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05129

Distr.
LIMITED

ID/WG.161/7
6 July 1973

ORIGINAL: ENGLISH

United Nations Industrial Development Organization

Expert Group Meeting on
Industry-University Cooperation
Vienna, 3 - 7 September 1973

UNIVERSITY-INDUSTRY COOPERATION IN TURKEY 1/

by

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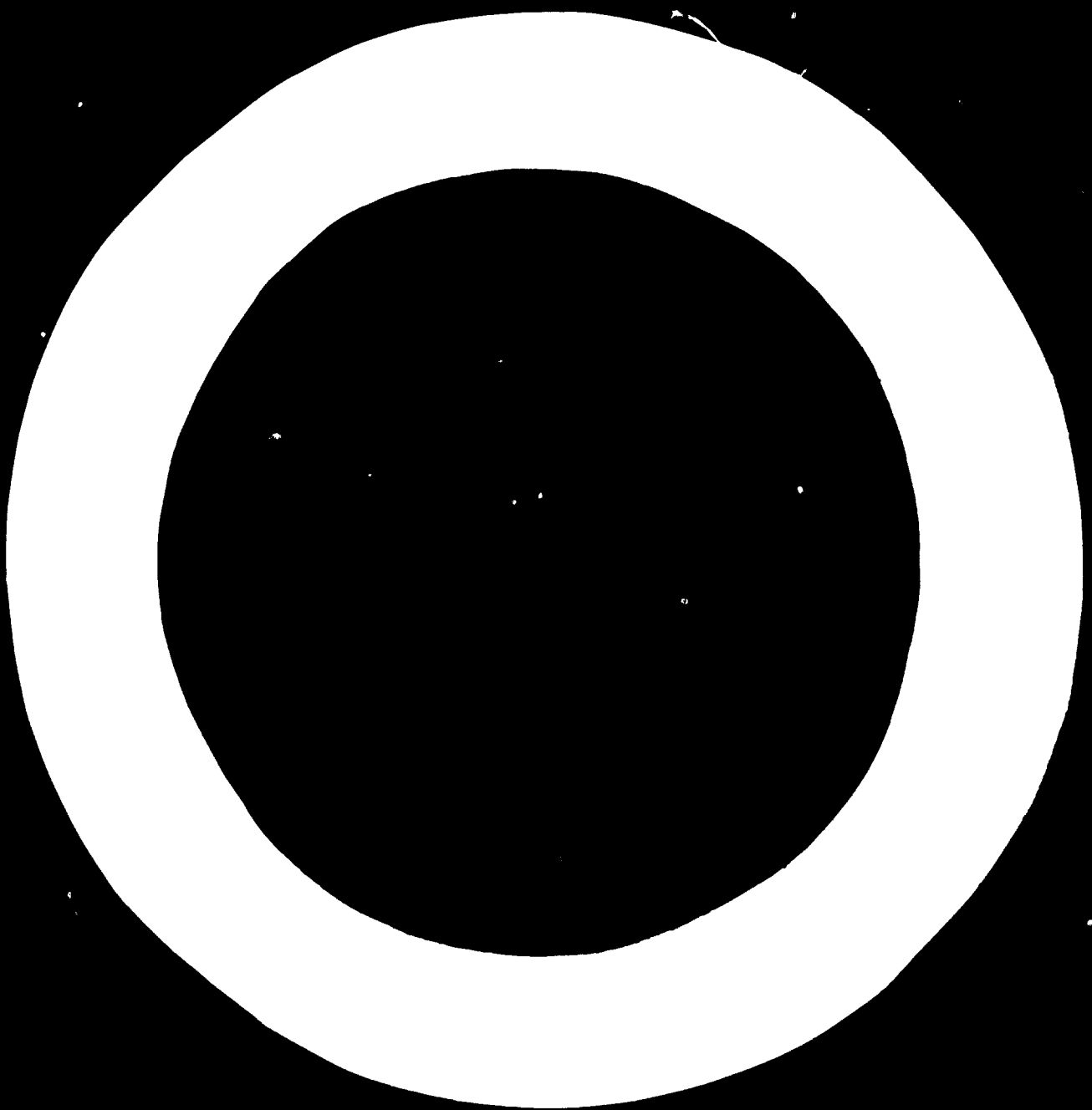

