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# SOME PROBLEMS OF TECHNOLOGY TRANSFER*

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Technology is defined in the Oxford dictionary as "science of the industrial arts". Transfer of technology it is said, is based on the various *elements of technical knowledge* which enterprises in developing economies have to get from industrialized countries *when they set up new production facilities.* Richard Burt, in the Christian Science Monitor, certainly hits the nail hard on the head when writing about India's research and development effort concerning defence, he admits their progress has been impressive but adds "the main obstacle to . . . . . acquisition of an advanced "black box" capability is . . . . . the ability to manufacture (this) equipment in large numbers".

The concepts of technology and technology transfer mentioned earlier are far too circumscribed as they do not take into consideration the picture as a whole. After all, the transfer of technology that we are interested in is of the know-how which solves problems, be they technical, administrative/managerial, commercial or otherwise within or without government. Burt's reference to production in large numbers and the implication that that's where the rub lies is so very true. It amounts to saying: if you are capable of handling large size organizations efficiently then you are capable of utilizing ie applying technological knowledge effectively, which is, of course, what we are looking for.

It makes most sense to improve the performance of existing assets from a resource utilization viewpoint and this may have nothing to do with functional specialization in a particular engineering discipline. For example, we are all agred as the Minister for Fuel, Power and Natural Resources stated in a TV interview in the first week of October 75 that if the overall power losses of WAPDA could be reduced from the current high of 35% it would be possible for more to go around. Surely, do we need know-how to assist us here? This requires an understanding of complexity, because whether we like it or not we are living in an age of complexity on account of the large size of organized endeavour or on account of the high level of technological and scientific brain power required to say, produce an integrated circuit on a chip no larger than a paisa equivalent to so many hundreds of transistors.

It is, therefore, not out of place to mention that in June 67 a far thinking Dutchman-Klaus von Waveren stated at the Chemical Week---AD Little Seminar at Fraunkfurt "that the widely discussed 'technology gap' between the US and Europe is a symptom rather than a cause of disparity in utilization of technology. The underlying cause is a difference in managerial environment". A little later the famous book The American Challenge by Servan-Schrieber said much the same thing. The technology gap is a myth, what we suffer from is a 'management gap' which is synonymous of resistance to change. Having a few star performers proves we cannot rely on them for too long---there simply aren't enough of them to go around. As Servan-Schrieber says "The wealth we seek does not lies in the earth or in numbers of men or in machines, but in the human spirit. And

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particularly in the ability of men to think and create. The training, development and exploitation of human intelligence---these are the real resources, and there are no others", a truism that we prefer to gloss over, do we not? Technology transfer is dependent on this.

Or as the Brazilian Helio Jaguaribe says "underdeveloped countries of western or westernized tradition are not underdeveloped countries of western or westernized tradition are not underdeveloped because they cannot master the appropriate skills. They are underdeveloped because their own elites want it that way. In order to maintain their privileges, they are dependent on maintaining the status quo. What is important is to force social change by giving new qualifications to the new generation. . . . to create a functional elite whose interests are compatible with and dependent on an increase in general welfare".

From the above we would conclude that technology can be transferred but just as it is necessary to prepare the ground when one transplants a seedling the same is required to ensure that borrowed know-how will work in an alien soil. Technical knowledge is built up over a period of time involving learning lessons through trial and error, through investment of resources directed towards a particular end or goal---usually continuity---whether it comes through diversification, consolidation or innovation. In more mundane language this means it costs money ie it has capital value. This also means it is usually purchaseable. The problem, therefore, would appear for a transferee to be able to pay the minimum for what the transferor would want a maximum. If the maximum/minimum differential can be bridged through compromise or otherwise the interface resistances dissolve permitting flow/transfer. It is as well to remember that nobody but nobody hands over anything on a plate. However, there are other constraints which enter the picture, principally of foreign exchange payments whether "one-off" or of a recurring nature, or of protective tariffs, subsidies and quotas which help to complicate the picture slowing down or accelerating the transfer process.

There are two aspects to this transfer of technology or know-how to solve investment problems

---the short term (usually 'one-off' jobs) and
---the long term.

The know-how required for each of the two stages is different and I believe an analysis provides the basis for understanding how to move forward in the application of technology or know-how to problem-solving.

The short term includes all factors necessary to ensure that a new venture is conceived/planned and then set-up. The skills involved in 'one-off' jobs are different from those required for the day-to-day routine after project completion. Such know-how can be purchased, at a price. When concluding a deal it must be ensured that arrangements are made to ensure that locals have access to an understanding of the essential coordinative and control skills required that have a direct bearing on a projects financial viability, so as to learn the underlying principles governing project progressing.

