recognized as a win-win transaction for both partners, because the technology developers can derive greater commercial benefits by disseminating their technologies to other parts of the world and the non-developers (recipients) can use such proven technologies for furthering their own economic development.

But the perception of mutual benefit alone does not mitigate the issues involved in international technology transfer, because the commercial interests of the parties, coupled with the complexities of the transfer process, give rise to a host of issues specific to each project. These are aggravated by the different conditions of the nation in which the new technology is developed and of the nation to which it is transferred. The absence of an established transfer process, or rather the

non-availability of universally acceptable principles or processes of technology transfer, coupled with social, political, cultural and economic differences, make international technology transfer all the more complicated.

Yet the fact that the economic development of a large number of countries depends on the transfer of technology makes it necessary for those involved in such projects to understand what factors contribute to success. This is a need for the transferor too, as, success in technology transfer would lead to wider acceptance of the technology, which is not only a source of larger revenues but also of further innovations on either side, with beneficial consequences to both.

Prior studies

For a developing country like India, the policies of economic liberalization within the country - with its natural consequences of privatization and globalization - have created unprecedented business opportunities, especially to leverage on emerging technologies. Taking advantage of such opportunities is largely a function of the ability of the country's economic factors that enable it to participate in international technology transfer, not only as transferees but also as transferors.

In a larger economic context, it is an established fact that technology is the key for the economic growth of a nation.[1] It is prudent for any developing economy to avail of technologies that are already developed and tested for functionality, because developing a new technology often requires very heavy investments as well as trained manpower, which therefore may not make it a viable proposition.

It is a known fact that the developed nations have reached their current stage of economic prosperity by leveraging on technology. A global survey will clearly show that it is not a lack of technology but a lack of appropriate systems and methods of technology transfer that keeps the world divided in terms of economic prosperity. As the indigenous technological capabilities of developing countries are weak (by default), they have to import technology internationally. Research has shown that, in doing so, a number of obstacles might render the technology acquisition process less effective, or a failure economically and/or technically.[2] The accepted strategy for medium- and large-scale industries in less developed countries (LDCs) is to build new technological capabilities based on technology transfer with the aim of achieving competitiveness in international markets.[3] Companies in industrialized nations find it cost-effective to develop a global supplier network by subcontracting specific tasks to parties in industrializing countries, which makes technology transfer inevitable.[4]

For the transferors too, especially for large global companies, technology transfer is an established mechanism to consolidate and expand their market to gain competitive advantage, especially through joint ventures, and to popularize their technologies, but the success of such projects depends on the nature of their relationship with their partners, which in turn is determined by several other variables.[5]

While technology transfer has now become a globally accepted business practice, there are misconceptions in some quarters, especially in developing countries, that it is a one-time affair. However, as the business scenario changes rapidly, one cannot afford to treat technology transfer as a one-time affair, but as a continuous process in the organization because this is the only way to keep the business robust. A study[6] has found that the rapid globalization of knowledge production and knowledge sharing has increased the significance of technology transfer to developing countries as a potential mechanism for achieving competitiveness through learning and innovation.

But technology transfer, as a subject of study under the newer paradigm of equal partnership is still in its infancy and hence new research initiatives in this field, particularly in the context of developing nations, will be useful.

Given the inherent complexity of the subject, it is not surprising that the findings, conclusions and assertions of what we know about international technology transfer are fragmented along various specialties.[7] A survey of existing literature on technology transfer reveals that most of the studies focus on broad issues and general factors, namely, the role of the transferor's economy[8,9,10,11]; the nature and pricing of technology by suppliers[12,13]; the general capabilities of the transferee[14]; motivators for importing technology[15]; models of technology transfer[16]; public policy of the host country[17,18,19, 20,21]; the bargaining power of the two contracting parties[17]; social factors, such as religious and language similarities[19]; and so on.

In short, it is evident from the existing literature that there are few or no studies that have investigated and analyzed process-specific issues impacting the success of technology transfer.

The present study identifies a few of these specific issues affecting the technology transfer process, in particular using two contrasting case studies, with a view to assessing their impact on the success of the technology transfer initiative.

Methodology

The two case studies were selected from a set of cases, prepared as part of a larger research project on technology transfer. The contrasting cases provide the control data required to strengthen the conclusions. One case is based on a successful, and the other on an unsuccessful, experience of international technology transfer. Further, to comply with the size specifications of this article, we have substantially abridged the cases.

