# Reorganizing For Research and Innovation

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There can be little mystery about the reasons research and development has become a topic of major concern in this country and in countries around the world. With economic productivity more closely linked than ever before to scientific advancement and technological expertise, most nations look to two sectors, namely the university and the industry, to prepare needed specialists and conduct basic and applied reasearch.

In Korea in particular at issue are economic health and social stability as well as national pride, but more precisely, survival of the nation from external economic threats. The threats stem form various forms of nationalism and protectionism regarding exchanges of knowledge, technology and resources. Not surprisingly, debate over the roles and responsibilities of the university and the industry with respect to generation and accumulation of knowledge and technology under these conditions has engaged academic, business and political leaders alike.

Furthermore, there is growing awareness that to serve such national interests, the colleges and universities have to change in significant ways. This is a seach for new solutions to old problems, except the fact that now they have high urgency about them than ever before.

However in order to bring about changes in the university, other sectors interfaced with the university have to change with it at the same time. They are the industry and the goverment. And the changes have to be in the nature of fundamental thinking about the capabilities and responsibilities of each sector and have to deal with both "hard" issues as well as "soft".

## Differentiating the Roles

Knowledge is defined as understanding of a science, art or technique ; or as the body of truth, facts, information and principles acquired by mankind. This is a static definition. Really knowlege is a continual flow like a river. It runs form the upper stream to mid-stream and to the downstream. As it does, it undergoes a transformation. It flows from its origin with pure and basic sciences and information and even with the remotest mathematical speculations, and finds its way to its down-to-earth,

everyday applications by the ordinary run of men.

In the 19th century and before, it doesn't look like the "rivers of knowledge" had existed in the world, although here and there the reservoirs of knowledge might have. Thus the outcome of the basic research at the origin did not flow downstream, say, to the practical applications and market places. Into the 20th century, however, the "rivers of knowledge" rose and the rate of their flow started to accelerate. Of late, the universities where most of the original knowledge are generated and industries where they are made useful have been interlinked by the rivers. In some instances the universities and the industries became adjoining villages so far as the flow of knowledge is concerned. 〈Figure–1〉 pictorially gives a model of the "knowledge river". One can imagine that the distances from the upstream to downstream of the flow of knowledge will be shortened in terms of time as well as space.

As shown in the picture the university, industry and other sectors of the society have their unique locations with respective to the kownledge flow. They all have their own roles in regard to adding to and, modifying and pushing forward the flow of knowledge so that downstream it may ultimately become useful.

Today it became inevitable that the university and industry realize their linkage in the fashion described and find ways to accelerate the flow. To this end they communicate with each other, share their unique resources, and cooperate, sometimes compete, with one another, to the benefit of both.

It's therefore obvious to say from the flow of knowledge argument, while universities are suited for the creating of new knowledge and making of new discoveries which is called "basic research", industry and business community are more suited for converting these knowledges and discoveries into useful goods and services which is called "development and commercialization". The concept may be simple. But problems arise in a number of areas. First is the question of division of labor, namely, whereabouts in the mid–stream will the industry meet the university? This is an interesting question because by answering this the roles of the two sectors are defined regarding the national R&D requirements which in turn determines where to allocate the national resources. The picture becomes even more complex because there are a number of nationally funded public research institutes under different ministries. For simplicity in this descussion, they may be considered the mid–stream actors who are there to link the upstream with the downstream. Also they are, by their charter and capabilities they possess, suited for national R&D projects which are of large scale, high risk, high budget, long range, and national security nature.

This is where the goverment has to come in. It has to match the availability of technical resources and skills with needs of the society. At the same time, it has to achieve appropriate balance between creation and utilization of knowledge ; balance among projects and programs by scientific vs. economic vs. political values and objectives ; and balance between short– and long–term objectives. Also the government has a job of coupling among the various sectors of the national R&D resources. An effective coupling of universities with in-

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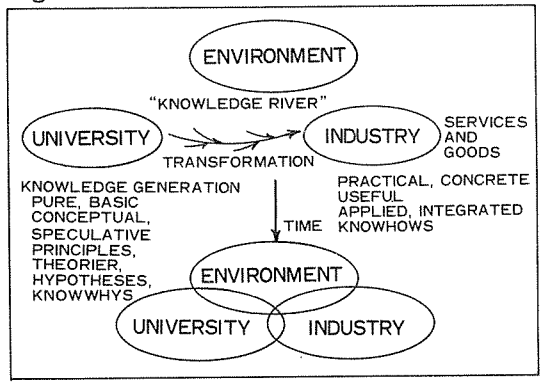
dustrial sector may be the first thing to look at in view of the nation's limited scientific and technological resources.

