MESSAGE

Research is one of society's most fundamental tools for development. It sustains growth, it revitalizes current modes of thinking and it embodies man's search for truth and knowledge. It cannot therefore be alienated from the rest of human society's endeavors. In order for it to serve its purpose, it must reach out and address itself to the larger society upon which it derives support and recognition.

The researcher or the scientist does not exist in a vacuum. He has a responsibility to the larger community where he belongs. That community has the right to know what areas of research have been covered and the degree of success of such endeavors. For any research has to be evaluated not only in terms of its economic and technological value but in its social and cultural implications to society as well.

The objective of this compilation is, therefore, to attempt to reach the greater mass of society, not only to inform but also to elicit feedback. It is hoped that this compilation would perform such a function effectively and thus, justify itself.

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FOREWORD

Improved technological utilization and diffusion which are needed to accelerate the country's development and improve the well being of its constituents can only be achieved with a progressive research base particularly in areas considered to be vital in the overall development framework. Research in the field of engineering has been gaining more importance and greater attention is getting to be focused on its results due to a realization that its role is critical in the country's continuing efforts at national growth.

There is a need for a mechanism by which important sectors such as industry can avail of information on on-going and completed researches so that their results could be adequately promoted and utilized at a larger scale. As a national entity which exists to promote research, the National Engineering Center sees the publication of this compilation of engineering researches as a good opportunity to serve the two important sectors involved — the researchers and the users of research results.

This compilation is far from being complete although efforts were made to make it as exhaustive as possible. This is an effort to make a contribution and if it can generate reactions and suggestions intended to make researches in the field more effective, then this effort has not failed.

This special issue of the Philippine Engineering Journal is dedicated to all researchers in the field of engineering.

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A FRAMEWORK FOR THE ORGANIZATION OF RESEARCH AND DEVELOPMENT ACTIVITIES IN ENGINEERING AND RELATED FIELDS

by

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INTRODUCTION

The country's goal of self-reliance requires sustained growth and development in various sectors. In almost every sector the need for expertise in the various fields of technology and engineering can be felt and while transfer of technology can be useful in this respect, there is certainly a great deal of research and development work that has to be undertaken particularly within the context of a developing country's environment.

Research and development in engineering takes place in many forms with the involvement of various individuals, groups and entities. Industrial organizations, professional organizations, private foundations and individuals spend time and effort for research on various aspects of engineering problems however different may be their objectives for doing so. Schools and universities are similarly engaged in these activities either through their faculty members and students or through their centers which have been created with research as a main task. Ministries and other organizations of the government also incorporate research and development work in the performance of their various roles. Various technology centers and institutes are engaged in research and development operations specializing in specific engineering fields. And of course there is a superbody like the National Science Development Board which deals with research on a whole wide realm of science areas.

While many sectors are actively involved, it is recognized that resources are scarce — funding for research projects are limited, engineering research expertise is difficult to get and to maintain, and tools, materials and research paraphernalia are not easily available. On the other hand progress in research and development work is badly needed in almost every sector and therefore resources have to be effectively and efficiently employed and utilized.

NATURE AND TYPES OF ENGINEETING R&D ACTIVITIES

Research in general is classified broadly into basic or fundamental and applied research. While engineering itself is an applied field, the distinction between fundamental and applied engineering R&D work can still be made. In terms of the various groups involved in R&D it is noted, as would be expected, that the more fundamental types of research are undertaken by the government-run research and technology centers as well as schools, universities and foundations

while industrial organizations, professional organizations, line government organizations, and many individuals are mostly engaged in applied R&D work.

Engineering R&D can also be classified according to the approach or methodology used. There are researches that require actual experimentation and the construction and testing of prototypes. Some are being conducted with the use of physical models and pilot set-ups, while still some others require survey methods only or the use of mathematical abstraction or modelling. Impact studies, policy studies and forecast studies also deserve to be mentioned at this point although they probably belong to a different classification.

The direct or immediate beneficiaries of R&D results can also be used as a basis for classification. The organization undertaking the R&D project may be the direct beneficiary itself, it could be other organizations with whom it has entered into an agreement, it could be a group of companies or a group of industries, it could be a larger public such as students, communities or the population in general.

There are a number of other possible bases for classification (e.g., scale of operations, project time frame, factors that bring about the inception of the project, etc.) but the classifications described above are considered useful in coming up with an organizational framework.