Case A is based on a technology transfer project, where there is a two-way transfer, from a developed nation (USA) to a developing nation (India) in the initial stage and then in the reverse direction in the second stage. In Case-B, on the other hand the transfer is unidirectional from a developed nation (Germany) to a developing nation (India). In both cases, the technologies under study have proved their operational and commercial viability in their respective nations of origin.

One limitation of this study is that the cases have been developed on the basis of data collected only from one party to the technology transfer, that is, the transferee-transferor in Case-A and the transferee in Case-B. But, in both the cases we have found that the

respondents took a realistic approach in analyzing their technology transfer projects. To put it in the words of one of the respondents, "technology transfer is a continuous process and we need to be realistic in analyzing and evaluating each project, because it is in our business interest that we learn the strategies of making technology transfer a successful organizational practice at the earliest". Helped by the realistic attitudes of the project personnel, our investigation has brought out reasonably objective and reliable data about the two cases.

Case A

IT outsourcing is now an established business practice and many Indian companies are moving up fast in their value chain by developing capabilities to provide services in the high technology segment. One of the major activities in this process is to develop customized technologies and transfer them to prospective clients. To put it in the words of a senior executive of an IT company in Bangalore, "as far as we are concerned, technology transfer constitutes the core of our activities, and transfer of technology is a continuous affair for us".

In the case under discussion, the company was given the mandate to develop, transfer and maintain an element of NextGen network technology for a telecom client. The nature of work was highly complex, involving a large code base, interfaces with different technologies and the handling of complex pieces of equipment. As the project mandate was to develop a part of a huge integrated system, the technology transfer in this case was a two-way process, which meant that the client had to transfer certain technologies to the vendor company so that the latter would understand the whole system; and the vendor would develop a part of the technology, which would then be transferred and integrated with the whole.

According to a Vice President of the vendor company, the foundation of such a two-way transfer of technology is mutual trust, especially the trust of the client in the company that their intellectual property rights (IPRs) would be protected. Also, the issue as to who (the client or the company who actually developed it) would hold the IPR of the newly developed technology is a matter of interest and concern for both the parties.

The transfer process and the different stages of its implementation are briefly described below with a view to bringing out the issues that need to be addressed at each stage.

Initiating the transfer process

This initial stage had five major activities, namely (i) the formation of a special cell or team for transfer of the technology; (ii) the preparation of a feasibility study and risk analysis; (iii) the setting of a quantified objective; (iv) the signing of the contract; and (v) the preparation of a detailed plan.

The formation of a special cell or team within the company to oversee the entire transfer activity was the first step in the process. The main task of the new cell was to interact with the personnel of the client on a regular basis regarding the project so that, over a period of time, the company's staff and the client's staff would function like one team. This would help in reducing communication gaps to a minimum. "Information technology has made it possible to carry out technology transfer from a distance," says one of the lead members of the project, "but its success depends on the effectiveness of communication between the parties involved." Another major outcome of this special cell-based interaction with the client was that it helped develop mutual trust between the parties.

In the second activity, namely, feasibility study and risk analysis, the adequacy of expertise and resources of the company to execute the project was examined. Another major aspect assessed in this activity was the level of participation expected from the client, in terms of both knowledge and equipment components of the technology. During the feasibility study, all the areas of possible risk were identified so that adequate precautions could be taken and provisions made in the contract as well as the action plan.

The next activity in the first stage was to quantify the objectives of the transfer, that is, to specify the result to be achieved at different phases of the project. In other words, one has to specify the transfer targets to be achieved by different milestones and be clear about what will be transferred and what will not.

This was followed by the most important activity of the transfer in its initiation stage, namely, the framing of the contract. Structuring and inking a suitable contract for technology transfer is an art. According to a senior executive, it is the most difficult part of the project because it is nearly impossible to decide as to what should be specified and what need not, especially in the interest of protecting the IP embedded in the technology. Though the content of technology transfer is expected to be specified in the formal contract with the client, there will always be something unwritten that the parties understand and accept as part of an informal contract.

The last activity of the initiation stage was the preparation of the detailed plan for technology transfer. The detailed plan included key milestones, criteria for milestone completion, resources (people, equipment, etc.) required for each milestone, training to be provided by the transferor and transferee, tasks to be performed by the transferor and transferee, etc. However, "a detailed plan is never detailed enough and so we should allow some room for flexibility", commented the project manager.

Creating transfer readiness

The second stage was preparing the company for technology transfer in terms of making the resources available, assessing training needs and conducting training, identifying operational tasks and assigning these to the right people, and so on. Technological knowledge and people resources for its implementation together constitute the critical factor that determines the success of technology transfer.

