Science and technology in developing countries

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The author who is the head of the Electronics and Communication Sciences Department, Indian Statistical Institute, Calcutta, believes that in any country science and technology policy is a function of planning strategies in various sectors of national economy and also classical mathematical tools being inadequate, new approaches may be useful in dealing with socio-economic and environmental uncertainties inherent in the situations themselves.

ONE APPROACH is to start with the assumption that there exists a science and technology policy or any other policy up to the operational level in a developing country and then to investigate the social, political, cultural and other factors that are creating obstruction at the application level. The second approach is to make an attempt to evolve a flexible coherent policy framework on the existing base relating national goals, science policy and technology assessment for the country concerned.

This article aims at adding a small part, by following the second approach. After making a brief review of the state of the art in planning policy formulations, a fuller understanding of how the science and technology policy process can be increasingly rationalised and how methods for improving that understanding may be developed is the crux of the problem.

useful approach

In the opinion of the author simulation modelling is a useful approach to design controls which would tend to dampen out the undesirable effects of the environment. Without formulating a model as a forecasting tool, as is usually done, the outline of models should be used as a test bed on which the effects of possible present and future scenarios could be projected and long term dynamics of contributing factors and their control policies studied.

Partly because short term economic statistics and other relevant information base of developing countries are not available, econometric or state space models of these systems or economics are made obsolete shortly after publication, as the forecast enviornment in which the plans were made and optimised no longer bear any resemblance to the current environment. Even with a data base of comparatively high accuracy the credibility of these models are questionable. At present our knowledge for rationalising the formation of national science, technology or any other policy or strategy is in a primitive stage of development. Considerable self-correcting analytical effort is required before any significant progress can be made in this respect. Rather than a direct frontal approach, it is necessary to work systematically on the key elements of a policy framework. In reality decisions for expenditures on science and technology are normally

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made piecemeal and then added up to a fashion of total budget at the institutional, departmental and national level. The process is dominated by subjective, political, jurisdictional and historical factors, and sometimes, may be, by analytical considerations of goals-means relationships.

The effects of science depend on its use, and are determinate only to the extent that content predetermines use. Technology is another matter. Technology is science plus purpose. Science and technology are both option generating processes; it is only the application of technology that is option choosing. Apart from that, in any country science and technology policy is a function of the planning strategies in other sectors of national economy. In circumstances like this search for optimal policies becomes more difficult as one has to take account of uncertainty factors. Eventually the search may turn from a concern with exact optimality to a concern with identification of policies which lead to satisfactory values of the criterion function and which are robust against possible misspecification.

inadequate tools

I venture to suggest that the classical mathematical tools are inadequate and new approaches may be useful in dealing with socio-economic and environmental uncertainties that are inherent in the situations themselves. The search will bring planners close to control engineers to work on the concept of fuzzy sets[1] and algorithms, which may permit solution of approximately specified problems.

The concept of fuzziness as enunciated by Professor S. A. Zadeh[1] has been extended to algorithms, learning theory, pattern recognition, probability theory [2,3,4,5] and decision-making processes. The theory has also been extended to fuzzy mapping and control which will be pertinent to the study of social and economic systems, and control systems of incompletely specified processes. Many famous economists rightly confine their studies to trends or abstract models and avoid using exact mathematical descriptions. On the other hand control engineers tend to treat their mathematical models of physical systems as exact and precise, though they know that the models are neither. The present author suggests in both cases to have computer simulation methods using fuzzy mathematics or any other similar approaches, which represent exactly the inexact state of knowledge. In this way our highly pluralistic and decentralised civilization may be pro-

gressively tuned and improved to serve the needs of both society and science more effectively.

References

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