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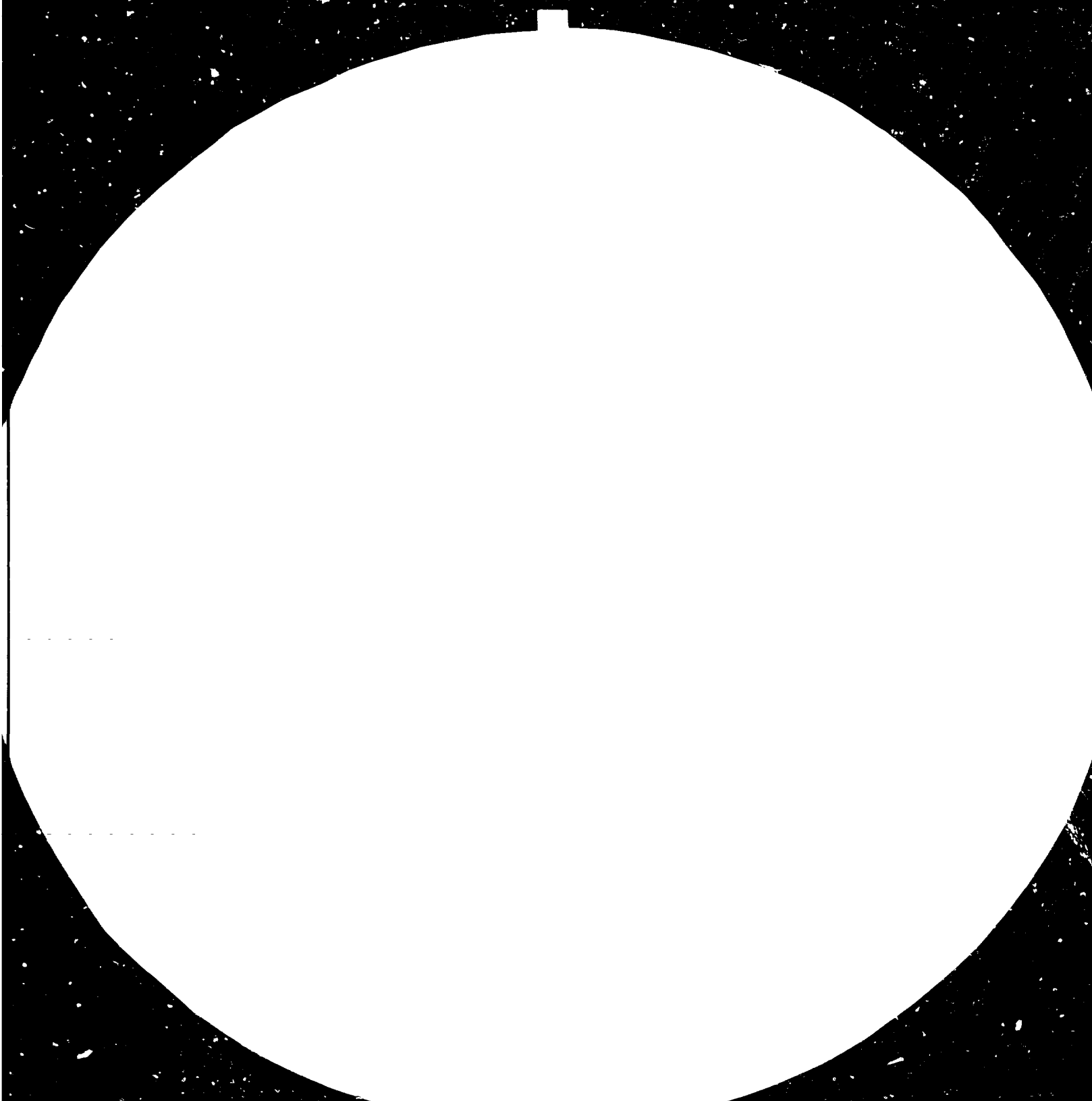