## Facts and Figures

While it is difficult to say exactly how far downstream the university should go in knowledge flow, it is obvious that roughly 1 / 3 form the origin of the flow is basic research which is the university's domain. Now there is the concept of "generic technologies"which are certain basic technologies that are inbetween the basic research and the development stage attractive to industry and on which firms build their new products and processes. The creation of such generic technologies is a high–cost, high risk proposition. But these technologies underlie major advances in an industry. And they can have a major impact on the nation's economic growth. For certain generic technologies bringing industry and university researchers together may be an interesting proposition. Product design and develoment are not in general considered the university's R&D domain.

Most universities in Korea may be considered large–scale comprehensive organizations for interdisciplinary research. Their primary functions are to conduct basic research as well as

〈Figure-1〉 A Pictorial Model of Knowledge River




give instructions to students. But there are a number of reasons the university community in Korea, which hinders if not prevents it form doing R&D as suggested in the earlier discussion. They are difficult reasons, some of which may be common to many countries and others are peculiar to Korean situation at the present time.

First, the environment outside the university including the government has a serious misconception about the role of the university. It looks at the university as an institution of teaching students and produce garduates. Thus most of the legal and administrative setups for the university are to support teaching, not research. The environment is changing, but not fast enough, in the direction of accepting the fact that university's outputs are not only the graduates but also new knowledge and technology.

Secondly, adequate ways means for research are not provided at the university. Namely, they are research hardwares, literature, facilities, and funds.

Third, faculty members in universities are over loaded with teaching and administrative duties. The student / faculty ratio is at about 40 nationally. Under these conditions, they simply don't have enough time and energy to devote themselves to research. For financial reasons universities do not recruit new faculty members. This is a serious problem to which both the government and foundations responsible for respective universities have to take the blame. No immediate improvements are at sight at this time.

On the other hand, there are some facts which are in favor of the universities for research. One can mention that some 7,600 in number or 80% of the engineers and scientists with doctoral degrees are working in universities.

The rest are with private firms(370) and public research institutes(1,400). It is true that R&D activities involve not only advanced degree holders in technical areas, but also all other levels of technical and nontechnical people. But those facts are a good indication of availability of highly trained people in universities as compared to other institutions. If graduate students, teaching and research assistants, technicians are included, the research manpower in universities is in order of one million, as compared to a few hundreds in private industries and public research institutes.

Up to this point, some issues which may be described by "hard" variables are presented. Some work in favor of and others against R&D in universities. Issues associated with "hard"-variables generally have to do with resources, i.e., money, human and time. Once the basic policies, priorities and incentives are in place and understood, these may be resolved perhaps with less difficulty than issues stemming from "soft"variables.

An examination of the issues discouraging R&D in universities show that they are basically attitudinal and behavioral arising misconception, value disorientation, mistrust and suspicion. Understanding these patterns is crucial to making proper constructive adjustments. The only way to correct this is to initiate and implement good communication. To effect good communication, each sector should know what the expectations of the others are. Being aware of each other's expectations, someone has to make the first move. Along this line the concensus is for the university to initiate the big move toward effective communication.

Where as the attitudinal and behavioal problems are discussed here with regard to sector to sector interactions, arguments similar to these should be applicable to individual researchers in universities. Each must interact with others and with the environment in conducting his R&D and achieving its goals.

## Conclusion

The university is a large–scale comprehensive organization for research and development, having in it a large number of qualified research manpower. Given the opportunity it can conduct research which is vital to national interests. By its tradition and make–up, the university can take charge of the upstream segment of research and development efforts which is manely the basic research. At the same time, by coupling with the industry, it can engage in creating certain generic technologies.

However, there are issues discouraging R&D at universities. They are mainly lack of resources ; money, human and time. Other issues are attitudinal, behavioral and cultural. The former need to be resolved by the government, setting in place the basic policies, priorities, and incentives. But these must be done througt concensus building among various ministries concerned and sectors involved. In Korea the government is the major influence on R&D and commercialization of technology, by its impact on the availability of the nation's resources and the development of them. For this reason, as R&D policies are developed the role of the government needs to be fully recognized by all parties involved, particularly by the various branches of the government itself.

In this connection one of the government's roles for the national R&D may be to actively try to build effective linkages between the nation's universities and industries, letting form new kinds of parterships.