SUMMARY

In this paper the necessity for the research and development work, and the basic means to carry out such work in the universities of the developing countries are discussed. The paper gives special weight to the development of research capabilities in the universities together with assigning responsibility to the universities in the transfer of technology. The paper also discusses the cases of cooperation where either a technology has to be transferred or re-created within the developing country. Several examples of successful engineering application are given which indicates that university industry cooperation in the developing countries can optimize the use of available man power in the technological fields.

Introduction

Modern economy and society have reached a stage where research and development work become an essential part of the present day life. In the gigantic UN meeting in Geneva in 1963 Scientists and Technologists from more than 100 countries over two weeks have discussed and searched ways and means for accelerating the development of the developing countries. One of the main conclusion of the meeting was that, by the careful planning and genereous utilization of research and development work capabilities, economical growth could be made more easily and would be less costly, And that by this process, optimum utilization of available capital for re-development would be made possible. The conclusion of the 1963 UN conference did not make any distinction between the developed and developing countries.

In the old days the cooperation between the universities and industry was not universal. Intellectually there was a big gap between the two. Fortunately, the rapidly changing technology not only closed the gap but in many instances the industry become more advanced than that of university in their dealings with the current technological problems. The period of superiority of the universities has come to an end. As a result of this the relation between the university and the industry have changed its old pattern and a new communication system between the two have been developed. The use of consultant by the industry have accelerated the transfer of knowledge and problems from industry to the universities and research laboratories. All these transformation took place because Sciences and Technologies are expanding and changing very rapidly. The machines, systems and components which are being used by the technologists of our time are taking new forms with even changing characteristics. The noble desire of modern man to be on the threshold of applied sciences cannot be fulfilled if he cannot contribute his share to this, technological transformation. The responsabilities of the educators in the technological universities are therefore extremely significant. If these educators themselves cannot take active part in the developments of their time then the offerings of their institutions will also be behind and certainly will not be able to cope with the problems of the advanced technology.

Another point to consider is the level of education. It is authors firm opinion that the level of engineering education in the developing country can not be basically different than that of education level attained in the universities of the developed country. Furthermore, the social structure, economic organization and cultural level of all countries, are changing at different rates. It is desirable that the educators from developing and developed countries make some observation on the similarities of the responsibilities of applied scientists in their respective countries. This first point should indicate that the level of teaching and the way of educating engineers at an advanced level must not have functional differences reflected in the curriculum cores. Certainly there is no justification for differentiating engineering curriculum on the basis of the different background of the countries. This is an obvious fact because it is not possible to find a basic difference in the brain power requirements for the solution of engineering problems in both group countries. For instance, the

Turkish engineer who is responsible with the application of computer frequency control system on the state power system in Turkey and the French engineer who will be doing the same work for EDF must have equal basic and technological knowledge. In actuality the engineer in the developing country must pass much wider experience and broad view. Because he is not only dealing with the modern techniques, but he will also be dealing with the problems which have been transferred from engineering level to that of technician level.