A SUGGESTED FRAMEWORK

The framework suggested here does not imply a single organization that will administer, supervise or regulate engineering R&D activities. It is a network that involves all the groups that perform such activities. A superorganization such as the NSDB (or a Ministry of Science) is expected to translate the country's economic and development goals into a science research program that includes engineering as a major component. This superbody is also expected to distribute responsibilities for the engineering R&D program to specialized technology centers within its area of supervision in the form of specific research missions or targets. All other complementary and supplementary programs should then be communicated or transmitted to an engineering R&D coordinating body. This is probably where the distinction between fundamental and applied work could be useful. This coordinating body for engineering will then integrate these inputs with the inputs obtained from industry and from line government organizations. These last two mentioned groups undertake their own R&D work also but in general these have to be complemented or supplemented by other R&D activities. The coordinating body will then come up with a line up of priorities, identify the work which it can handle, and supply the other R&D groups-the schools, foundations, professional organizations, individuals and other entities — with all these information.

It should be mentioned at this point that the identification of priorities should be arrived at with the participation of all possible points of view. It should also be pointed out that the task of coordinating requires a knowledge of the classifications discussed earlier particularly in the process of matching the capabilities and needs.

The coordinating body for engineering R&D will serve as a research arm as well as a facilitator. It is also an advisory body that will act as a nerve center with

up-to-date information on the scope and status of engineering researches. It will facilitate the exchange of information regarding the existence of needs, the availability of engineering research capability, the availability of support for engineering R&D and developments in the different engineering fields. It will also interpret policies and delineate guidelines.

THE ROLE OF AN ENGINEERING INFORMATION CENTER IN R&D

An Engineering Information Center, to serve the needs of researchers in engineering, is necessary as an organizational complement to R&D activities. This information center will gather, process, publish, manage and disseminate information that will update engineering researchers as well as practitioners, educators and students. Aside from maintaining up-to-date information on engineering researches here and from other parts of the world this information center is expected to maintain books and other printed material in engineering which are relevant to the country's needs and conditions, to keep a central bibliography of engineering information found in other collections or information centers in the country, and operate a data bank that will contain statistical and cost information, information on engineering expertise in various fields, engineering codes and standards, documentation of surveys, project studies, policy studies and impact studies involving engineering works, as well as engineering designs, mathematical models and computer software.

As a whole the existence of this center will minimize duplication of efforts — in research activities and data gathering — and it can make information available at a lower cost than if the individual users were to get these information themselves. It compresses time, it maximizes utilization of information, and it guarantees the safekeeping of research results.

TRAINING AND THE PROFESSIONAL DEVELOPMENT OF RESEARCH ENGINEERS

Professional development of researchers is not equated to continuing education alone. It requires a mechanism through which researchers can get involved, through which they can be motivated, through which they can be recognized, through which they can share, and through which they can be heard. These can be achieved, not only for a few but for the greater majority of deserving researchers, if there is an organizational framework which is recognized by the various sectors.

A number of things which have been said many times before may be said here again for emphasis. There is a great need for government support in the continuing training of engineers. There is a need for an upgraded incentive and regard system. There is a need for better recognition and protection of the works of researchers. The utilization of local expertise should be maximized in lieu of foreign counterparts and training obtained from the more developed countries should be put into use and shared with others. These should all lead to greater self-reliance.

Engineering curricula should be continously updated to make fresh graduates adequately prepared and curricular options, even at the undergraduate level,

should be made available to students who desire to have careers in research. Researchers should be encouraged to teach and teachers should be required to do research that is attuned to the needs of the country. Students' potentials should be tapped and their activities should be made relevant, too.

FUNDING AND OTHER PROBLEMS

The funding of research and development activities particularly in engineering and related fields appear to be always sadly lacking. While this is generally the case it can also be noted that some fields are favored while other fields are not. These may be due to developmental priorities but in some instances they are not. It can also be noted that there are researchers which have been undertaken and completed without benefiting a single individual other than the researcher (and in some cases not even the researcher himself), even after a reasonable period has lapsed. Some researches have been made for the sake of undertaking research alone and not really for some useful objective. Research grants have oftentimes been a privilege of senior researchers at the expenses of others who may be younger but more creative and productive.

It may be impossible to develop a system that would convert every research resource into a viable research result but certainly the mechanism for allocating resources, for reviewing progress and output and for soliciting involvement from various sectors can be improved. It is also necessary that strategies be reviewed from time to time. Engineering research needs a big leap forward and everyone should be concerned.

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