

UNIVERSITY - INDUSTRY LINKAGES FOR TECHNOLOGICAL INNOVATION

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Appropriate linkage between research institutes/universities and industries must be formally created and strengthened, in order to enhance applied research and to stimulate technological innovation. This paper assesses the incentives for and the barriers to the establishment of such linkages, describes some alternative modes of linkages, and suggests a model of a linkage for possible implementation in hi- tech areas.

1. Introduction :

Technological innovation encompasses a wide spectrum of activities, from basic research to commercial application and marketing. Science and engineering departments of universities/institutes are traditionally engaged, in varying degrees, in the following activities :

- i) Producing skilled manpower for industry, Government, research and teaching needs.
- ii) Generating new and appropriate technological ideas for indigenous development; and
- iii) Expanding the frontiers of

knowledge in science and technology through basic research and its application.

In addition, university extension centres have provided curriculum improvement, continuing education, and other services. In performing the above tasks, the faculty of the universities/institutes have devoted, quite reasonably, greater attention to the teaching and research tasks, while significantly less efforts have been made towards generation and transfer of technologies (Rao, 1978).

In India, as in most developing countries, the market for university research has to be created. This calls for innovative approaches to what may generally be termed as "extension

activities". This is especially so, since the Government has been the major source of funds for university R & D in India, with industries evincing little (if any) interest in committing significant resources towards basic research and innovation.

The existing pattern of university-industry isolation must be replaced by new types of linkages for generating and developing new technologies. Realising that the faculty of the universities/institutes are preoccupied with teaching and research, and that the client-industries invariably demand quick results for commercialisation, appropriate linkages must be created and strengthened between research (universities/institutes) and innovation (industries).

This paper aims to :

- i) Enumerate the incentives for, and the barriers to, the establishment of university-industry linkages;
- ii) Describe some alternative modes of linkages; and
- iii) Suggest a model of a linkage for possible implementation in hi-tech areas.

2. The University-Industry Connection:

For the innovation process to be effective, the generation of new knowledge and the translation of that knowledge into commercial products and services must be linked (D'

Ambrosio, 1979). Such linkages depend on close interaction between those who perform 'asic research, and those for whom the results of basic research are the raw materials for product development and commercialisation. Because a major share of basic R & D is done in the universities/institutes and R & D institutions, while technological development is lodged primarily in industry, strong university-industry relationships can enhance the basic R & D - innovation linkage.

There are a number of technological areas offering immense challenges and scope for both research and commercial applications. A few examples of such hi-tech areas are bio- technology, informatics, computer, food technology, etc. However, the technological challenges in these areas have not yet been fully met in India, due to the following reasons :

- i) Separation of academic research from perceived industrial needs;
- ii) Decreased interest amongst university graduates in industrial research careers; and
- iii) Industry's insignificant role in basic research.

3 Incentives and Barriers :

The major incentives for the university/institute in developing linkages with the industry are that it can look towards the latter in the following respects :

- i) as a source of research support;
- ii) as a partner in making new knowledge and technology commercially useful; and
- iii) as a stimulant for its on-going research activities in the chosen technological area.

The potential advantages for the industry are :

- i) it can avail the vast scientific resources in the university/institute to enhance its R & D efforts;
- ii) it can draw upon competent scientists/engineers as additional sources of ideas, knowledge and technology; and
- iii) it can enhance the quality of its products and services for commercial advantages.

The major barriers for the university/institute are as follows :

- i) university research has not traditionally been directed at new commercial products or processes, although it may have been the basis of such innovations;
- ii) university research is characteristically a long-term process, with inherent attributes of freedom of communication and publication; and
- iii) the uncertainty of research, with its associated high stakes and

risks.

For industry, an additional important barrier is the perceived need for secrecy - since competitive edge is critical to the success of a commercial venture, patents are important and the results of research often are proprietary and may not be published.

4. Types of University-Industry Linkages :

Broadly speaking, there are four categories of university- industry linkages :

i) Corporate contributions to university/institute :

Such contributions may be in the form of undirected gifts, corporate contributions to specific departments for equipment, renovation, etc., and contributions towards fellowships, scholarships, etc.

ii) Procurement of Services :

In this category, university/institute may procure services from industry, such as prototype development, fabrication, specialised industrial training, etc. Industries, on the other hand, may obtain from universities services in the form of consultancy, education and training, contract research and testing, etc. A university/institute may also have industrial associates i.e. companies who pay fees to the university to have complete or partial access to the resources of the organisation.