Preparing the people was obviously an in-house activity of the company. Training was a major tool to prepare the staff for the implementation of the project. In addition, there were other activities, like visits by both the parties, communication with each other on a day-to-day basis, surveys, conferences, video conferencing, etc. Such training

programmes were aimed at enabling the personnel connected with the project to handle each new situation in terms of the new technology, people and culture. “Project-specific training should focus especially on the intricacies of communication”, said one of the executives of the company.

The last two activities of this stage consisted of splitting the entire work into several operational tasks with quantifiable targets, so that the different tasks could be distributed among the different categories of personnel in the project. Along with the task distribution, tracking systems were also established by way of weekly meetings and reviews to assess the progress of the work. While fixing the responsibilities of each individual, special care was taken to create a reporting system so as to monitor the activities by focusing them on the common objective of the project.

Developing the technology for transfer

The development of the new technology (devices with embedded software) was the most time-consuming phase of this technology transfer case. Though this was an internal activity of the vendor company, constant communication with experts at the transferee company was essential to keep the work on track. According to one of the project managers, “the success of developing a customized technology for the client was ensured by involving the client in the entire processes of such development”.

The development of technology started with the overall designing of the device and the software structure to be embedded in the device. These two activities were carried out separately by groups having the respective specializations. The entire work was divided into units, clearly specifying technical and functional specifications to be achieved. Thereafter, each unit of work was allotted to teams for coding, at the end of which process, each unit was tested to ensure its correct functioning. This was followed by system testing, where fully developed software was loaded on the device to find out whether it was producing the desired results.

The next stage was the system integration testing, which was to ensure that the device embedded with the software was working in synchrony with other interfacing technologies. The final activity in this phase was a ‘user acceptance test’, which was conducted at the client's site, and the technology development phase ended with the client's approval that the technology was ready for transfer.

Installing the new technology at the client's site

In this stage the technology developed for transfer was delivered and made operational at the client's site. “Technology delivery and its operationalization at the client's site were the actual content of the work,” said one of the senior executives of the company, explaining the key factors contributing to the success of this stage of technology transfer. “In this phase nothing can replace the face-to-face contact between the personnel at client's site and us.”

This aspect of face-to-face interaction was all the more important for this project because the new technology from the company had to be integrated with the existing technology at the client's site. The crucial activity in this phase was assessing the results of implementing the new technology at the client's site to find out whether the objectives were achieved or not. In this stage both the company personnel and the client's personnel worked together as a single team.

Monitoring transfer and signing off

The technology transfer was not considered by the partners to be completed just by transferring technology and installing it at the client's site. It had another important stage, where the performance of the new technology at the new place was monitored and measured. The final results were assessed for their conformity with the established objectives of the project.

The performance of the new technology was monitored to make sure that it was working in sync with the other technology interfaces and was giving the desired result. During this phase the success criteria for supervising the working of the technology were established so that the technology could be left with minimum interference. On satisfactory working of the technology, the vendor company withdrew and the transfer was declared complete.

Servicing

Though the transfer was declared complete, it would be necessary to carry out repairs or make modifications to suit a particular situation that might emerge later at the transferee's site. The question then was who should do such servicing, the transferor or the transferee.

In this particular case, experience showed that, when the transferees were allowed to open the device to do such work, they mostly tended to spoil the equipment and put the blame on the transferor. In some cases, this became a dispute. Another problem in allowing the transferees to open the device and access the related software code was that it increased the possibility of unauthorized duplication of the product. The major issue involved in such situations was the protection of the IPRs that were in the name of the transferor company.

To date the transferor company has not been able to come to any satisfactory solution to this problem. Sometimes, this problem has become a stumbling block for transferring certain technologies to some clients because the transferor company has no confidence in their commitment to protecting the IPRs. As a partial solution to this issue, the company has allowed its client to access the code partially and operate them on restricted licences, which, however, is not a fully satisfactory solution.

This case reveals the fact that technology transfer is a complex process, in which several multi-dimensional and multi-disciplinary issues crop up. Even though, in this case, the transferor company adopted a very methodical approach, there remain several issues that have not been solved satisfactorily but were managed through some temporary working arrangements.

This is especially true of IPR issues involved in technology transfer. To put it in the words of an executive, “technology transfer is a continuous process

and, as the old products are phased out, the life cycle also rolls along. The scope of improvement in each technology transfer is substantial as the old methods become progressively obsolete."

Case B

Mr. Herbert Adler had six more months to retire from the company in which he had worked for 24 years and had risen to the level of Managing Director of the company's Indian operation. Looking back at his career, he believed that his nine and a half years in India had been most fruitful and satisfying.

