

POLICIES, PRACTICES AND PREJUDICES: THE HUMAN ASPECTS OF
INFORMATION FOR TECHNOLOGY TRANSFER*

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Technology transfer has been endowed with a certain mystique. Because technology transfer is part of a much larger system, outside factors have an impact on the process and, in turn, the installation and operation of new technology affects many areas. It requires large capital, as well as dedicated human commitment, yet its long term effect is always uncertain. Still, even with the growing number of successful ventures, only a few who are involved in major technology transfer projects have an overview of the complete process; despite the extensive literature on the subject, it was rarely captured in its entirety.

In a process where so many areas are involved, information services can offer a breadth of support. It is astonishing, however, that even with the range of information needed from the conception to the completion of a project, information services within organizations are not better utilized nor is the information needed to control the project fully coordinated.

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Information managers are not usually members of the project team and information specialists, typically placed in too narrow a niche, play only a tangential role in the technology transfer process. Many do not realize that good information managers, perhaps even more so than other managers, are also generalists and must understand the organization and its aims to develop their services appropriately. But the extent of these services is too often not clear to others, unless senior management has recognized their importance, or information managers have been assertive in redefining their function in the organization.

Technology transfer projects offer exciting challenges to information managers as well as opportunities to be recognized as part of the management team. To be able to participate more deliberately in such projects, information managers must first have an integrated concept of technology transfer and be able to view it as a system that includes each area touched by the transfer process: be it people, governments, small societies or major regions of the world, as well as materials or scientific information. In closer partnership with project management, information managers will be able to provide better focused information. Realizing what information would be useful they can also supply information that others had not thought about before and offer advice on the coordination and management of project information.

To help information managers view the process in a more integrated fashion, this paper will review some non-technical aspects of technology transfer, focusing on issues related to transferring complex technologies. Moving technology from an industrialized country to a developing region presents the greatest challenges. Therefore the examples typically are drawn

from the international area and describe experiences with developing countries. Although the problems associated with development can confuse the picture, but an analysis of three decades of World Bank development work confirms that the needs and problems of developing countries fall into the same categories as those of the industrialized countries. The differences are only qualitative.^{1,2,3}

The paper touches on a variety of problems: obtaining complete or reliable information on technology transfer processes; the need to select an appropriate technology; the effect of outside factors, and other selected aspects. It closes with a suggestion to include, when appropriate, provision of information, just like provision of training, to technology transfer contracts.

The paper is limited to discussing technology transfer from one organization to another, rather than the development of new technologies from the laboratory to commercial scale; it omits discussion of transferring relatively simple technologies that affect the everyday life directly. I do not pinpoint the opportunities for involvement of information managers in each instance but the opportunities are certainly implied.

Special Challenges

Technology transfer has been central in raising living standards and allowing people to lead longer and healthier lives. But the process involves more than transmitting information or showing how to use certain tools: the experience of one group must be transplanted into a new and often very different environment. Beyond the actual knowledge of what it takes to operate a plant or use a process, technology transfer touches on or is

affected by international politics, finance, marketing and accounting, national and local laws, management and interpersonal skills, environmental concerns, safety requirements, quality control, the necessary infrastructure. The latter might include diverse areas, such as transportation, food service for workers, and schools for their children.

Information must be gathered from numerous and often diffuse sources and must be transmitted to many levels of users in ways that enable them to absorb it. Thus it is not surprising that at times neither the providers nor the recipients of the technology have a clear view of all areas involved in or touched by the process. Even institutions financing technology transfer do not always fully understand the process. Legislatures, apparently far removed from such projects, are often unaware to what extent national and international policies affect technology transfer. Major technology transfer projects also encounter problems because so many groups are involved in them. Specialists and administrators, familiar with their own fields, can be unaware of some vital information that is outside their domain of interest; insufficient coordination of information causes difficulties during technology transfer and later may frustrate proper evaluation of projects.

