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PLANNING COMMISSION
MINISTRY OF PLANNING
GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
SHER-E-BANGLANAGAR, DHAKA

Theme: THE "RESIDUAL" AS THE CRITICAL FACTOR OF INDUSTRIAL GROWTH IN BANGLADESH

Paper ; **AN INSTITUTIONAL ARRANGMENT FOR TECHNOLOGY TRANSFER AND DEVELOPMENT ; A PLAN OF ACTION FOR A LEAP FROG IN THE "RSEIDUAL"**

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AN INSTITUTIONAL ARRANGEMENT FOR TECHNOLOGY TRANSFER AND DEVELOPMENT : A PLAN OF ACTION FOR A LEAP FROG IN THE 'RESIDUAL'

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Introduction:

In the industrialization of Bangladesh, the first choices with respect to technology were comparatively easy. Industries which could help the growth of agriculture, agro-based industries, e.g. jute and traditional production units for import substitution such as textile, sugar, steel rerolling mills etc. got preference for obvious reasons. The technologies involved were not complicated. For instance, textile, jute and sugar technologies are simple and repetitive. But succeeding choices are more difficult. The next choice is for more intermediate products, complex technology and needs higher skill levels. These choices are difficult, and require extensive background studies and search, and highly qualified scientists and technologists to advise.

Recent studies made for the Planning Commission indicate that fiscal and financial policies had very little impact in improving the total factor productivity or increasing investment in industry. One speculation is that it is perhaps due to lack of emphasis on technological innovation. According to Nobel Laureate Solow, over 87% of the growth of the US economy between 1900 and 1950 was due to productivity enhancement largely attributed to technological innovation.

Towards Technology Based Planning:

With the acceptance of technology as an important strategic variable in development the need emerges for establishing modalities and institutions for the critical process of integration of technological considerations in national planning. Obviously, depending on the government policy planning practices and preferences, such modalities, procedures and institutions

will depend on the changing situation in Bangladesh. However, there are certain elements in the planning process which remain common to all situations. These elements include, interalia, planning mechanisms of different agencies at various levels, institutional arrangements for technology assessment procedures, the policy instruments formulation and modification from time to time, the operational linkages necessary for plan implementation, and the monitoring and review mechanisms at various levels.

Some Necessary Steps in Integrated Planning:

The integration of technological considerations during the national planning process can be viewed to take place involving certain basic steps, viz.,

* Establishment of a Vision and Development Goals.
* Building a scenario in the form of long term Perspective Plan which identifies certain strategic areas for development.
* Acceptance of Technology as an important Strategic Variable.
* Classifying national development plans, programmes and projects into three technology domains, viz., Importing Technology Domain, Evolving Technology Domain and the Exporting Technology Domain.
* Establishment of public as well as private sector technology assessment mechanisms at appropriate functional levels.
* Clear identification of the technological gaps and opportunities based on above analysis and prioritization of remedial measures based on overall development goals.
* Introduction of governmental intervention mechanisms in the form of legal, fiscal and financial policy instruments in order to bridge the identified gaps, explore the potential and promote development in the strategic areas taking into consideration all the four components of technology.

* Implementing investment decisions to bridge the gaps, explore the potential and promote development.
* Introduction of review, monitoring and feed back mechanisms at appropriate levels.

Rationale for Governmental Initiatives

End of the colonial era after World War II ushered in an era of development planning for newly independent countries. Some degree of government intervention and central direction of the economy have been evidenced in practically all developing countries. Particularly, the South Asian countries chose to implement their development plans through a mix of investment allocations, guiding policy instruments and restrictions on market mechanisms. However, after nearly four decades of such planning efforts these countries are no-where near the growth in productivity shown by some East Asian countries during this period. The latter countries have made rapid progress through liberalization, export promotion and private initiatives. Nevertheless, even in these countries, the first initiatives for injecting technology in the economy for higher productivity were taken under the aegis of active intermediaries in the public sector. While the South Asian countries try to follow the policy prescriptions for liberalization, the vital catalytic role of the government in promoting technology should not be underestimated.