A last point to consider is that in the developing countries, capital for industrialization is not limitless. This fact has become a main reason for slowness in the economic and industrial expansion of the developing countries. The mechanism for the accumulation of capital for industrial expansion has not been found and the condition for it have not been securely established. Due to the unavailability of capital for industrial expansion, the responsibility of engineers has grown beyond the limits seen in the western countries. Any error that an engineer may make regarding expenditures which requires engineering decision could endanger the economy of the country. Shortages of capital as well as of experts in economy and finance put a heavy load on the shoulders of the engineer. Therefore, the technological universities must absorb the additional task of providing necessary background information on finance and basic economics for engineers. The problems that are broadly described above can be solved only by a man of proper education, experience and attitude. The prime responsibility of the technological universities is to give these basic qualities to the engineers of the future. How these qualities be given, in what medium and with what type of personnel? The author feels that the problems described can only be solved if the institutions providing engineering education are actively engaged in industrial and basic research. Research is a way of training in the mind which makes it possible for the research worker to adjust himself to the requirements of his time and provides him with a tool for solving problems not previously encountered. Could these qualities be acquired in an institution where little or no research is done? Certainly not. Thus for the sake of the engineers of the future, our institutions must involve themselves in research work on a much larger scale.

Scientific discoveries have forced educators to incorporate more and more new materials into the undergraduate curriculums. This tendency brings a new problem to

the surface, which is the selection of materials to be included in the engineering curriculums. D.G. Christopherson[1] proposed the following criteria for the inclusion of a particular subject in engineering:

> "... it is sufficiently fundamental and based on scientific principle to remain valid and relevant no matter what developments in techniques and materials may take place during the professional lifetime of the student; "... is broad enough to form a basis for communication and cooperation with almost any other branch of science or engineering; "... all the subjects studied form a coherent whole so that the student can understand the relationship between them and the reason for the inclusion of each of them in the education of a man proposing to take his place, at least in the early stages of his career in a particular industry..."

Spontaneous applications of these criteria are not sufficient. The faculties must also have other preparation such as industrial experience and research experience based on industrial motivations. On the basis of our experiences at M.E.T.U. (Middle East Technical University, Ankara), and certainly it should be true in all engineering colleges, one could safely state that instructors with little or no industrial experience have slight appreciation for the profession for which they are supposedly preparing their students. In order to correct this unhealthy situation it is necessary to develop university industry cooperation which will permit a much wider interchange of ideas and personnel.

The pre-university education of the students should also be controlled. The habits one can get in early school years can play a vital role in a person's future career. The job of the universities could be very much eased if in the country's technical and scientific high schools or lycees one established proper teaching facilities. The stimulation of a scientific outlook must be encouraged in every phase of the lives of a people who are concerned with their economic development. Efforts must be genuinely made for popularization of science and technology. Technological and scientific publications should be distributed as widely as possible.

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1. CHRISTOPHERSON, D.G., "Whither Engineering Education", journal of Engineering Education, Vol.53, No.9, November 1962,

Thus in order to bring research into universities, the country in question must provide the following as a whole: public awareness, science-and technology-oriented schools at the secondary level, strong cooperation between universities and industries in the field of research as well as training faculty and young engineers, and sufficient financial support to form a sound foundation for scientific development. The final stage of the development of a young engineer will be completed in the university, where he will gain his knowledge, scientific outlook and attitudes. In this process the influence of this university professor will be very effective and predominant. A simple play-back type of education would not work. The teacher must be able to inject new ideas into his lectures from time to time, which he can do if he has been doing research.

However, research as part of the university's activities should not be over-emphasized. Dr. J.H. Holloman, Assistant Secretary of Commerce for Science and Technology[2] advocates an ideal balance between research and social awareness. He stated:

> "Our engineering schools have become citadels of research, staffed by faculties which are more oriented to theoretical problems than to real problems. Our graduate engineering students are more prepared for research than for analysis synthesis, conception and design. There is little provision for teaching know-how and how-to. The practical approach, the hard solution of problems, the awareness of cost-benefit ratios, these elements are all too often ignored or looked down upon".
>
> "The situation is all the more incredible when we consider that engineering, by its very nature and definition, is basically composed of these vital ingredients. It is sometimes facetiously said that the scientist does not care what happens to the knowledge he seeks, that he doesn't even care about its useful applications. Whatever might be said about the validity and appropriateness of this point of view for the scientist, we are in trouble when the graduate engineer begins to adopt these views, for to whom else do we turn for the solutions of our problems, who else is concerned with the application of

2. HOLLOMAN, J.H., "Information, Knowledge and National Power", RID, Research and Development Vol.15, No.1, January 1964.

knowledge for the benefit of society? I question whether engineering can truly be considered to have come of age until the profession has learned these valuable lessons..."

