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# TECHNOLOGY MANAGEMENT

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## Module 4



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## Objectives

1. [Technology Assessment](#)
2. [Methodology of Technology Assessment](#)
  - [Stages in the TA process](#)
3. [Technology Evaluation](#)

### Technology Assessment

Historically, every society in some way assesses the introduction of new technology in an implicit way, e.g. Tipu Sultan while-introducing rocketry in warfare made an, implicit assessment of the havoc the novelty of it would cause amongst the British soldiers, rather than its actual damage, distinctive effect. However, the distinguishing feature of present day technology assessment (TA) is that it is an explicit attempt to assess and consciously select the implementation of a new or expansion of an existing technology.

The birth of TA in its formal sense originated in early sixties when the Congress of USA, concerned with the pervasive and often undesirable effects of introduction of new technologies, especially on the environment, called for a new form of policy research and analysis to deal with the subject. TA thus, has been largely applied in USA and to some extent in France, Germany and other E.E.C. countries but very less in developing countries, including Pakistani. This is not to give the impression that since most new technologies originate in the developed countries, TA is undertaken in such countries and is of relevance to them. TA is also relevant to the developing countries. Consider, for example, the introduction of computerization in banking and insurance, farm mechanization, robotics in assembly line manufacturing etc.

Obviously their impact would be vastly different in the Pakistani context than say in USA or Japan. This would indicate that TA needs to consider the social, cultural, political, economic, and industrial environment not only of the country but even of different target groups within it. Government departments, depending upon their responsibilities, have to form opinions about technologies say construction of a major dam, extending telecom facilities to rural areas, location of a 'shooting range' for defense purposes, introduction of a new contraceptive, etc. In these tasks, technology may play from a major to a subsidiary role. Traditionally, for TA the government has relied on advice of civil servants,

advisory committees, experts, commissioned consultancy reports etc. But these advisory arrangements are generally a far cry from the full-fledged formal TA that should be undertaken to help the government arrive at meaningful decisions for public good/interest.

### Methodology of Technology Assessment

Due to the vastness and the inherent interdisciplinary nature of the subject and the complexities of the issues involved, there has often been ambiguity in defining what TA methodology should include. Here, the TA methodology is defined to include not only the listing and application of major stages in the TA process itself, but also the organization and, the management of TA exercise.

### Stages in the TA process

Several well-known authors' on the subject have listed what are considered as the key stages in the TA process. Some of these are given in Figure 1.

Stages	Porter et al (1980)	Jones (1971)	Defined by centre J. Coates (1976)	Amstrong and Harman (1977)
1	Define problem	Define assessment	Examine problem statements, identify parties interested	Define the assessment domain
2	Describe technology	Describe relevant technologies logics	Specific systems alternatives, identify macro system alternatives	State data acquisition parameters
3	Technology forecast			Technology projection
4	Social description and social forecast	Develop state of social assumptions	Identify exogenous variables or events	Whole societal features, social values
5	Identify impact	Identify impact areas	Identify possible impacts	Select impact criteria
6	Impact	Make preliminary impact analysis	Evaluate impacts	Predict and assess impacts
7	Evaluate impacts			Impact comparisons and presentations
8	Analyse policy options	Identify possible action options, complete impact analysis	Identify decision apparatus, identify action options for decision apparatus	Analyse policy options
9	Communicate results		Conclusions (and possible recommendations)	Validation, public participation

Figure 1. Stages in technology assessment

A brief explanation of the various stages is given below.

### *Problem definition*

This involves the proper specification of the problem to be studied and establishing its limiting (bounding) parameters. Automatically the questions that need to be answered are:

- For whom or what purpose is the study being done?
- Who are the affected groups/targets?
- Over what time horizon is the problem to be studied?
- What is the spatial/geographical coverage?
- The extent/range of technological options to be covered?
- What is the choice of projected societal values and structure?

It should be recognized that this stage is not a onetime exercise, but a continuous process that permits the problem to be refined and redefined as the study progresses.

### *Technology description/forecast*

The three main elements of technology description are:

- Establishing the boundary of the technology
- The data pertaining to the technology to be acquired and
- Technology forecast, which involves defining the current state of the art of the technology and projecting it into the future along feasibly attainable alternative paths.