The rationale for government initiatives in national technology based development efforts can be summarized as follows:

- Inability of Private sector to appropriate adequate share of total gains for such efforts.
- Imperfections in capital markets, which precludes automatic provision for bringing about technological changes.
- Inadequacy of market mechanism to coordinate and direct large scale cross sectoral development initiatives.
- Social failures in the dissemination of desired level and

intensity of scientific and technological information.

Additionally, some form of central direction is perhaps necessary because:

- Human Resource Development and building of technological capability can only be viewed from a country wide perspective.

- Strategic macro-level implications of international trade need to be appreciated centrally.

Creation of appropriate climate for technology is one of the principal prerequisites for technology based development. In addition to the conventional ministries, government departments and agencies, some special efforts and institutional initiatives are called for if creation of proper technology climate is to be aimed at in the country. From a survey of the special policy measures adopted by the countries in the Asian region it appears that those with success records in technology -based development had set up some key institutional arrangements for absorption, adaptation and improvement of imported technology as well as innovation of products for international trade. In addition, they had instituted mechanisms for interest coordination and overall formulation and review of cross sectoral programmes for technology development and trading in technology.

Technological needs of Bangladesh industry:

The downward trend of commodity prices in the world market, and the depletion of non-renewable natural resources through increased export make it essential for Bangladesh to diversify its industrial base and export manufactured goods of high technology content for improving its balance of payment situation. But, Bangladesh is realizing that once it competes with the developed economics in the international trade, its

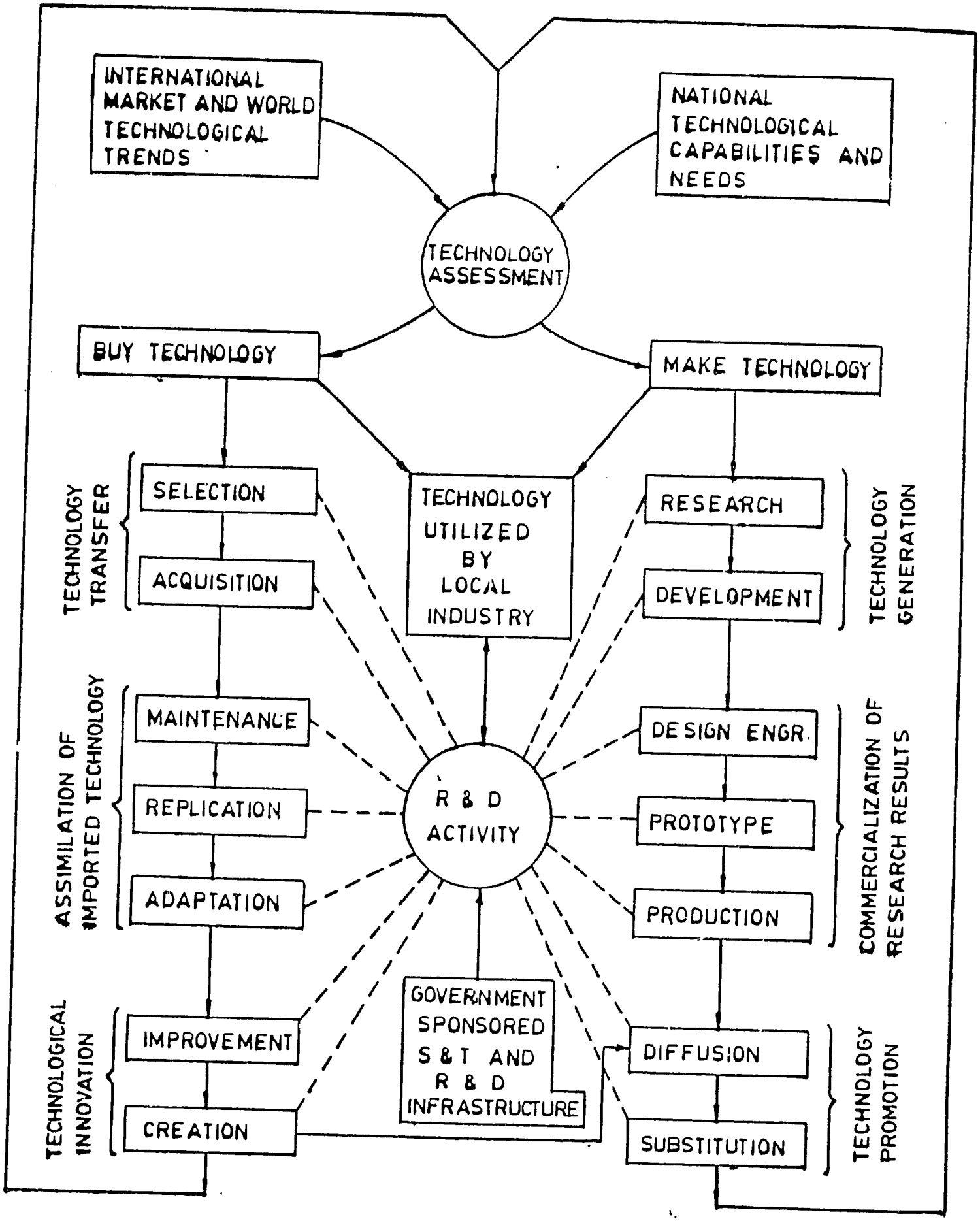
industry must be based on modern technology. Furthermore, in an increasingly interdependent world, a deliberate emphasis on carefully selected areas of specialization and adoption of the make-some and buy-some technology strategy are essential for sustainable development. Therefore, decisions on new industry that do not take proper account of world technology market may commit financial resources to less production ends.