Because major projects are so complex, it is extremely difficult for a licensee or host country to give an exact specification of what information it would need to put a new technology into place. But neither can the seller of the technology. When problems arise, the seller is often blamed for not having disclosed all the necessary information. This may well be a problem some of the time, but one must not overlook other--though not necessarily obvious--underlying causes. Many new technologies require expensive

equipment, large organizational structures, and institutional support. Even if sellers opened all their books to the recipient and made all their information available, the success of a project cannot be assured if, for instance, the technology has been poorly selected or if the chosen site is inappropriate, management is inadequate, the technicians not trained sufficiently, the product or process is not accepted by the population, or there is a sudden change in the economy. In a developing country one has to be particularly alert not to blame the technology transfer process for problems inherent in such countries.⁴

With much hope, effort, and money invested in technology transfer projects, perhaps it should not be surprising that much of the literature has an emotional or ideological undertone. Enthusiastic reports of projects might omit mentioning difficulties that had been encountered, leaving the reader unaware what barriers were successfully removed or of the problems that were solved. Other writers stress the problems, believing that society's difficulties stem from careless or even malicious exploitation of technology.⁵ Because everyone has an inherent cultural and ideological bias, information officers and others evaluating projects, reading reports, or participating in discussions on technology must be alert to recognize subtle influences of their own biases as well as those of others.

Selecting the Technology

Selection of technology requires vision, common sense, and detailed knowledge of the environment into which the technology will be transplanted. The first step, therefore, is not a literature search to find appropriate processes. Instead, information managers can contribute to the evaluation

of the social and political environment of the host country. The specific goals and objectives of the organization (as they relate to the project) must be defined, and in the case of a governmental project, the priorities of the country must be established.⁶

The goals and objectives provide the framework that will determine and limit the choices. If, for instance, a country wishes to provide the cheapest energy for its population, for instance, it would very likely adopt energy technologies different from those it might adopt if its aim were energy independence and the restriction of energy production to domestic resources. The objectives of private organizations might be more obvious, but it is useful for information officers to be aware that governments also have their objectives and hidden agendas. These objectives typically differ from those of private organizations and may shift suddenly with a change in the internal or external political situation.

Information support is also essential for site selection, an area especially critical for large projects. Wherever a plant is intended to be built, it is vital to determine ahead of time whether local utilities can handle the added load and whether roads, port facilities, and appropriate transportation exist to bring in supplies and feedstock, ship out the product expeditiously, and dispose of waste in an environmentally acceptable way. Such an analysis of the infrastructure can be quite complex. Labor supply, housing, schools for the children of workers, or health facilities are not of the same concern in all countries and are not equally important for various technologies; nonetheless, all of these issues must be considered before the site is determined.

Although information is not always easy to obtain, many successful projects prove that considerable thought has been given to these factors. Yet two incidents in recent history show that available information was not used; both pertain to planning and transportation. In one situation, a project for an industrialized country was indefinitely delayed while the new and expensive equipment was rusting in a port city waiting to be shipped to the plant. Only train transport was available for delivering heavy equipment to the site, but no one had checked whether the equipment could pass through the railroad tunnels. Another, much more devastating failure could have been prevented in an industrializing country if transportation expenses had been realistically estimated for a project that was to provide jobs in a remote region. Work on a new plant had to be stopped when it turned out that in addition to the billions of dollars that had already been spent, airlifting the necessary equipment to the site would have increased the cost by about two billion dollars. The cost of obtaining complete information would have been minimal compared to other expenses and the cost of shattered hopes. Had cost estimates been realistic, the government would most likely have selected other means to revitalize the region.

Having selected the process and the site, the recipient must have the capability and the organization to manufacture the product, and, since the product must be sold, market knowledge and marketing ability are also essential. Thus, whether a plant is expected to supply the needs of the local population or to launch a new industry in a region, it is crucial to determine ahead of time who its customers are likely to be and whether the market is large enough to ensure that the operation will eventually be

profitable.⁷ In developing areas, where fewer people have a knowledge of marketing and failure of a major project can have devastating results, furthering market capability is especially important. Information managers cannot provide marketing capability where none existed before but can at least provide appropriate information about markets and marketing.

Appropriate Technology

For a period after World War II many believed that fast industrialization and introduction of advanced technologies would be best for developing countries. When the results turned out to be disappointing the pendulum swung back: appropriate technology is now advocated. This should not imply, however--as some well-intentioned people interpret the concept--that only relatively simple technologies, requiring few skills, inexpensive machinery, and no need for complex organizational support, should be transferred to developing countries. Appropriate technology should invest in local skills, make optimum use of available resources,⁸ and at the same time should best suit the objectives of the organization or the host country. For many companies in highly industrialized countries, the most advanced technology would not be the best choice. On the other hand, a country like Venezuela needs to do both: it must introduce lower-level technologies in its attempt to improve the health and living standard of its rural population, but, competing on the world market with sophisticated oil producers, it must also use the best methods and up-to-date equipment for petroleum processing to succeed.