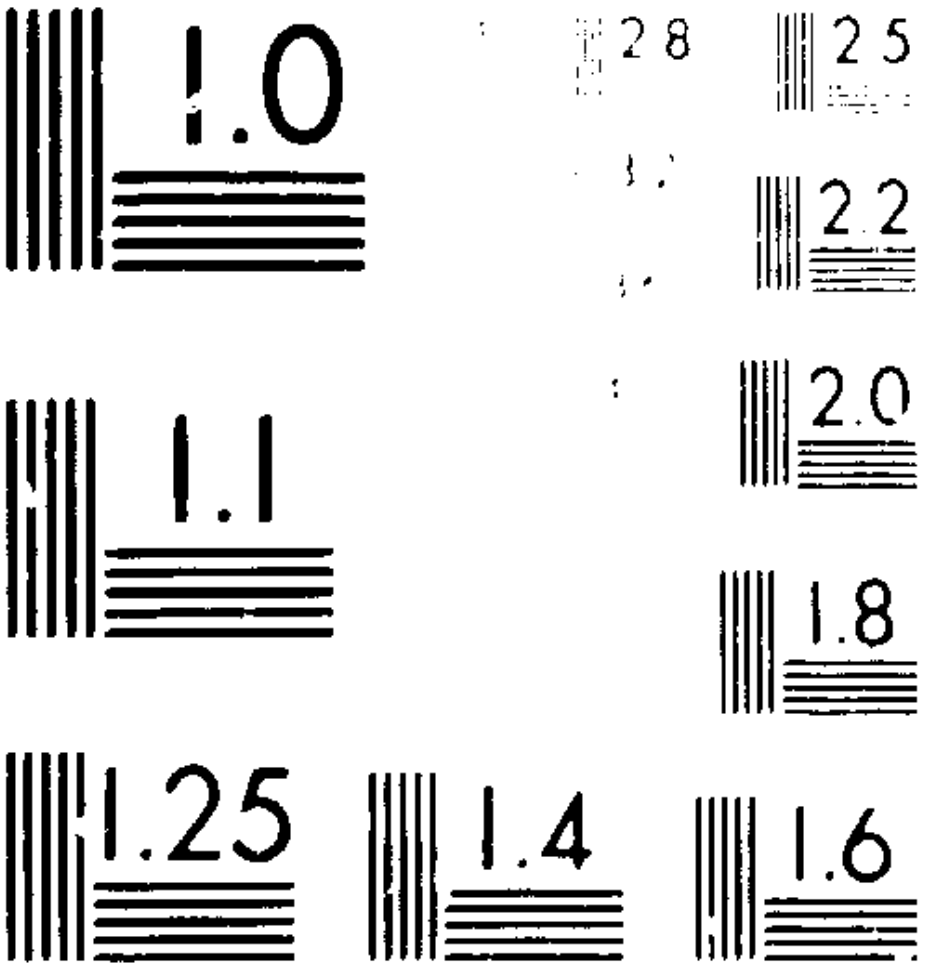
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INSTITUTIONAL AND STRUCTURAL CHANGES:

MEANS AND MECHANISMS*

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Contents

INTRODUCTION

An attempt is made here to identify policies, means and mechanisms by which the institutions and structures in developing countries could be strengthened and reoriented or new ones set up, to meet the challenge of technological advances.

For this purpose it is necessary to consider what exactly is the character of technological advances and the challenges posed by these advances and also to review the current status of existing industrial and technological institutions and structures and their weaknesses and strengths.

Technological Advances Character and Challenge

Technological advances are more and more science based. Basic research at the structural and molecular level is interdisciplinary. The gap between basic research and productions is greatly shortened. Technological advances appear to converge with a synergistic effect, and the combined impact on industrial, economic and social structures is very large. Technological advances affect 65 per cent of the existing industries bringing about new processes, products equipment and materials of construction, uprooting the existing industry and changing the patterns of technology transfer and international technology markets.

Fortunately, technological advances do not conflict with existing technologies, in fact, they help upgrade traditional technologies and hence decentralised production is made possible. Technological advances could be used with advantage to improve the quality of life and enhance rural development. Biotechnology, genetic engineering and microprocessor combination could convert the abundant biomass in developing countries into food, fodder, fuel, fertilizer, chemicals, composite materials etc. Technological advances appear to be specially designed and tailored to developing countries' needs and resources with an opportunity for leap-frogging and providing an alternate pathway for industrial development. Technological advances are versatile, efficient and economic and it is imperative that developing countries participate in this new adventure.

Certain common characteristics of technological advances may also be noted that necessitate a change in the attitudes and structures.