This can be ensured through the process of *general* on=the-job training under supervision of experienced *"project men"*, this training is different from functional training or even general training away-from-the-job. It is of interest to note that H Bondi says ("International Collaboration in Advanced Technology") in the 21st Ste-venson Memorial Lecture at the London School of Economics (1972) that the essential features of any advanced technology project is that it does not contain any very advanced parts. They are not systems to try out untried gadgetry. The advance lies in making them work together and the problems are less technical but more human---involving formal coordinative skills as against progressing entirely through personal push/cooperation, the latter are clearly recognizable as one-man shows.

The difficulty that arises is that those who do not have the background experience are hardly in a position to know what skills should be transferred and of course those who know, need no coaching. It is, therefore, the enlightened transferor with a longer term approach who ensures that the skills that go into the successful determination of a project are exposed, measured, studied and applied openly so that the learning process can work. Association with such transferor's are rewarding and long-lived.

It follows, therefore, that the so-called 'intermediate' technology is not necessarily simple, for even if it is scientifically or technically simple, it becomes difficult because of the mere fact that when applying simple technology and attempting to obtain the benefits of reasonably large throughputs to bring down costs (economy of size) complexity in another form rears its head ie problems of size, which require know-how of another kind to resolve. We should talk in terms of appropriate technology. We may wish to transfer stones or earth from Point A to B. It is possible for one person to look after the entire effort if say, up to 200 labourers are employed. The manager looking after this effort would at a glance know who was absent or sick, who was working better than others and so on. But supposing we had to shift the same stuff from Point A to B in much larger quantities and to a deadline. If 25,000 workers are required the same manager would fail miserably if he attempted all that he was doing when there were 200. Could he know at a glance who was absent or ill or who was malingering? Of course not. And then what of the problems payment of wages, of overtime, of transportation, of feeding, of sanitation? If we were to introduce some other complicating factors such as crushing and grading prior to movement from Point A to B we are faced with comparing a simple effort of making a small bund to that of putting up Tarbela Dam!

How can we prepare the ground for transfer of technology? A little thought will lead to the conclusion that in the final analysis on a continueing basis technology can only be paid for by technology ie knowledge for knowledge. When the basis of exchange is so very different distortions will be created over a period of time leading to severe difficulties and a breakdown of the process. One could hopefully wish that technology should come neatly packaged in a crate that just needs to be pried open and plugged in to work properly? The ground can be prepared by applying the concept of engineering economy which is the art of compromise based on the conscious application of science to the problem of economic output. When we talk of compromise, it means there are alternatives, which means we must budget or plan for scrap or waste. Let us learn to

accept less than perfection conceptually for in any case we ultimately get far less in practice! This is in keeping with the inductive method---the empirical approach of which we need so much out here. The deductive approach should be given a back seat for a number of years. In any case the empirical or scientific approach is not foreign to our heritage, it was this methodology that was the real reason for the quick expansion of Islam during the seventh and eighth centuries AC---all in a few years.

With the general background given above let us see which is the quickest way of acquiring know-how. Undoubtedly it is through licencing arrangements with agreement to export to certain areas. It ultimately costs less in this fashion and telescopes time. One can allocate money, but in order to convert the various resource inputs into viable financial output calls for managerial capability, which money cannot buy like a commodity. Through licencing arrangements it is possible to have access to the principals' methods of planning, execution and control. All this is merely saying technology cannot be produced on command. It is clear that it is knowledge not labour that creates productivity.

What are the factors that need consideration in the transfer of appropriate technology? Table 1 below provides some ideas that require consideration prior to arriving at a decision. When we look around it is easy to see that the most efficient expansion or of new projects in industry have been brought about by those organisations who have developed reasonably sophisticated managerial competence or know-how over the years. Hence the need to understand, that paramount importance must be given by those in authority towards creating receptive conditions for appropriate technology.

The tool we have for handling complexity is "organization", unfortunately our traditional concepts of organization are far too rigid or mechanistic ie simplistic to be able to adapt themselves to the unique problems facing us. What is required is flexibility. Flexibility is induced if we consciously move away from antediluvian procedures and methods (which form the sheet anchor of present-day effort) to the use of the scientific method which should become the new sheet anchor and as mentioned earlier this is older than we think. It is worth while pondering over the fact that many of our talented professionally qualified individuals have not been able to achieve much here but in other climes are functioning marvelously well despite competition and with the dice loaded against them. Why is this so? It must have to do with the different environmental conditions after all somebody's brain drain is the same someone's mutt glut!