In the beginning most industries in Bangladesh will have to be based on imported technology. Therefore, it is necessary to have an effective mechanism for the assimilation of these sophisticated technologies imported from industrialized countries. However, the private enterprises in Bangladesh, being very small, can hardly afford to have their own manpower and facilities to carry out this function. The necessary R&D (research and development) activities require a long-term investment which cannot be borne by small-scale private enterprises. It is, thus, desirable to have an institutional arrangement to perform the functions of selection, acquisition, assimilation and adaptation of appropriate advanced technologies for both public and private industry in Bangladesh to be able to produce exportable items. Furthermore, it is through this learning process in adapting imported technologies that the capability for producing new technologies are acquired.

Forms of Technology in Industry:

To assess the existing institutional arrangements, particularly the R&D system in Bangladesh, it is desirable to understand the characteristics of production technology in terms of its different embodiment forms.

Technology is most commonly perceived to be only the physical means as "black box" used for production. As such, the importance of the related skills, information and management are



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often not realized. Therefore to facilitate a thorough understanding and for effective policy formulation, consideration of the components of the technology "black-box" may be useful. The four interrelated components are:

(1) Technoware -- Object-embodied physical facilities like machines and factories which advances through a process of substitution of old by new for better performance.

(2) Humanware -- Person-embodied individual abilities like expertise and creativity, which advances through the acquisition of higher level skills for increased efficiency.

(3) Inforware -- Document-embodied known facts like theories and designs, which advances through the accumulation and systematization of knowledge for time compression.

(4) Orgaware -- Institution-embodied linkage frameworks like management and marketing, which advances through an evolutionary growth for better competition.

Technology is being broadly defined to include the stated 4 components because the 4 components are so closely complementary that the deficiency or weakness of one will reduce the effectiveness of other components drastically. It may be relevant to state here that economists who have raised the role of technology in production and growth to elevated levels decompose technology into "embodied" and "disembodied". the former may be embodied in machine (Technoware) or man (humanware). Embodiment in man, better known in economic parlance as human capital, includes managerial and entrepreneurial capacities as well as worker skill.

The disembodied part refers to some facets of what we have

called orgaware and inforware. Disembodied technology raises productivity and growth without any addition of or more than proportionately an increase in constant-capacity men and machines. Economists and scientists/technologists, thus, seem to agree on the broad definition of technology employed here.

Existing institutional arrangements:

Having noted the important elements of technology essential for industrial development on a competitive basis, the shortcomings of the existing institutional arrangement for technology-based development in Bangladesh may become quite apparent. First set of well known problems are:

(1) Private sector R&D is totally absent. Public sector R&D organizations suffer due to old and outdated facilities, which are not maintained properly, and hence poorly utilized.