In the developing countries industry and government organizations cannot be used as rich sources of qualified teachers for university level education. Usually industrie do not have research and development departments. The most able persons on their staff are usually burdened by administrative duties which leave them no time for technical development and scientific discoveries. The training of faculty members becomes almost exclusively the responsibility of the academic institutions. Calculations indicate that the rate of expansion in educational facilities must be much higher in the developing countries. Therefore universities have the additional responsibility for training the major part of their own increasing staff. Is it possible for a university to train potential faculty members without active research programs? The answer is certainly negative. Perhaps this by itself is a formidably powerful reason to bring research into the universities as soon as they are established. There have been many examples of bad teaching in universities where research never had sufficient priority. In such institutions it is not uncommon to see professors teaching the same subjects year after year using the same textbook without changing problems or even exam questions. It is very unfair to a young engineer to go through this inadequate educatio and he will suffer when a more advance knowledge and application is required of him. University administrators must be alert and should design nec ssary control devices for checking the ill effects of "out of their time" faculties.

SPECIFIC RECOMMENDATIONS FOR THE DEVELOPMENT OF THE RESEARCH CAPABILITIES

Research and engineering education has become an inseparable entity due to the requirements of the present technology and its possible changes in the near future. Thus in the technological universities the following should be provided in their curriculums.

1. Educational programs must be designed so that graduates will possess capabilities which will make it easy for them to adjust to the requirements of their country at a future time. This kind of ability, which yields self-reliance, can only be acquired through training that includes research experience.

2. If the curriculums are designed to incorporate a maximum amount of basic sciences the graduate will then be able to follow up new discoveries because he possesses the required physics, mathematics and techniques for analyzing problems of his own particular branch of enigneering.

3. Engineering institutions should assess that the profession of engineering requires lifelong learning, and entails a responsibility to pass along the fruits of this learning to others in the profession.

4. He must be given a broad enough background for him to realize his position in society and his responsibility toward its members. There is no doubt that applied scientists have much to contribute to the happiness of mankind. The curriculum must provide this kind of understanding in the nontechnical subjects.

5. In summary, the applied scientist must acquire these attitudes during his education. He must know how to cooperate with people within and also outside his profession; he must be able to coordinate his activities with the works of others on a given problem; and finally, he must be able to communicate with others in order to gain more benefit from his work as well as from the works of others. It may justifiably be stated that without cooperation, coordination and communication it is not possible to do serious research.

In the developing countries the most difficult part in establishment of research programs is the lack of confidence and ability to make a start. The reason for it is that in their universities a scientific atmosphere has not been established. They lack organized seminars, through which new ideas can be generated and unsolved problems identified. The organization of Ph.D. programs would do much to avert waste of mental capacities.

Methods of Selecting Research and Development Projects

Research and development in growing countries is initiated largely by government agencies responsible for assessing and developing the natural resources of the country. The methods used in these processes may be classified as research but, in general, research and development in the accepted sense can only be introduced by the establishment of research institutes and universities as well as by the development of large industries.

The major task in starting research is the identification of basic problems. Since the economy is essentially weak, there must be a specifice objective. In other words, the problems selected must be concerned with either engineering or applied research. Basic research in the developing countries will follow as a natural need of the growth and accumulation of experience in technological and applied science research. However, it must be said that if it is possible to do basic research first then it will eventually give rise to the development of engineering and applied research capabilities.