The Question of Licensing

If the selected technology is not in the public domain, the organization must decide whether to develop it or license a proven process. Development of a new technology is considerably more risky. Increasing the production of a new chemical, for instance, from a few liters in the laboratory to full commercial scale is typically a lengthy, drawn-out procedure. Furthermore, a company may have to spend large sums of money and commit its best people to develop a new technology and establish a market position for the product. On the other hand, licensing a process developed by another organization can also be costly because of the technical and market risks developers have to take. Thus the final decision requires careful analysis of costs and capabilities.

Licensing agreements are complicated business transactions that must be carefully negotiated to ensure that all important points are covered. The buyer of technology is concerned about receiving complete information about the process; what that entails is difficult to determine exactly, yet details must be specified. Whether the buyer of technology comes from the private or the public sector, whether the organization is in an industrialized or a developing country, technology transfer projects can be planned rationally. Experience shows that successful projects serve the interests of both the buyer and the seller and are based on mutual cooperation. With shared trust and confidence, the difficulties which are bound to arise can be ironed out and the licensee, or the host country, can move ahead faster with its business plans.

Licensing of a process, however, is decided by managers after consulting with engineers, marketers, and lawyers, but not with information specialists.

It is hardly discussed in the information literature. Thus, for information managers, licensing is perhaps the least understood aspect of technology transfer. A number of them look at it with mistrust, partly because the fees seem unfair to them and possibly because licensing agreements vary as they are adjusted to specific situations. It may be helpful for information managers to think of technology transfer under a license as a joint venture of the developer and seller.

Licensing fees may be modified for a process that had not been fully tested; another organization, eager to make use of it, may be willing to work with the developer to test out and even improve the process. Licensing agreements may seem arbitrary to outsiders, especially when the objective of the developers or their governments is more than just the transfer of technology. Developers, at times, allow an organization to use their process because they wish to establish a long-term relationship with that group. In this spirit companies from several countries gave pilot plants to China, because China could become a strong market for their technology. Governments may enter the picture by offering loan guarantees and arranging for reduced interest rates for potential buyers of technology because a country may want to increase its business activities or strengthen its relationship with another country.

Because licensing costs are high and negotiating all details calls for special expertise, international agencies and institutions can be most useful in working with developing countries. These groups could help the countries in obtaining funds and in negotiations to enable them to transfer technologies that are appropriate for a fair cost.

Policies and Practices

Whether or not a project is financed by a government, the policies and the environment governments create have a major impact on the development and the transfer of technology, and affect projects carried out by private companies. An internal shift in national priorities can also have a strong impact on projects. When, for example, India suddenly changed its import laws to preserve currency, one of its growing companies almost went bankrupt together with the European company that developed the technology and also supplied the parts for the Indian enterprise.⁹

The funding of new projects and the viability of projects in their early stages can be affected by the changing policies of countries that may be far removed geographically. The United States, facing economic uncertainties at home with a more conservative administration, reduced the funds it made available for development projects. Russia, wishing to realign its economy, sharply decreased its interest in the Third World and is consolidating the support and reducing the subsidies made available for development to certain countries.¹⁰

The attitude of a country is not only reflected in its laws, but also in how the laws are enforced, how its bureaucrats act vis à vis technology transfer, and what incentives it offers to provide a favorable environment. Governments may offer tax writeoffs or other subsidies to encourage projects; they might allow needed equipment to enter the country, exempt it from import restrictions, and offer purchase guarantees to the producer; or, in the case of exporting countries, several governments offer guarantees against losses to companies providing technical assistance to economically or politically unstable regions. Some governments, however, wishing to build

up their country's internal technological capabilities, firmly discourage technology transfer from without. Governments can ensure development of technology and encourage technology transfer by sharing the risk and funding certain projects. But the overall effect of government intervention can be unsettling and can also endanger the success of these very projects.¹¹

Regional governments can also be influential in technology transfer. To revitalize the economy of the State of Illinois, its governor decided to establish an environment that would encourage the establishment of new technology-based enterprises, whether they were licensed or newly developed, high-tech or revitalized older technologies. In addition to providing economic incentives for companies, Illinois increased state support of education--from elementary to university levels--grants funds for worker training and re-training of older workers, and encourages research through industrial parks and support of university-industry cooperation.

Information managers can certainly recognize the opportunities for contributing to technology transfer project by providing support and also by coordinating the necessary information. Deeper background knowledge of the regions or countries involved in the transfer of technology will help all parties in the negotiations, speed up the transfer process and improve the chances of success.