Whether it be in research, education or policy making an interdisciplinary integrated systems approach is called for, with closely knit forward and backward linkages. Technological advances are based on innovation flow and rapid changes are taking place. This calls for an environment for creative innovative flow and a dynamic, flexible venture-oriented, risk-taking management. The emphasis is also on quality; excellence with a change in levels of skills and demanding new skills. High intellectual inputs are brought to bear on the ground level problems. There is a need for new orientation in education, training and research and in management perspectives and attitudes. It is important then, that both the public and decision makers should be vigilant and aware of the impact of technological advances and look out for change instead of waiting for it to come and overtake in its sweep.

Because of the existing heavy industrial infrastructure industrialised countries may not develop all the areas of technological advances and all the more reason for developing countries to get into the generation and utilization of technological advances. As such a development is costly and risky, co-operation among developing countries becomes imperative with enough room for international co-operation.

A Review of Institutions and Structures

The spectrum of technology for industrial development covers not only science and technology institutions but also the industry, business firms, banking, labour, education, government and finally the enterprising spirit of the people. Under each category again, there are different types of institutions and structures. It would be difficult therefore to cover all these in detail. However, some pointers and directions could be considered there.

The conditions in developing countries vary. Some do not have the necessary infrastructure at present. Some have to begin from the very start and some have to fill the gaps to complete the structure. Where institutions exist, several weaknesses have been identified like lack of political will and commitment, clear policy, goals, management, finances, risk capital, linkages, inform-

ation, markets, industrial experience, trust, authority etc. Some suffer from gerontology both in men and machinery. Researchers blame industry; industry blames banks and banks blame government and government blames everybody. The common research - industry culture and the interdisciplinary task force approach to problem solving are less visible. Therefore changes are needed in these institutions and structures to meet the challenges and character of technological advances.

Science Technology Institutions

Industrial technology is imported or indigenous. A network of institutions as indicated below is needed for science and technology competence building. They may be promotional, regulatory or service institutions but each institute should have clearly set goals, functions and programmes.

1. Goal Setting - These may be policy and planning bodies like National Council of Science and Technology (NCST) and Promotional and Co-ordinating Agencies (PCA). Each institute must have set goals and creative leadership. The goals must reflect societal values and must be dovetailed to national needs and priorities. Technology policy must be integrated with other national policies like education, industry, commerce etc.

2. Technology Information and Awareness Intelligence and Technology Assessment No matter how small, it is important for every country to set up a small core expert group for each priority sector, to collect information, analyse and assess, and keep the decision maker and the public aware of the implications of technological advances. Similarly a small interdisciplinary group of economists, planners, social scientists, scientists, bankers, industrialists may assess and arrive at development alternatives and choices for the decision maker to take. Both these do not require large institutions, though the task is important and the need is imperative. Small core groups can be trained for this purpose.

3. Technology Imports and Acquisition - Similarly for technology imports, it is necessary to set up a technology registry; technology banks to identify the gaps between the existing technologies and the need for import or generating indigenous technology, to build competence for negotiating,

and acquiring imported technology. Many developing countries need this competence equally urgently. Imported technology comes in various forms. Ability for unpackaging a technology package is critical. A proper institutional mechanism is needed badly in developing countries for technology assessment and acquisition.

4. Technology Generation - Research is both basic and applied. Experience shows that research in isolation achieves little. Research should be relevant and excellent and should be an integral part of the development process. Technological advances place emphasis on basic research and the interdisciplinary task force approach. Changes are needed to modify or break the existing rigid structures in education and research. This may be achieved by first identifying national projects defining technology tasks and components and assigning each component to a competent task force, providing good leadership, funds,authority and responsibility to the team leader to get on with the job. Time and again, it has been proven that where goals are set, tasks defined clearly, the task is done on time if not ahead of time. Such task forces may be formed drawing on the best of the talents from different existing institutions bringing about the much needed interdisciplinary, interorganisational approach to solving a problem. Financial control is the subtle tool. Major funds will be made available only for such task forces and not for individual research projects.

Yet another way is to couple the older institutions with newer institutions. The leather or food research Institute may jointly undertake research programmes with biotechnology, genetic engineering and microelectronics research institutes or groups.

Research captive to the industry or an all inclusive institute, integrating from basic, applied research through production and commercialization like atomic energy would prove more effective. The mobility of scientists between university, industry and R&D institutes should be encouraged to get a fresh flow of talents and to build a common culture. The rigid administrative rules and structures have to change. Yet another important thing is to introduce technology manpower audit in industry to ensure that a greater number of trained scientists and engineers is employed

in industry. This will improve the interaction between research industries and research institutes.