In the initial stage the responsible organizations, mainly the universities, must be given considerable responsibility for carrying out research and development. This must be established as part of normal academic life. It not only will help the academic personnel in the universities to gain experience and proficiency but at the same time bring them into close contact with the problems of their country. Therefore universities or research institutes should work closely with the various appropriate organizations in the country, in order to select proper research problems. Such contacts should be planned with great care, because it may be very difficult for the leaders of industry to admit frankly that they have a problem which they do not know how to solve. In fact, occasionally one may meet a situation where a responsible person in an organization may not even recognize how research and development can ease his problems. Research workers in the universities or in the research organizations must do their best to gain the confidence and co-operation of their colleagues in industry.

At M.E.T.U. few years ago we went in small groups to talk to industrial leaders on general problems and on the possibility of identifying joint work. In fact, in most cases we asked them to help us to start research or development work. By listening and talking to them, we have been able to list many problems which we think require special attention. Later, we discussed among the university staff those problems to which on the basis of available equipment and personnel we thought satisfactory solutions could be obtained.

It should also be recognized that universities or research organizations must gain the confidence of industry by obtaining results which have immediate application. Thus, the initial problems selected must be outstanding and easily solved with the

facilities at command. Once a promise is made by the research organizations or university for the solution of a specific problem or development of a special device the promise must be kept. When industry is convinced that there are definite gains from research work, then the required relations for more joint work will be established, and support by industry for research establishments will increase.

Until sufficient experience is accumulated in selecting and conducting research work, it is advisable that a frequent review of potential and existing research projects be made in order to decide which projects to continue, which projects to close down, and which to initiate. In fact, evaluation of existing projects is probably more important than selecting new project. The research leaders must alo decide on the importance of each project in order to fix the priority of allocation of the available facilities.

The new universities everywhere have a common problem in selecting suitable candidates for training and acquiring qualified scientists on their staff, at the same time providing working conditions and atmosphere in which the scientist can produce and work happily. This is the major task of the administrators and founders of a new university. Similar problems exist in the newly established unviers ities in the developed countries. However, in the developing countries, in view of the lack of experience in university administration, lack of facilities and lack of a basic infrastructure which automatically produces healthy growth, much more routine work will be required from the teaching members. Unfotunately, these handicaps are definite deterrents to creative research and could be used by academic personnel as reasons against instituting research projects.

Once the scientist fails to provide a creative environment, it will also be extremely difficult for him to acknowledge the fact that he is falling scientifically behind and that he has lost contact with his own particular scientific interest. When this dangerous stage is reached, it is possible that he will use trivial academic points for their political significance to his position and suppress young and more competent people beneath him. He will try to reinforce his position by acting the "big man". The stagnation of the scientific potentials in developing countries is due mainly to the existence of this attitude. The author feels very strongly that the prime objective in establishing a new university in a developing country should be

the creation of capabilities for research and development right from the start.

The stage of development, especially of applied science and technology in developed countries, force scientists always to look ahead and not tolook back at previous work, which means they will take for granted that some of the problems which have been solved,and the solutions which they have been using for several years do not need further consideration. Such practices may yield endless sources of development and research problems for scientists working in new universities. The powerful industrial organizations would rather develop new products and rarely go back to further development of those things which they themselves have engineered several years ago and which they could improve. Therefore, by inventing new ways of doing similar job, scientists in the newly-established universities could improve on the operation and performance of already established processes. The history of the development of Etikur AM Carrier Receiver and Transmitter, developed by M.E.T.U. for the State Power Company of Turkey (Etibant), is an excellent example of this fact (see. Turkish Patent III49)

Lastly, the new universities in the developing countries require large amounts of money for training staff, for buildings, new facilities, and for getting necessary teaching and research laboratory apparatus Thus, they must have all the support that government and other organizations can give to them. For this purpose, they must prove by their efforts in research and development that they can contribute to the economic and industrial development of the country

(1) by training properly qualified personnel who will serve in government and civilian organizations with success, and
(2) by developing innovations which will create new jobs and thus contribute to the economic development of country

In order to achieve these objectives, the government of the country of the developing university and the supporting organizations msut be firm from the start t encourage the highest possible standard. It must be realized that this cannot be bought cheaply however and investment in universities has the richest national retur

Following this, it should also be remembered that the psychological impact of research and development in the new developing countries plays a significant role in getting the required political support which can easily be converted into financial support.