Herbert had come to India in the year 1988 to head the Indian operation of Auto Precision Components AG, one of the world leaders in manufacturing auto components. The company was headquartered in Berlin, Germany. Herbert, a qualified engineer, who had been with Auto Precision Components for over 14 years, was known for his technical expertise and was specially selected for the Indian operation, because the company wanted him to upgrade the manufacturing operation in India by transferring advanced technology from the parent company in Germany.

By carrying out several pioneering technology transfer projects at Auto Precision Components, he had added more shine to his reputation as a technology specialist. He also realized that there were several business opportunities in India that could be seized by transferring the right technology from developed countries.

Herbert's retirement plan was to spend the rest of his life in Bangalore and he wanted to venture into a technology-based business. He was particular that the technology and the business should be something unique and useful to society, as well as a pioneering effort. His action plan involved two major activities: (a) identifying a unique technology, and (b) finding a suitable Indian partner to start the venture in India.

Search for the right technology

Herbert insisted on finding a technology which would not create an impression that he was carving out a business from his parent company. The technology should not be related to the field in which Auto Precision Components operated. Another criterion was that it should be manageable with minimum investments, both financially and administratively. The preference would be for those technologies that would help him to present the project as something for greater societal benefit. He thought that this way it would be easy to gain acceptance for his products in the market and that such a project would also increase his social recognition in the host country.

Believing that transferring of technology from the West was the best option, he started writing to his contacts in Germany and in other European countries, detailing his plan and seeking suggestions for possible technologies or sources of right technologies, which would help him implement his business project in India.

The people with whom he communicated were aware of his technological knowledge and his expertise in conducting business in India; and soon Herbert was bombarded with several technology-oriented projects. But all the proposals were similar to that of Auto Precision Components in technology as well as in size: some were even bigger, and proposed by other multinational companies (MNCs) who wanted to establish their operations in India. Herbert was willing to offer them his expertise in the capacity of a consultant but was not willing to start a venture with any of them, as he did not want to be a competitor to Auto Precision Components.

It was during one of his visits to Germany at this time that he found that a close family friend, Mr. Bob Gottschalk, was producing biodegradable cleaning products, based on a unique technology and formula. His cleaning products were steadily gaining market in Germany. Such environment-friendly products were predicted to replace all other synthetic products in Germany; and the government and many NGOs supported and even promoted such products. Encouraged by this success, Bob had already begun to expand his company by developing, producing and even licensing a new generation of thermoplastic and completely biodegradable materials. By now, Bob's company, GermoTec had developed expertise in blending and modifying such resins to special compounds and blends, concentrates and master-batches.

As Herbert interacted with Bob, he got more and more convinced that the technology of developing and marketing biodegradable products had a good future all over the world. He thought that in India such products would be most suitable for Bangalore, because he could foresee several IT-based MNCs starting their operations in Bangalore, converting the city into another Silicon Valley. These MNCs, he presumed, would prefer biodegradable cleaning agents. Another advantage was that this technology was not complicated. It was only a matter of knowing the blending formula, and the production machinery would be supplied by GermoTec. Herbert felt that this was the kind of technology he was looking for as a basis for his new venture.

He discussed his plan and desire with Mr. Bob Gottschalk, who was happy to expand his business, but felt that there were several legal and business aspects to be looked into before actualizing the plan. One of the primary requirements for bringing the technology to India was to identify a collaborating company for the new start-up, who would also accept Herbert's plans and leadership for being the sole link between the companies involved in the technology transfer.

Search for a partner

Herbert had many options for selecting a partner because he was already well known and accepted in industry circles in Bangalore. But, the primary consideration for him was that the collaborating company should allow him to run the new company as his own with minimum interference. This was a prerequisite for Bob too, because the core technology of the blending formula would be handed over to Herbert with a condition that it would not be shared with any other persons or entities. Such an arrangement was suitable for Herbert also because, by virtue of holding the core technology to himself, the control of the new company would never slip from his hands.

Though Herbert talked to a few companies, he finally chose a business group - the Pertech Group - which had started their operations in 1973 as an exclusive supplier to Auto Precision Components and with whose founder and chairman, Mr. Debashish Roy, he had a very good relationship. Mr Roy was more than willing to help Herbert start his venture, accepting the latter's terms. He also felt that Herbert's presence in the group would be useful to increase the credibility of the group, especially with Auto Precision Components, which still was one of the most important clients of the group.