Other Aspects

Managing the introduction of expensive technologies requiring costly equipment, larger organizational structures, and institutional support is difficult when the political climate is uncertain, institutional support of technology fragile, and public administration weak.

Those responsible for technology transfer must therefore be careful to evaluate the capabilities of managers and to examine the overall management structure of the host company to uncover possible underlying problems. If such problems are uncovered, the training of the managers can be modified to suit the conditions and alleviate the situation.

Training on all levels is crucial when transferring complex technologies. In addition to skills, it is necessary to impart proper attitudes towards work, maintenance, and safe practices. But adequate training--another method of information transfer--is costly. Thus, to arrangements for training must be included in the licensing negotiations.¹² A typical agreement executed by Mitsui Toatsu Chemicals, as the contractor, might commit the company to the following:

- a. . . . [provide] the necessary assistance for establishing a management organization and developing technical management of production, maintenance and materials control systems, and . . . to introduce the latest and most up-to-date methods, systems and techniques for the operation and management of a modern chemical plant.
- b. . . . provide assistance for assuring that maximum production of the plant is achieved as quickly as possible and continuously maintained, and that the management and operation of the plant is conducted as economically as feasible. . .
- c. . . . train the personnel of the Owner [licensee] . . . enabling the Owner to manage and conduct its operations without the assistance of the Contractor at the earliest practicable date. . .
- e. To carry out the Contractor's responsibility [provide] the required number of experienced, competent and professionally qualified personnel . . . to the Owner, who shall serve in the Owner's country and/or at the Plant site.¹³

If technology is transferred across borders, and especially if the level of industrialization of the countries differs considerably, the cultural differences between the developer and the host country must be overcome. Engineering construction firms working worldwide have become experienced in

modifying their operations—from negotiations to training—and adjusting them as the circumstances warrant it. Mitsui Toatsu Chemicals, for example, had systematically gathered and applied a wide range of information relevant to the transfer process and was able to turn over the operation and management of the plants it helped set in place in a relatively short time to host organizations in South Asia, Africa, and Latin America.

The company analyzed not only the technology but also the philosophy and technical preparedness of the host organization. It studied the local customs and practices, as well as the policies of the country and selected a team that could work comfortably and effectively with the host organizations. Once cultural differences between organizations or even groups within the same company were identified and project planning was adjusted to take potential difficulties into account, some expected problems did not even arise. By reducing tensions, cooperation between the contractor and host organization enhances the success of the project.

Cultural differences exist among different industries even within the same country. Different training and different practices caused some of the problems when electric utilities in the United States switched from direct burning of oil to coal gasification and liquefaction to obtain the energy they needed. The technicians employed by the utilities were unaccustomed to carry out the more complicated processes and were not fully prepared to function as well as operators in the chemical industry.

Yet one must be careful, however, not assume that cultural differences are the chief cause of difficulties when two organizations work together. In some instances the process to be transferred is so complex that the developer might not have tested it out under all the conditions which the

licensee is considering. Then, no matter how good formal information transfer and interpersonal communications are, they cannot make up for some key information that is missing. This was the case when Amoco Corporation (then Standard Oil [Indiana]) entered into a licensing agreement with UOP. Both are highly sophisticated companies, located in neighboring communities. Many discussions took place between individuals and compatible working groups, yet completing the transfer of technology took longer than either company had expected. Finally, to ensure that the process would function well under the conditions Amoco intended to use it, the company found it necessary to build a pilot plant that would provide the needed operational information.

This caveat should not detract from the importance of being alert to cultural differences. People intent to carry out the job at hand are often unaware of the impact of cultural orientation has on their work. Information managers who recognize the challenge can contribute to the project by alerting those responsible to the large body of information in the non-technical literature, which can be useful for technology transfer.

In regions where personal safety and health standards are less stringent one must test more carefully whether information about safety principles and standards is absorbed and understood. In addition to more elaborate safety measures, systematic collection of information—favorable and unfavorable—about any process or equipment being used would be most valuable for the staff and the company. Information managers can contribute by providing appropriate databases that would be easy to handle by any of the groups for whom such information may be useful. Because of the ambience of the organization in which they work, information specialists often cannot be

directly involved in the collection, organization, or transmission of project information. But they should at least be aware of the needs and where relevant external information can be found.

