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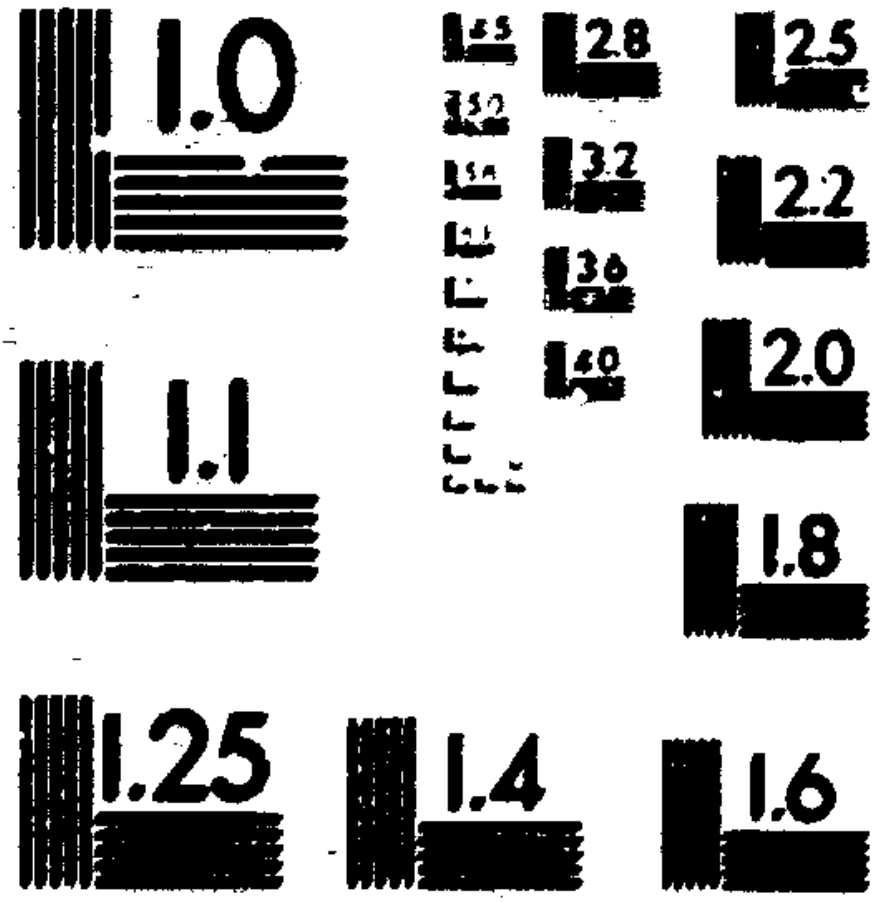

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COMMERCIALIZATION OF RESEARCH RESULTS IN PARTICULAR REFERENCE TO ENGINEERING SECTOR OF PAKISTAN*

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Today, more and more areas of our life are being influenced by technology. From nuclear weapons to nuclear power, from space exploration to satellite based communication system , from production by industrial robots to genetic engineering , life is directly and increasingly being shaped by technology. In this perspective , the immediate need for the much neglected area of Research & Development acquires urgent importance for a developing country like Pakistan. Pakistan is lagging behind significantly in research efforts. There are very few institutions in the country which are rendering such services. As these institutions are manned by poeple possessing highly advanced skills and vast experience , the cost of services of these institutes is high and beyond reach of small scale investors. Most of the research and development activity in Pakistan is undertaken by such R & D centres as sectoral research councils and institutes of the federal government , universities , provincial research institutes , extension / advisory stations and testing and survey units. The most important research organisations are :

(a) Pakistan Council of Industrial & Scientific Research.

(b) Appropriate Technology Development Organisation , Islamabad.

(c) Pakistan Industrial & Technical Assistance Centre, Lahore.

(d) Cotton Textile Industrial Research & Development Centre, Karachi.

(e) Metal Industrial Research & Development Centre, Lahore.

(f) Sugar Research Institute , Hyderabad.

(g) Leather Industry Development & Research Organisation, Islamabad.

2. These research institutes although give an impression that there is a well developed infrastructure and considerable research activity in the country, yet this appearance is rather misleading because notwithstanding their number the effectiveness of research in these organisations is greatly impaired due to very severe weaknesses afflicting them. Some of them are :

(a) Sub-critical level and excessive fragmentation of scientific R&D effort measured in terms of personnel , equipment , funding etc.

(b) Want of conducive environment for creative research work resulting from factors such as inappropriate organisational structure , cumbersome financial and administrative procedures , lack of professional freedom.

(c) Absence of effective mechanism for linkage of research efforts with country's economic planning process.

(d) Isolation of the scientific research community from the production sector of the economy, their research efforts thus lack the sustained momentum that can come from its channelisation towards variable goal.

(e) Lack of effective communication and dissemination of research results to the prospective end-users , absence of appropriate mechanism for proper utilisation and commercialisation of research results.