(2) As fund allocation is inadequate, most of the R&D money is spent on salaries (employment generation!) of staff who are permanent and are engaged in research in too many areas with sub-critical resources.

(3) There is too much emphasis on producing something new (scientific knowledge) with inadequate measures to commercialize research results (technical knowhow).

(4) There is virtually no institutional arrangement for systematic digestion and adaptation of technologies imported by industry.

Besides the above set of well publicized problems, there are also more serious problems which are often not realized. Some of

these are:

(1) Activities are primarily directed to technoware (object-embodied physical facility) related R&D and the other three components of technology (humanware, inforware and orgaware) are totally ignored. Inadequate attention to the total system leads to obvious failures.

(2) The value of information (documented facts), market orientation and the importance of the ultimate resource for technological development (humanware) are very often undermined by tradition, rigid administrative control, or scientific discipline based management style.

(3) The R&D organizations are not geared to the needs of local industry and Bangladesh economy. Research is done for research's sake with virtual isolation of R&D activities from upstream (academic) and downstream (industrial) activities.

(4) No effort for strategy formulation through technology assessment, technology forecasting and monitoring world technological trend for the benefit of bangladesh industry.

To those who view a research institute as an assembly of people busily engaged in laboratory investigations directed toward the production of new knowledge, Bangladesh economy does not appear ready for such an institute. But Bangladesh industry and government need the services of an institute which can perform broader functions than just generation of new knowledge. This institute must not suffer from the problems mentioned above.

Rationale for a Change:

In order to achieve desired results, two policy options are available. The first is to evolve one of the existing institutions into one that is required. The second is to create a new entity. The first option would run into the vested self-interest as the changes required are not mere cosmetic but will involve major surgary. Therefore, the second is to be preferred. Another reason for establishing such a new institution would be an attempt to get out of the present hopelessness by testing the feasibility of something new in the Bangladesh context -- an independent institution, directly linked with industry, operated on the principle of contract research and contract employment with the potential of drawing back capable Bangladeshi scientists, engineers and economists now employed overseas.

The institute would have to be free from domination by government as well as industry; its studies would have to be objective and responsive to the needs of Bangladesh. Its services would undoubtedly include economic and engineering feasibility studies, assistance in the importation and adaptation of modern technologies, information services, and laboratory investigations. However, unless the staff has access to modern equipment, it cannot provide the services required and also preserve its technical competence. Furthermore, a schedule of reasonable reimbursement needs to be created that will permit the institute to attract and hold a highly competent staff.

The role of the institute for industrial R&D in Bangladesh will be to open a window on and develop an effective communication channel with world science and technology. It must achieve an adequate level of support for fundamental studies necessary for the continued development of its staff while giving major attention to applied studies of importance for technology-based development of Bangladesh industry.

Implementation Schedule

It is envisaged that the proposed centre, more or less to conform to the 15-20 year perspective plan, shall be developed to full maturity over a period of 10 to 15 years. The implementation schedule shall have three distinct phases viz., (1) Introductory Phase, (2) Growth Phase and (3) Mature Phase. Each phase will have a time frame of five years. During the initial half of the first phase no investment in physical plant is envisaged. During this period a core team of multidisciplinary experts will carry out an extensive technological needs and capabilities of the country in order to identify gaps and opportunities for industrialization through absorption of imported technologies and application of some locally generated technologies. During the second half of the first phase research on maintenance, trouble - shooting, replication and adaptation of imported technologies may be carried out. It is hoped that during this period the centre would begin to prove its ability to attract contract research from local industry.

During the second five year period or the growth phase more creative R&D work leading to improvement of imported technology will be undertaken. It is during this period most of the physical plant will be put in place. During this phase the centre may begin to earn some revenue to support its programme from its own income. During the final phase the centre may be expected to reach maturity when it can look forward to becoming self supporting at the end of the fifteen year development period.

List of Studies and Research activities in the first half of introductory phase

During the initial phase the proposed core group of the centre shall carry out technology needs and capability studies both at specific industry levels as well as sectoral levels. Such assessments of industries/sectors may then be aggregated to obtain the overall national technology needs and capabilities. The procedure to be followed is outlined below:

(A) An Overview of the Industry/sector and qualitative Assessment of Technological Capability.