Venture oriented, flexible, decentralised, participative management and creative leadership is essential both for education and research and for industry particularly to deal with technological advances. Similarly, venture oriented risk and seed capital is needed. Consultancy firms should be a good cross link between research institute and industry. In building new institutions, neither the "man centred" approach nor the "master plan" approach but a combination thereof may give better results. Also it is important to choose only a few areas to build competence and excellence as research takes money and long lead time. But in all cases active involvement of the industry from the beginning will prove fruitful.

5. Science and technology institutes also cover technology delivery and utilisation like technology transfer centres, extension service centres, polytechnology clinics, technology brokers, consultancy, design and engineering companies research and development corporations etc. Similarly technology support services like marketing management, productivity, standards, quality control require institutions and structures. Consultancy teams can play an important role in each subsystem of technology total system.

Technical Manpower Institutions

The need is for trained manpower at different levels such as skilled workers, technicians, technologists, production-engineers, managers etc. Special training is needed in the areas of technology information, selection, acquisition, transfer, adaptation, absorption and generation. Similarly special training is needed for research management, policy and planning evaluation of research.

In view of technological advances, the need is for "new forms" and not "reforms" in education and training. Both the form, content and method have to change. Technological advances demand interdisciplinary culture. The life blood of biotechnology, life sciences, environmental sciences etc. is interdisciplinarity.

Similarly education, research and industry should become a trinity covering

the total science and technology spectrum. Several new experiments in the direction are setting up teaching companies, technical universities, science and technology parks and industrial R&D centres located in the vicinity of the universities etc.

Training and retraining of workers, teachers, researchers, managers become necessary. Short-term and long-term, refresher and other courses have to be planned using newer tools, techniques, science and technology toys, kits, video, television, satellite etc. Updating of skills will be both in educational institutions and at the level of industrial enterprise. Computer education is already being introduced in primary and secondary schools in some countries. The syllabus and curriculum have to be updated and new books produced.

The educational and research institution must accept "extension" as a third dimension in addition to training and research and public service as a primary function with a change in evaluation system, legitimising development oriented projects for research.

Technological advances demand rapid innovation flow. Invention and innovation promotion centres may be set up for this purpose. The developing countries' ability to exploit technological advances will largely depend upon education and training institutions and their ability to anticipate change and train necessary skilled men.

Industry

Technological advances call for change in industry management attitudes and skills, and induction of a greater number of scientists and engineers. Thanks to computer aided design and computer aided manufacture and computer aided information techniques, decision making becomes fast and accurate. A greater awareness of the fast changes taking place is important. The accent is on quality and excellence. Some technological advances do help decentralised production and centralised management. A smaller firm may have greater innovative ability so needed by technological advances. A new brand of scientist entrepreneurs may come into industry. Industry should be closely integrated with education, research and banking.

Every person may have to change at least three jobs in his/her life time requiring better or newer skills. More intellectual skills and less physical labour may be needed. The age and the skills profile of labour force is crucial. Training and retraining at all levels will be necessary. Reduction in employment or displacement or relocation of jobs may create problems of social tension and social security. Similarly technological advances may result in additional leisure time that may lead to boredom. All these and more are likely to affect management labour relations. The management has to anticipate such problems and make the present structures more flexible and resilient to change.

Development Banks

Banks have a major role to play. As partners in industrial progress, banks must realise that technological advances call for more venture oriented capital and capital for replacing existing equipment and for retraining of people etc. Technological advances need constant vigilance and assessment. The competitive edge they provide has to be understood. The traditional thinking of the banks for stability, security and safety must change.

Government and People

If technological advances are for people, people should be involved and there should be a social control. There should be an awareness of technological advances and their impact on society. The people should also participate in public discussion and debate on these issues. Their ability to absorb technological advances and thirst for newer ones should be increased. For all these, some old and new institutional structures have to be thought of.

Recognising the character and impact of technological advances the government must face the challenges posed and provide political will and commitment, funds, laws, centres and the necessary environment for technological advances to thrive.

Conclusion

From this account it is seen that technological advances have a character of their own and pose challenges to the existing technical and industrial

institutions and structures. The innovative, interdisciplinary, integrative, fast changing character of technological advances forces changes in perception and attitudes of the management and a new orientation in industry, education, research banking and government institutions and structures. Some of the means and mechanisms to strengthen or reorient the existing structures and to build new ones have been indicated. The opportunity costs for developing countries for not participating in technological advances is high. The time is now for developing countries to act.