When a project is being planned it would be useful for the participants to know whether traits inherent in a local culture will affect the training of technicians for relatively sophisticated technologies. In countries where professionals traditionally do not work with their hands yet have inexperienced operators starting up the plant, the manner in which information is conveyed will have to be changed: the training of supervisors must be modified.¹⁴ At other times the training can be reduced. Indonesians, for instance, develop high spatial intelligence as children and have an unusual capability to think three dimensionally.¹⁵ Eskimos are often able to repair equipment better than their customary users even though they might not fully understand the operating principles.¹⁶ Thus, even though their verbal and literacy level is low, both can be trained in a relatively short time for technical jobs.

Even with careful preparation, the individuals involved in international projects may still not be completely at ease working with their counterparts in a different country.

People are often uncomfortable when working with others who behave differently from themselves. Since knowledge transfer depends not only on how much information is presented but also on what information the recipient is ready to absorb, ways must be explored to make the process easier. By becoming more aware of various cultural characteristics, managers should be able to enhance the way people of different cultures learn best, find ways to train more effectively, and speed up the transfer process.

With the internationalization of industry this culture-induced discomfort lessens as more people on all levels of the organization are exposed to other nationalities. In the future we can expect to see a growing number of joint technical projects. Instead of a single engineering construction company carrying out a project, companies from several different countries are now joining together to provide the management and design, the manpower, equipment, materials, and feedstock to build, put on stream, and carry out the initial operation of new chemical plants.¹⁷ This diffusion of responsibilities adds another degree of complexity to planning and communication. Organization of project-related information becomes an issue of paramount importance, offering new opportunities for information managers. Companies involved in such projects are strongly motivated to find ways to work around some of the problems that will be encountered; it will be interesting to see how these projects will be carried out in the future, what new patterns in technology transfer will develop, and how information and communication will change.

Information Management

For successful technology transfer the information support needed is more complex than the collection of external information on technology, and internal financial and administrative matters. In developing countries organizational structures must be built, institutions may have to be strengthened, and the information infrastructure may need added support.¹⁸ With the experiences of the past three or four decades the complexities of the technology transfer process are much better understood but project related information is not necessarily better coordinated. Information

managers and information specialists can play a major role in integrating the needed information for technology transfer projects. The improved information tools--computer, telecommunication, and new optical disc technologies--now permit information managers to consider the entire system and define how information can best be transmitted. Through organization and database structures, they can provide control over the information that has been collected.

How fast this involvement will come is uncertain. It took practically a generation after the introduction of computers before senior management of the most sophisticated companies began to view information as a resource. Managers in smaller companies and in developing countries still do not realize the breadth of information needed to transplant technology, the expense of gathering information, or the cost of not having sufficient information.

Even with better tools for transmission of information as well as improved transportation the difference in technological levels among countries is greater than before.¹⁹ In countries where information resources may not be readily available, the problem is compounded that the infrastructure for information is still delicate and the formal and informal links for exchanging information among organizations are frail. Telephone service is unreliable and expensive, making the cost of online information gathering prohibitive.

Licensors or contractors are not attuned to even consider including information support as part of their service. Most organizations or countries needing such support do not realize that they could request that information support--just as provision for training--be included in the

contract. If the host organization does not have the capability to gather the needed information such an agreement could speed up technology transfer and make later operations more effective. Information support may include a certain number of online searches or the provision for some basic market information, or for continuing information on environmental impact. The complaint from developing countries about difficulties in finding information about their homeland could also be remedied. Appropriate information about cultures and human resource management should also be provided where desirable. Such agreements would not eliminate all the tensions and discomforts between working groups but would allow better communication on matters affecting the project. Information managers and librarians who have developed a broader understanding of technology transfer would have to be the core group promoting the concept. They understand best the contribution focused information support can make.

The foregoing discussion clearly implies that systematic coordination and control of the breadth of information needed for technology transfer would allow better control of such projects and present splendid challenges to information managers. But how far librarians and information managers will be drawn into the technology transfer process depends, in part, on their vision of the role they want to play. Their participation, however, depends also to a large extent on the management and the corporate character of the organization in which they work. But barriers that exist today do not have to remain forever.

In some industrialized countries the role of information managers is gradually shifting as new information and communication tools become available, and managers and professionals on various levels use computers,

create databases and retrieve information on their own. As the information aspects of the technology transfer process fully emerge and the various information components are identified, some groups will eventually take the responsibility for coordinating the information necessary to control technology transfer projects. Librarians and information specialists should be among the managers who will provide this service.

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