An overview of the industry which is to be assessed is to be carried out dmainly to indicate where the country stands in the global scene. Though there can be no specific format for the overview, it should briefly deal with major achievements and capabilities of the country in comparison with selected developed countries. It will be necessary, at the same time, to carryout a general qualitative assessment of the technological capability of the specific industry/sector with reference to the same industry/sector in other countries.

(B) Sector specific studies of national capabilities

(1) Assessment of Natural Resources: This will involve preparation of natural resource profile of the country with respect to type, availability and change pattern over time, Comparisons can be made in terms of parameter such as the share of the country's resources in the global stock or quantam of resources per capita.

(2) Assessment of Human Resources: This will involve analysis of country's human resources in terms of skill distribution, labour force structure and change pattern of distribution over time. In this analyses human resource is to classified with respect to the fraction engaged in operation,

maintenance, replication, adaptation, improvement and creation of transformation facilities.

(3) Assessment of Technology Infrastructure Base: In this respect the strength and linkages of development chains of the four forms of technology (i.e. Technoware, Humanware, Inforware and Orgaware) and their linkages with common promotion agents for technology capability development such as RDI's, HRD institutions, Information services, Management, Advisory, and Development Finance institutions.

(4) Assessment of Technology Climate: this will include analyses of previous plans and programmes, their implementation performance, Existing mechanisms for making technological decisions and implementation modalities.

(C) Industry specific capability studies

For each selected industry, assessment of the following is to be undertaken:

(1) Import, Export, Consumption and Production of natural resources, semifinished goods, consumer goods and capital goods (Technoware) in the form of transformation facilities are to be assessed.

(2) Innovativeness of the industry in terms of outputs and transformation facilities (Technoware) used are to be evaluated against some standard measure. The position of the industry with respect to introduction, growth and maturity phases of technological life cycle is to be assessed.

(3) Special characteristics of technoware in terms of application have to be indicated. Existing uses of generic, cluster and specific technologies have to be analysed.

(4) Technology contribution analyses have to be carried out

using recently developed technology measurement techniques which provides means to assess the "Technology Content Added" during a transformation process in an industry. Such analyses can provide a valuable complementary measure to the conventional "value added" calculations.

(D) Identification of Needs and Strategies

(1) Analysis of national socio-economic objectives and derivation of technological areas of relevance.

(2) Forecasting world market and technological trends for guiding the analysis of technological areas of relevance. This may involve, prediction of obsolescence rates, potential substitutes, setting R&D prioprities for long range development and prediction of skill requirement at various levels.

(3) Exploring potentials for leap-frogging in technologies which are scale-neutral, system independent and in a such a state of development that eventual catch up is possible with a little extra effort.

(4) Derivation of technological needs using the basic make-some buy-some strategy and dividing such needs into three domains namely the Importing Technology Domain, the Evolving Endogenous Technology Domain and Exporting Technology Domain.

List of probable R&D activities in the second half of the introductory phase

(A) Research directed towards better maintenance of existing technoware involving trouble shooting and replication activities like prototype production of essential spare parts manufactured by engineerinsg industries. Setting up of mechanical and metallurgical standards. Metallurgical investigations on heat treatment and surface treatment of locally manufactured spare parts, tool steels, non-ferrous metals. Spare parts may be those required for general engineering use, textile machinery, internal combustion engines, railway and marine use etc.

(B) Research may also be directed towards reliability of electronic components, standardization, testing and quality control services for the growing local electronics industries. Trouble shooting, maintenance, redesign and checking of process control systems in existing industries and development of design capability in this sub-sector may be R&D objectives.

(C) Design and prototype production of selected items of food and process industries, design of relevant instrumentation for the process units so designed. Design and development need based pilot plants for agrobased industries. Redesign of existing process industries to meet stricter environmental standards.

(D) Continuation of technological measurement studies undertaken during the earlier phase. Feasibility studies, system studies, design engineering studies on contract basis.s Establishment of technological data base, procedure for regular forecasting of world technological trends (based on studies undertaken during the earlier phase) Engineering, economic & management studies on contract basis.

(E) General material testing and chemical analysis services and system design on contract basis.