- iii) The mode of cooperative research projects involves direct

cooperation between university and industry scientists on projects of mutual interest, usually those characterised by basic non-proprietary research (Prager and Omenn, 1980). Normally, no money changes hands, with each sector paying the salaries of its scientists.

In cooperative research programmes, on the other hand, industry may financially support a portion of a university research project (the balance being paid by the university or from other sources). The results of such research would be of special interest to the company sponsoring the project.

A third mode of cooperative research is a research consortium, involving a single university/institute and multiple companies. In this mode, basic and applied research could be undertaken on a generic problem of special interest to the entire industry, and the member companies would receive reports, briefings and access to the university facilities used in the research.

iv) **Research Partnership :**

This closely interactive mode involves joint planning and implementation of a research work of mutual interest, where both the industry and the university contribute substantively to the research enterprise. A detailed contractual agreement may be arrived at to govern the specific relationship.

5. **A Proposed Model of University-Industry Linkage in**

Hi- Tech Areas

In determining an appropriate model of university-industry linkage, the following factors must be taken into consideration :

- i) the size, structure and profitability of the industry, the nature of its business, and the progressiveness of its R & D programmes;
- ii) the type, size and financial health of the university, the relative size and stature of its science and engineering departments, and the orientation of its research and researchers; and
- iii) external factors, such as Government policies and incentives, geographic proximities of the partners, and the location of university alumni in key industrial positions.

The model that is proposed in the following paragraph may be most relevant and applicable for industries with progressive R & D programmes in emerging hi-tech areas, such as computers, informatics, biotechnology, food technology, etc., Similarly, the partner university/institute should have the necessary expertise and facilities to undertake medium-to-long-term R & D in the chosen technological area.

In this context, a university-industry research consortium would be a good model for strengthening the research-innovation linkage. The initial emphasis in such a cooperative research

effort would be towards basic R & D, aimed at a fundamental understanding in the research area. The subsequent efforts would naturally be directed towards exploring the applications of R & D for the development of new products, processes and services.

Some of the necessary features of the proposed model from the implementation point of view are summarised below :

- i) the seed money for setting up the research consortium may be obtained from financial institutions (eg : IDBI, ICICI, etc)
- ii) the critical mass of the consortium for the chosen technological area must be established, and the required number of interested companies may be coopted as partners in the consortium;
- iii) the initial expenses in operating the consortium, say for a period of 2 to 3 years, may be met partly by the sponsoring financial institution, and partly from the annual subscriptions of the member companies;
- iv) for the subscriptions paid by the member companies, they would acquire technological know-how through special reports, technical advice and guidelines on follow-up R & D, and access to the research facilities at the cooperating university/institute;
- v) the actual research relationship would be governed by the specific contractual agreement. Such an understanding may involve joint planning, management and implementation of the research programme. Representatives of the university/institute and the industry may jointly identify R & D problems in the chosen area, and also determine the level of mutual interactions and responsibilities;
- vi) gradually, after a period of perhaps 3 to 5 years, the consortium should strive to work as a profit entre, generating revenues from the commercial exploitation of the results of the cooperative research efforts. This may be accomplished by means of patents, licensing and royalty; as well as by direct sales of the products, processes or services emanating from the joint technological research.

6 Conclusions :

- i) Science and engineering departments of universities/institutes can look towards industries for research support and as partners in development of new ideas, knowledge and technology. The industry also can avail of the vast scientific resources in the university/institute to enhance its R & D efforts;
- ii) The alternative modes of university-industry linkage include cor-

porate contributions to the university/institute; procurement of services such as consultancy, training, fabrication or testing; cooperative research projects or programmes; and research partnerships;

- iii) A research consortium, consisting of one university/institute and several companies, has been proposed as a model of university-industry linkage for possible implementation in hi-tech areas. The salient features of the proposed model have been detailed, and its successful implementation would make a significant contribution to technological innovation.

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