Pertech Group Companies (PGC)

PGC's slogan, 'a blend of Western technology with expert Indian craftsmanship', reflected the group's strategy of technology collaboration with Western companies for leveraging advanced technologies for its operation. True to its strategy, the PGC group collaborated with world leaders. The latest in the making was GermoTec of Germany, which was unique because of its business segment. PGC developed its present day technological strength largely through the technology transfer process in collaboration with Western countries. The record of quality standards and performance of PGC was also outstanding and the group has won a great deal of recognition from global manufacturing leaders like GM, Clark and BT. The group's manufacturing facilities were certified for ISO 9001 and QS 9000.

The birth of Inviro CleanTech Ltd.

The chairman of PGC himself took the initiative in forming the new company in collaboration with GermoTec. Herbert enjoyed complete freedom in working out the terms and conditions of technology involvement and other operational details with GermoTec in Germany. An agreement was signed between PGC and GermoTec, fulfilling all the legal requirements of both the countries to form a new company in December 1998, exactly three months after the retirement of Herbert from Auto Precision Components AG.

The new company was christened as 'Inviro CleanTech Ltd' (suggesting India, environment and clean technology) with Herbert as its Managing Director. Mr. Jagadish Jain, a technocrat in his 60s, whose tenure in PGC was extended even after his attaining the age of retirement, was deputed to join the new company as Vice President. The salient features of collaboration were: (i) PGC would hold 51 per cent of the shares of the company and GermoTec 49 per cent; (ii) PGC would provide the required infrastructure; (iii) Herbert would be the managing director of the new company; (iv) GermoTec would supply the machinery; (v) the know-how would be given only to Hebert and he was expected not to divulge it to anybody; (vi) GermoTec would supply free raw materials for the first three months; and (vii) the new company could use the marketing set-up of PGC for the new product.

Commercial production

It took two more months to get the machinery from Germany. Though Herbert had been to the manufacturing facility of GermoTec and was himself a technocrat, he could not set up the production line without the help of a technician from GermoTec.

The ground realities on the shop floor were different from boardroom planning and strategizing. This had not been anticipated by Herbert, and the German technician had to spend almost two months in India setting up the plant and training two technicians and six other production boys recruited for the manufacturing operation. The new employees had to get acquainted with several activities like plant layout, machine and equipment positioning, repair and trouble shooting, material testing, quality control procedures, periodical service and maintenance of the machinery, manufacturing processes and procedures, operational procedures and norms, etc.

In all these processes, communication was a big hurdle because the German technician knew only German and the employees could barely speak or understand even English; in fact, the latter were comfortable only with the local language. This necessitated the continuous presence of Herbert at the site to speed up the installation process.

It took another six weeks to start the commercial production. After the first batch of production, the German technician handed over the operation to the Indian team and left for his parent company. However, the operations could not be carried out smoothly as the blending formula was known only to Herbert and therefore his constant presence and involvement in the plant became absolutely necessary. The initial capacity of the plant was fixed at 3,000 litres, which could be achieved by three feedings (all the raw materials in a particular proportion had to be fed to start the production). This meant that, at least three times a day, Herbert should be present in the plant to ensure continuous production, and this arrangement became an inconvenience for him. There were occasions when production was delayed or even stopped due to his inability to reach the plant on time.

Another issue was that, in case of a breakdown, either it took an unduly long time to put it back on track by 'trial and error' method, or they ended up calling Germany for guidance; and this could be done only by Herbert himself because of the language problem. Herbert was thus almost locked up in the plant.

The Vice President had his hands full with several administrative and liaison activities, which included obtaining approvals from various government agencies for the company. He also felt that his presence, unlike Herbert's, was not necessary at the plant because in any case he did not know the 'secret formula' of blending the product or the know-how of the machines involved, and hence was unable to help with anything on the shopfloor.

The market

All over the world, the eco-criterion is becoming an increasingly important factor in deciding the market acceptance of products like cleaning agents and detergents. Biodegradability of a product has gained tremendous importance as one of the major criteria for evaluating the quality of a product. Biodegradable products have always had captive markets, and Inviro CleanTech was also blessed with such markets where they could just unload their products.

Within two months, however, the company realized that such captive markets could only help in launching the new product. Inviro CleanTech pushed its products by using PGC's contacts in different institutions like hospitals, hotels and companies. One of the leading hotel chains in India was a regular customer of Inviro CleanTech. PGC and its associate companies also used this product. However, the market had not been penetrated enough to consume the continuous production of Inviro CleanTech.

Most of the marketing activities were carried out by the Managing Director and the Vice President of the company. But soon they realized that the marketing effort for the product was not adequate. In this situation they recruited a sales specialist, who was given the task in writing to bring more institutions and companies to the client list of Inviro CleanTech.