Prior to using a technology forecast we need to decide:

- The extent of projecting past trends as compared to defining future objectives;
- The extent of considering technological alternatives;

### *Social descriptions/social forecast*

Since the core purpose of TA is to examine the effects of technology on society it is appropriate and necessary to describe the society in which the technology exists or will exist. There are various ways of describing society, such as:

- The state and stability of society (war, no political upheavals etc.),
- Macro indicators such as characteristic of the economy in terms of industrial/agricultural/services shares, income and its growth, population as characterized by male; age and educational profile etc.

- Specific descriptions of aspects such as percentage of children in the population, percentage of people in a certain income group, literacy, etc.

Some experts suggest that there should also be a description of the symbolic elements of society that the policy makers are trying to achieve or goals they have set for themselves e.g. decentralization, panchayat level planning etc. Social forecasting is extremely difficult and complex and there are very few models that could be advantageously used. The two most used approaches are cross-impact analysis and scenario construction, though they have their limitations.

### *Impact identification, analysis and evaluation*

It mainly consists identifying, analyzing and evaluating the impacts of the specific technology. It is thus concerned with producing knowledge to assess the range of consequences that will result from particular technology development. It also involves performing a comparative evaluation of the technological alternatives using broad-based criteria such as social, cultural, political and environmental concerns along with more conventional concerns such as technical performance, economic, legal and institutional considerations. The selection of criteria by which the impact of a technology is assessed is a critical step in performing TA since, in a sense, it pre-focuses the entire impact assessment effort. The impacts identified are then rated according to their importance so that the impact field could be within manageable levels. The importance of impact and the criteria followed could vary in terms of significance for the policy makers, the affected groups, the political system etc. This should be clearly specified. Each of short-listed impacts including the second order impacts are analyzed in terms of their significance, probability, timing, costs, affected parties etc.

This could be carried out in the following ways:

- Scientific analysis: Subject wise experts, are employed to conduct and analyses the impacts in their respective fields e.g. economic impact, environmental impact, psychological impact etc.
- Interdisciplinary and futuristic analysis: This covers a large range of fields and involves systems analysis and futures research. Some of the common techniques used are; expert opinion, cross-impact analysis, scenario writing etc.
- Social impacts analysis: The emphasis is on a broad set of social impacts identified for each of the short-listed impacts. The common techniques used are expert opinion, polling, morphological analysis etc. The last stage is evaluation of impacts. This basically entails the assigning of values to specific impacts, e.g. degree of environment non-pollution for a

fertilizer plant project could be assigned a higher value than the profitability, etc. The values assigned are largely dictated by the bias of the evaluator, and/or the sponsor or the social group it represents. But the primary concern is to enhance the objectivity of the TA. One of the ways to achieve this is by involvement of the stakeholders (interested parties) in the evaluation through conferences, polls, public reviews, interviews, direct participation in the evaluation team, etc. To some extent impact evaluation is implicit in initial stages of TA as well. At this initial stage itself the underlying assumptions/biases are made explicit. Several techniques are available for evaluation of impacts, e.g. dimensionless scaling, decision analyses and policy capture.

- **Policy analysis:** The policy analysis consists of two levels: the first level deals with specific policy options and is carried out in four steps: (a) formulating feasible policy options through which to implement each of the technological options, (b) comparative analysis of the policy options by using the impact assessment and evaluation, also listing there in second order and perceived impacts, (c) synthesizing the best or optimal policy or combination of policies and the strategies for implementing each technological alternative and (d) presentation of a summary comparison of the selected optimal policy options and a comparative evaluation of the advantages and disadvantages of each policy option. It may not always be possible to follow these four steps as application of one or more technological alternatives may extend beyond the scope of policy thrust itself.

The second level policy analysis deals with identifying and assessing general circumstances, obstacles, concerns and conflicts that might be associated with the technology alternatives. However, the outcome of policy analysis should be to provide the decision maker with fairly substantial, realistic and objective description of the various available alternatives, their implications, and their feasibilities.