3. In view of the above, Government of Pakistan has set up a high powered National Commission for Science and Technology (NCST) which inter alia , was entrusted to formulate effective policies regarding promotion of fruitful research activities in the country. Special emphasis on research and development was laid in the country's 6th five year plan (1983 - 88) as can be noticed in the Government of Pakistan's industrial policy statement in this regard.

"..... Private sector will be encouraged to set up R&D facilities industry-wise. For this purpose, industries will be asked to earmark a small part of their pre-tax profit for R&D . Government has already allowed deduction from income from business or profession of any amount paid to a recognised scientific research institute or a University to be used for scientific research or technical training related to the business of the assessee. Similarly , any expenditure directly incurred on scientific research in Pakistan related to the business carried on by the assessee or any amount donated to the Fund for promotion of Science and Technology in Pakistan is, subject to certain limits , eligible for deduction for the purposes of income-tax. The private sector must fully avail of this concession to set up R&D institutes or contribute to a recognised R&D Fund in the private sector. The R&D should aim at :

(i) filling up of technological gap ;

(ii) perfection of designing aspects and catering to the changing preferences in foreign market ;

(iii) quality standard improvement ;

(iv) packing and packaging improvement ;

(v) absorption and diffusion of technology , after import , on national level , and

(vi) effective capacity utilisation and increased productivity.

The proposed industrial policy and procedure committee will periodically review progress of R&D efforts by the industry and institute necessary corrective measures , if so warranted by the situation ..... "

4. Accordingly NCST made various recommendations which can be summarised as :-

(a) All the existing research institutes may be given an autonomous character and should undertake goal oriented research in accordance with national objective.

(b) Adequate finances should be provided to ensure effective implementation of programme. Financial and administrative procedures should be simplified.

(c) Serious deficiency in adequately trained manpower in research institutes should be made up as speedily as possible.

(d) Research institutes must be provided necessary resources and develop adequate pilot plant facilities.

(e) R&D cells should be established in all nationalised and large private industrial establishments for facilitating technological improvements on a continued basis.

(f) Scientific consultancy services in various technical fields including R&D work should be organised in the public sector on commercial lines to cater for important projects within the country and abroad.

(g) Research in universities should constitute priority goal and the requisite budgetary provision made to achieve it. For this purpose well-equipped laboratories must be provided as quickly as possible.

(h) Joint committees of representatives of industrial and research establishments should be set up to provide liaison and linkage between the two sides.

(i) A national centre for technology transfer should be set up to assist, inter alia , in collection , analysis and dissemination of information on technologies and to render advise, when asked for, regarding negotiating technology agreements on most favourable terms and in unpackaging technologies. This centre besides maintaining liaison with technical cells in the ministries / departments will also maintain a data bank for storage and dissemination of information regarding plants , machinery , processesses and results carried out locally and abroad.

(j) Local consultants should be actively associated in all capital projects including foreign aided projects , as far as possible , on the basis of experience.

(k) Availability of high level manpower for research activities should be ensured through training , exchange of personnel between universities and R&D institutes , deriving maximum advantage from the national talent pool scheme , utilisation of retired eminent scientists and technologists on contract appointments , improving service conditions and providing incentives for scientific and technical manpower , creating conducive environment for creative work etc.

(l) Isolation of Pakistani scientists and technologists from world centres of knowledge should be removed by providing adequate opportunities for close international liaison.

5. Thus for the first time, a comprehensive plan and the policy package for the promotion of research in science and technology has been formulated by the government which if persued in its entirety will have far reaching effect on the commercialisation of research activities in the country , and provide proper linkages between research , industry and institutes / universities.

6. In pursuance of the above policies , research and development cells have been created in the major units of the country for example , State Engineering Corporation of Pakistan which controls and manages a wide cross-section of the engineering industry in the country producing variety of complete plants and capital machinery , light engineering goods and steel rolled products in the public sector has created R&D cells in all its operating units. The units are spending about 1% of their total sales turnover depending upon the nature of the R&D activities being persued by them. The present R&D activities are directed mainly towards improvement in quality of the existing products , product design and manufacturing techniques in order to improve the competitiveness of these products in the market. Thus the commercialisation of the R&D results has been the main objective of the R&D of the units. The examples which follow would show that encouraging results have been achieved in the commercialisation of development activities on research persued in these units :

(a) A metallurgical factory in public sector producing intermediary engineering products such as castings and forgings was able to improve its sales by about 10% primarily on account of research and development through improvement of metals (iron and steel and non-ferrous metal) , their quality and reduction in cost.

(b) Another unit in public sector producing light engineering goods such as pumps , diesel engines , electric motors etc has been carrying out its R&D activities on the improvement of design of

electric motors and improvement in horse power / weight ratio of diesel engines in order not only to maintain their share but also to increase it in a market which has recently become highly competitive. The company has met with partial success and been able to increase its share in the market in respect of these products by 3%.

(c) Yet another unit producing complete plants and heavy capital machinery had to face severe competition against similar imported products and was compelled to quicly improve design and technology employed in its product which should conform to the international standards. In this connection two pronged attack was launched. Firstly , technologies were acquired from the internationally reputed firms of industrialised world and secondly, in house R&D activity has been accelerated to improve its own products. This company has also achieved success in not only increasing its sales in local market but has also been able to confidently offer its products to foreign market.