After having worked in the company for two months, the sales specialist came out with the following observations about the market: (i) the cleaning product of Inviro CleanTech carried a price tag three times higher than the other cleaning products; (ii) contrary to expectations, companies of Western origin showed very little interest in the product; and (iii) it was very difficult to convince prospective clients about the special benefits of the product, but if properly tapped, there was a huge market for the product especially in Bangalore.

Present scenario

As a company, Inviro CleanTech was not functioning the way it had been envisaged. Production at the plant became intermittent on account of the problems mentioned above; and in a way it was a blessing because sales too were intermittent. Most orders were repeat orders from existing customers and there were virtually no new customers coming into the fold. GermoTec was not happy with the performance of the new company and they also felt that PGC was not getting adequately involved in the project to make it a success.

PGC on its part had repeatedly reposed its confidence in Herbert, and failed to understand what more was expected of them. The Vice President of the company felt that all the administrative systems were in place for the company to perform; and a proper marketing effort and production streamlining would make the project a success. Things got worse when Herbert left for Germany for a month for personal reasons. The project was almost abandoned.

Lessons from the cases

The two cases narrated above present a contrasting picture of the factors affecting the successful implementation of an international technology transfer initiative. A qualitative analysis of the two cases has brought out a few lessons for those who engage in international technology transfer. These will now be briefly discussed.

Need for defining the relationship

The success of a technology transfer project greatly depends on the nature of the relationship between the transferor and the transferee. It is true that most often the technology transfer relationship is defined through a contract. However, structuring and inking a suitable contract for technology transfer is very difficult. Though a contract for technology transfer should contain the business aspects, the primary content of the contract should clarify as to what kind of technology is intended to be transferred and under what terms and conditions. The ideal contract should specify both the technical as well as the business aspects of the deal.

A close look at the nature of the contract in Case B shows that its focus is on the business aspects, with the technological aspects of the transfer being outside the purview of the formal contract, to be operated through a single person. It is clear that this contract was person-centric rather than company-centric. In such cases, the entire project depends on the availability and capability of a single person. In case A, the contract was worked out in detail and the objectives were quantified. Even in this case the respondents were of the opinion that it is very difficult to decide as to what needs to be specified and what need not.

An inadequately defined contract was a major reason for the failure of Case B. A defined relationship would mean that the concerned parties are clear about the objectives of the project and also the deliverables from each party. Any activity that could become part of the technology transfer process should find a place in the contract, with a clear indication of the manner in which it will be carried out.

Even though many of the problems and issues of technology transfer can be anticipated and, to some extent avoided, through a proper contract, the reliability of a contract (the ability of a contract to complete the project to the satisfaction of both the parties) depends on the degree with which the parties are able to trust each other and collaborate towards the achievement of common objectives. In Case A, we can observe that, prior to the signing of the contract, a detailed feasibility study, risk analysis and objective setting was carried out, whereas in Case B there was no such exercise, and the contract was prepared primarily to protect the interest of the transferor and his agent. Such one-sided transfer initiatives are unlikely to succeed.

Integrated team approach

Another major lesson that can be learned from the comparative analysis of the two cases is the relevance of an integrated team approach. In Case A, the technology transfer process started by the formation of core teams by both the transferee and the transferor, and these teams eventually started functioning as an integrated team for the transfer. The role of these core teams was to supervise the project in their respective organizations. This integrated team could be considered to be the nucleus of all the activities of the project and had several advantages.

First, as the constituent teams included key personnel from both the parties, their close interaction on a regular basis reduced communication gaps, which are usually a major barrier in technology transfer.

Second, as these core teams were formed at the initial stage itself, it was possible to ensure the participation of all concerned, right from the planning stage. Third, though the technology

transfer was executed on the basis of a detailed contract, there were several occasions when certain unspecified but pertinent tasks came up, which could be managed because of the trust and collaboration between the parties.

Fourth, as team members from both groups had the experience of working on different aspects of the technology, combining their ideas and domain knowledge was very important for integrating the new technology with the entire system.

Fifth, the core team acted as a single window for the transfer of technology and hence bureaucratic delays were reduced to a minimum.

In contrast, it can be observed in Case-B that there was no team formed for the purpose of implementing the new technology and hence they failed in integrating all the activities towards a common goal. Even the contract was person-centric and, in effect, reduced the scope of teamwork. The entire project depended on the availability and knowledge of a single person, who in turn felt overburdened and could not perform regularly and systematically to make the technology transfer a success.