### *Communication of results*

Effective communication of the conclusions/ recommendations/results of the study are essential to the success of TA itself. The objective of the study is to present the results in a manner that is comprehensible to the diverse constituencies, the decision makers, the stakeholders and the public. The decision-makers have to be informed of the implicit trade-offs between future and present costs/benefits/impact etc. A communication barrier may nevertheless arise with the decision-maker as he may be unwilling to assume the risk which may be assigned to various policy options. Communication

to public may pose problems as most TA studies deal with potentially controversial issues. Lastly, communication within the study team on the revision of definition of the task etc. is also important.

### Technology Evaluation

In Pakistan, the formal acquisition of technology, through licensing or purchase, has been rather small. Indigenous technology sources such as NRDC, CSIR, ISRO, DRDO, AEC, DOE, DST, collectively license no more than 400500 parties in a year and import of technology accounts for a similar figure. In most cases technology is acquired through informal mechanisms such as mobility of persons, reverse engineering etc.

Technology evaluation as a formal tool has not been applied or used in most cases of technology acquisition in Pakistan. But with the integration of the Pakistani economy with the global economic and trade systems, industrial units in Pakistan would need to be globally competitive. For exports, not only product specifications and quality but also manufacturing practices and facilities would need certification and accreditation.

This would require that the entrepreneurs carefully select the technology to be adopted. The first step in this direction is technology evaluation (TE). TE is a firm/organization level exercise of choosing a technology from amongst a set of available technologies, the adoption or use of which will optimize on a set of defined parameters. These technologies may be available from abroad, within the country, or even developed in-house by the firm/organization. TE thus differs from TA in following respects:

- TA is a macro level exercise and seeks to look at the effects of a technological development on society and more specifically on special groups etc.
- TE determines the effects of adoption of a technology on or with respect to that firm only.
- In TA the effects or their quantification is not predefined, whereas in TE the technologies are to be compared on the basis of known/defined parameters.
- TA is often more concerned with secondary or unintended effects while TE is more concerned with direct or primary effects. Once again, like TA the difficulty lies in obtaining authentic data and information about a technology. Unlike TA one needs to obtain commercial data on the operation of a technology because the final decision in TE most likely to be a commercial one.

There is thus not much academic or formal literature on TE as it is a firm/organization level exercise and seldom do firms seek to publicize the outcome of their studies. Most often the information pertaining

to a technology is obtained from the licensors or other sources under a secrecy agreement and thus cannot be made public. The process of and interface between Technologies.

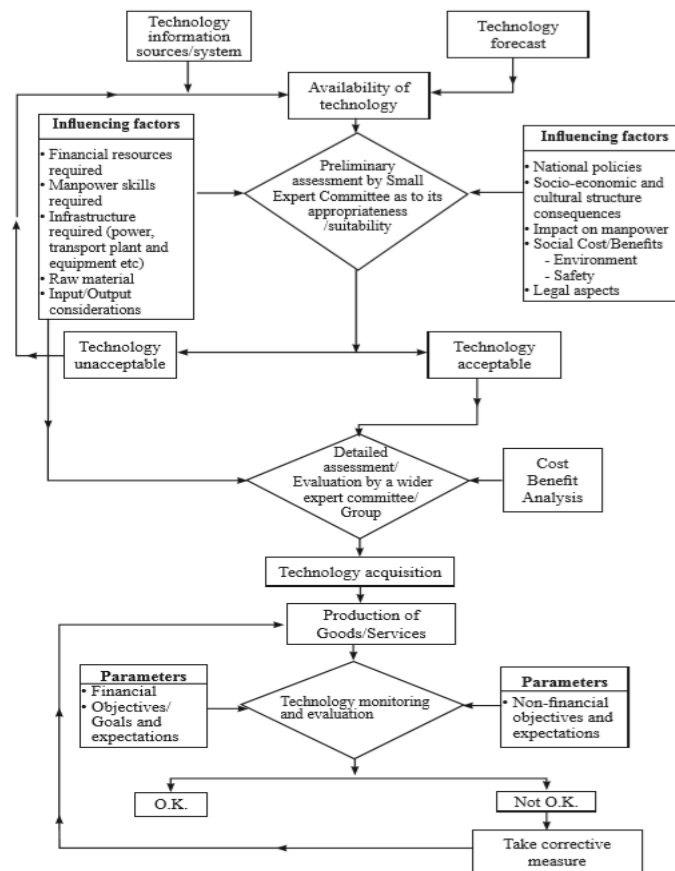


Figure: Process of technology assessment and evaluation