7. Engineering industry however is a difficult and complex sector. Research is costly in this area and funds for such purpose are limited, sometimes not available at all. In addition , in a developing country like Pakistan , engineering units are always confronted with the import of similar products from giant multi nationals who have the

advantage of economy of scales. Consequently, the profit margins of the engineering industry of developed countries like Pakistan do not allow R&D at the grass root level. In the final analysis, they have to fall back upon the recourse of acquiring readymade available foreign technologies and then if necessary make an attempt to further improve upon them. It would therefore be imperative for a company in a developing country to most judiciously utilise its resources on R&D and concentrate its efforts only in such areas which promise better chances of success and quick return as otherwise the limited funds available for this purpose would be ill spent, without bringing any commercial results. For the illustration of this point two case studies are cited below.

8. Case Study - I

8.1 One of the companies in Public Sector undertook development of a 'reaper' for harvesting in late 1981. The 'reaper' was driven by an agricultural tractor. The Company had undertaken this R&D work hoping that with expected rapid farm mechanisation in Pakistan considerable demand for reapers would be generated.

8.2 The design of the reaper had to incorporate the following main points :-

(a) Consistency with local farming practices

(b) Relatively higher speed of harvesting

(c) Minimum shattering losses / grain losses during harvesting.

8.3 In order to arrive at the main features of the reaper and its technical specifications , discussions were held with agricultural experts , Agricultural Research Institutes and the farmers. It transpired that the reaper using overhead collector reel mechanism with inclined flat belt conveyor had faster cutting speeds and minimum grain losses. The development work was therefore concentrated on this type of reaper in association withcountry's Agricultural Machinery Research Institute (AMRI) in September, 1981. The first proto-type was produced and tested in December 1981. As a result of this test / trial certain modifications were identified necessary for improving the design. For example , the main structure frame was found to be weak. The drive arrangement needed modification , wooden cleats on the conveyor belts needed to be replaced by rubber lugs and the speed of the cutter needed to be increased.

8.4 After incorporating the above modifications second test / trial was carried out in April 1982. Subsequently more modification had to be made in the design for improvement. The third trial of the modified prototype was carried out in December 1982. This time the performance of the reaper was found to be more satisfactory. Finally, extensive field test trials were carried out by a team of experts

and also by the farmers / users. This time again, certain structural machine elements weaknesses were discovered after long use of the equipment. In the period January to June 84 the design was perfected

and it was confirmed that failure of components was far less than those in similar competitor's models.

8.1 The development work took about 3 years and during this period company had to spend its considerable resources on this job. Unfortunately, commercialisation of this development posed immense problems and therefore return on the investment made on R&D of the product is yet to materialise. Although the product has been designed specifically to suit local conditions, yet the Pakistani farmers are hesitant to adopt mechanical means of harvesting as they are accustomed to manual farming practices. It was proved to the farmers through actual test / trials that the grain loss in manual cutting was about 3 to 4% while in case of reaper " the losses were only 1%. This obviously meant considerable benefit to the farmers. It is hoped that with education of farmers, extensive demonstration of the equipment and persuation / incentives provided to the farmers the use of the reapers would increase in coming years.

9. Case Study - II

9.1 Yet another company , also in the Public Sector , undertook development of a small agricultural tractor in the year 1971. The need for this development was felt in view of the government's stress on the early mechanisation of farming in the country, and the reports of success of small tractors in farming in countries like India , China and other Far Eastern

countries. The design work was initiated in late 1972 based on a proto-type of a small tractor available with one of the agricultural engineering workshops. The first proto-type of the tractor was produced in March 1973 along with certain implements. The design incorporated locally available materials and components. The prime mover of the tractor was a locally made diesel engine. The proto-type was subjected to thorough investigations under local field conditions. For this purpose 20 proto-types of the tractors were produced and distributed to some of the renowned agricultural research institutes, government farms and some progressive farmers for undertaking extensive field trials. During trials it transpired that the machine was not suitable for the job it was designed to handle. The main weaknesses noted in the design were : inadequacy of power, inadequate ground clearance, defects in transmission and clutch mechanism, the belt drive system, and the manual control system.

9.2 The design of the tractor was modified to remove the defects mentioned above and subsequently field trial tests were undertaken once again. This time the performance of the tractor had improved -- yet it was far from perfection. The development work at this stage had to be discontinued for lack of finances. It was also felt that the cost of production of this tractor was very high as compared to similar imported tractors. Hence even if the design had been perfected there was little chance for successful commercialisation of this product in the country.

10. **Conclusion :**

This is only a short account of the current scene of the commercial research and development in Pakistan. A country which has managed to acquire fairly respectable profile in the field of industrial development and technological know-how has to attend to its R&D needs far more aggressively but selectively. It can not afford to fritter away its limited resources and energies on entering basic research in all fields and every conceivable sector. At the same time, it cannot neglect the scope of original and essential research which the country's industry , agriculture and techniques call for in order to provide dynamism and competitiveness to its over all economic development.

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