It can be safely concluded that the absence of a team was one of the major reasons for not achieving the goals of technology transfer in Case B. No wonder that even the survival of the firm created through this technology transfer is under threat. Dependence on a single individual rather than on a team or an organization for technology transfer is disastrous.

Compatibility

A comparative analysis of the two cases reveals that the compatibility of the parties involved in technology transfer affects its success. The main area of compatibility is the technology itself, which means that both the parties should be operating in similar or at least related technologies.

In Case A, the transferee was a leading telecom company and the transferor was a company specializing in embedding software in telecom devices. On the other hand, in Case-B, the initiator of the transfer was venturing into a new technology (biodegradable detergents), different from his prior experience and expertise, which was the manufacture of auto components.

Compatibility with one's own technological capabilities would obviously have an impact on the interest and capability of the party to absorb the new technology. Another advantage of compatibility is that both the parties can bring in expertise and proficiency, which in turn synergizes the entire processes of technology transfer. Also, the common professional interest of moving ahead in a similar technology helps in motivating the personnel to get involved in developing and learning the new technology. In Case B, as the project progresses, the interest and involvement of the initiator diminishes and later he almost abandons the project. This may be due to his being an auto components specialist and therefore finding himself doing something which is not his forte or to his interest.

The second aspect of compatibility in technology transfer relates to common business interests. In Case A, the transferor at the first stage of transfer, being an outsourcing company, was interested in increasing its clientele, and the transferee wanted to improve its business competitiveness by outsourcing the technology. In the second stage the transferor and the transferee got reversed, but the business logic and interest remained.

In Case B, on the other hand, the transferee had no interest in the technology or business under consideration but got involved on personal grounds. Even the Indian company that joined as the partner in the JV did so because of its relationship with the initiator of the project and with the ulterior motive of continuing to get business from the initiator's former company. Extrinsic motives of this kind would not facilitate technology transfer. Thus, technological and business compatibility between partners is essential for the success of technology transfer.

IPR practices

A major factor that prevents or slows down free flow of technology is the lack of clarity on how to go about protecting the IPRs, especially of the transferor. This concern is very well reflected in both the cases under this study and probably this is the only factor on which both cases of technology transfer failed or were unable to reach fully satisfactory solutions. For example, in Case B, it was the eagerness of the technology supplying company to protect their technology that prompted them to hand over the technology to a single person on a personal guarantee that he would not spill it. This clearly reveals that the supplying company could not identify a reliable system to protect its rights and hence moved on with a personal arrangement.

A root cause analysis of the problems that led to the stagnation of the project will point to IPR issues. In Case A, there were several IPR-related issues left unanswered; they too have failed to develop a proper system for dealing with these. For example, though the supplying company could train the receiving company to do the servicing of the new technology with a mandate on their adhering to certain terms and conditions, they could not go ahead with it because they feared that, if they allowed the transferee's staff to open the device, the IPRs would be violated. So they managed the situation by allowing the client to partially open the device, which was obviously a suboptimal solution.

A recent study covering 16 countries[21] came to the conclusion that multinational firms are very sensitive to the issue of protecting their IPRs and that better methods of protection are definitely yielding benefits by inducing multinational firms to engage in many more projects of technology transfer. Thus, reliable and appropriate mechanisms (legal or non-legal) to protect IPRs are a prerequisite for international technology transfer.

In Case A, one of the respondents belonging to the senior management cadre categorically stated that they would not engage in any sort of technology transfer with companies in certain countries because of the weak legal system there for protecting IPRs.

Though the matter of IPR is largely a national level issue, a company-level adequacy in this area is achieved through the adoption of appropriate rules and practices within the organization. Besides, there should also be a negotiated agreement between the parties on these issues in the case of

each deal of technology transfer. All the evidence shows that there is no choice but to adopt a globally accepted system for IPRs to promote technology transfer.

Quantification and flexibility

The personnel involved in Case A considered clarity of objectives to be the key to successful transfer of technology. The method they adopted to achieve clarity was a quantification of objectives, which constituted one of the major activities at the initial stage.

The major advantage of having quantified objectives was that it was easily measurable and brought clarity at all levels of operations in the technology transfer process. The resource allocation against a quantified objective was easy and as a result planning became easy too. Teams with clear objectives and responsibilities could be formed based on one or a set of quantified objectives.

In Case B, quantification of objectives was not part of the technology transfer process; instead, all activities were based on a general plan, created and carried out mostly by a single person. This might have led to the loss of focus and ultimately to the loss of control over the final goal. It is possible that the lack of objectives in Case B adversely affected the team creation process and thereby blocked the implementation of the project.

Another outcome of the quantification of objectives experienced in Case A was that they were able to prioritize activities, which helped in agreeing on priorities in implementation. However, the most important outcome of the quantification objectives was that it brought in the required operational clarity to all involved personnel.

In Case-B, it is obvious that there was no operational level clarity and hence everyone was looking to a single person for any action on the project.

The most important advantage of having quantified objectives, according to one of the senior executives, was that the scope of dispute with the partner reduced because both parties had clarity about what needed to be achieved, at what time and to what quality standards.

Market study

In Case A, the technology transfer was based on a specific market requirement of the transferee to provide efficient telecom services to its clientele for retaining its market position in its country. The major criterion for choosing their transferor was its specialized knowledge and capability to execute the project. A thorough study on the availability of various technologies seems to have preceded the selection of the particular technology and its vendor (the transferor of this case) for the transfer process. Prior to signing the contract the transferor had carried out a feasibility study to ensure the technological and the commercial viability of undertaking the project on technology development and transfer. Thus ensuring the 'market fit' of the technology through a techno-economic analysis was a key step in the process, which apparently contributed to the success of technology transfer in Case A.

The case also makes it clear that the market study required in technology transfer is twofold - market study about the technology and its vendors and market study about the products and services that would be generated out of the technology.

The need for market study and its possible impact on the sustainability of the business expected to be promoted by the new technology becomes clearer by its absence in Case B. It may be seen that due to the lack of thorough market study, the promoters had to face unexpected market behaviour and found it difficult to sell their products. The basis of market analysis in Case B was a set of assumptions, especially the assumption that what is a success in the West would definitely be one in India too. However, they found that even companies of Western origin operating in India were reluctant to buy their products. It was a surprise for the promoters of the company to find that in spite of the environmental relevance of the product, the prospective consumers did not consider it a priority product as compared to much less environment-friendly products.

This case therefore illustrates the importance of market study, not only about the final product but also about the technology partner. It may be noted that the transferor company in Case B just accepted the transfer partner based on personal friendship, without any systematic search for the right kind of technical and business skills and experience.

Specific methodology and planning

As the factors that influence international technology transfer differ from case to case, it becomes necessary to develop and follow a unique methodology for each case. There are numerous factors (complexity of technology, special geographic needs, technology absorption capacity of the transferee, learning capabilities of personnel, mode and phases of transfer, the legal system and cultural factors of the countries involved, etc.), which should be taken into consideration in developing a methodology for transferring technology from one destination to another.

In Case-A, it could be noticed that technology transfer was carried out based on a specifically developed methodology. However, in Case B, there was no specific methodology and the issues were dealt with on an 'as it comes' basis. A transfer methodology should explain as to how each activity of the transfer process needs to be carried out. An analysis of Case A would reveal that all the activities of the transfer process were specified and followed in sequence or in parallel, which culminated in the smooth transfer of the technology. But in Case B, such planning was absent and hence half done tasks and unresolved problems started choking the transfer process. Thus, both the cases exemplify the role of transfer-specific methodology and planning, the first by its meticulous adherence to the process and the other by the lack of it, and obviously with contrasting consequences.

Conclusion

Considering the importance of technology for economic growth, it has become imperative for any nation to acquire it and learn its application for different purposes to make human endeavour more effective and efficient. For many nations, the only way to enjoy the fruits of good technology seems to be its acquisition by transfer of technology

by collaborating with those countries that have technologies at their disposal. For developed nations, transfer of technologies internationally is not only a good strategy but also a logical option for better commercialization of their technologies.

But the success of a transfer endeavour depends on several factors. Since a large number of such factors could be unique to the specific context of a particular transfer, it would not be possible to suggest a universally applicable method for technology transfer. It is indeed, however, a useful exercise to analyze successful and unsuccessful cases of technology transfer so as to understand the process and develop a framework and possible guidelines for the inexperienced.

The present article is an exercise of this nature and brings out critical factors. It should be noted that these factors are not exhaustive but are limited to the ones extracted from the two cases. To put it simply, the partners in each transfer should think hard in advance and identify the critical factors relevant to their specific project. On the basis of such factors, they should develop a methodology for carrying out the entire task to its logical end for their mutual benefit.

The underlying assumption in the whole process is that the transfer is beneficial to both the partners and that it is an equal partnership. All transfers should be treated as two-way transfers of technical and/or non-technical benefits. In projects like Case A, one can see that even technology flows in both directions. It is only under the assumption of equal partnership, where both parties would be benefited, that the concerns of both parties would be addressed to mutual benefit. That perhaps is the cornerstone of the success of any technology transfer.

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