Implementation of the Research Results

The most difficult part of research and development work is the utilization of the results of research, that is, commercialization of the work done in the laboratories or introduction of new manufacturing techniques. Unfortunately, in the less developed countries, the research organizations must continue in their effort after the completion of the research project, in order to make sure that efficient translation of the laboratory result into commercial practice will be made.

In the developing economies one can observe many examples of a grandiose start for the manufacture of some industrial goods, which then failed because of lack of support of those efforts by research and development departments. In fact, even the assembly line type industries, which are being introducedin the newly developing countries, will not survive the competition with the parent company or with other companies manufacturing similar goods. It must be stated that with establishment of new industries supporting research departments must also be formed.

The communication of research results from the research worker to the manufacturer or user of the research results is a very difficult problem, especially if the research is initiated without full support of the industry concerned. This constitutes a major handicap for the implementation of research results obtained in the universities, because, as it was in this country, in most cases the projects are initiated by the suggestions of scientists in the universities. Therefore, industry has some reservations on the successful utilization of the research results. This implies immediately that research projects initiated by the universities in the less developed countries induces a higher degree of responsibility of the type which, in the developed countries, belongs to industry itself.

Another fact to consider is the conversion of ideas into a practical device. In industrial countries a decay curve for the new products, developed in the research laboratories, i.e. ideas by stage of evolution, indicates that if 32 new ideas are considered, only one successful new product will be obtained.[3]

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3. Delmar W. Karger and Robert C. Murdick. "Managing Engineering and Research", book by the Industrial Press, 13 Worth St., New York 13, USA., page 10.

This figure should be very high for research conducted in the universities. To prevent such high mortality rate or to assure success rate in the applied or engineeri research, university research departments must also evaluate the following points as accurately as possible - before, during and in the application stage.

1. The end produce, either in apparatus or form of process, must be applicable to the organization which supports research projects.

2. If it is a particular device or a component of a device, [illegible], the supporting organization must have a sufficient number of needs for it.

3. Raw material or semi-manufactured components must be available for local manufacture, and necessary technical personnel should be found in the country for the introduction of the new manufacturing processes, as well as for the manufacture of ne devices.

4. The product should be manufactured with minimum capital investment, in fact it is preferable taht the first year's production should be realized by the utilization of existing facilities in the supporting organization.

5. The supporting organization should have a complete capacity and technical know-how for the manufacture of the product, or such capacity should be provided with manimum difficulties and costs.

6. The costs of the product, taking into account the costs of development, investment, and depreciation, must be competible with that of the available commercia products

7. The comparison of the new product with available ones must have favorable features for its introduction.

Obviously, the assessment of the above seven points will not be completed befor the completion of the product.

However, if the research worker has enough determination in seeing that his research will not be terminated into a mere patent, he should follow it through, as if he were the manager of the research development department of a well organised company. This is process of educating people in industry, in govvernment organizatio and the research workers in the research laboratories and universities, who all must

find their own ways and means of communicating research results to proper places for commerical utilization. The methods employed in well-developed industry may come later as a natural development of science, technology, and the art of industrial success.

Responsibility of Industry

The cooperation with industry could be accomplished more easily if the universities could show that industry would gain by applied research. The initiation of well-balanced relations with industry is very difficult. In order to break the ice between them it is desirable that the university should identify and solve some of the problems of industry without imposing any obligation. In the developed countries this relation has been established and mutual organizations for research, development, control of standards, etc., have been established. In the United States, E.C.P.D. (Engineering Council for Professional Development), A.S.E.E. (American Society for Engineering Education) and professional societies are all organized for this purpose.

The creation of similar types of organizations joining industry with universities could help to foster more productive relations between them. In a meeting at M.E.T.U. in June 1966 the author asked the leaders of industry to provide or do the following as a means to greater cooperation:

1. Engage in mutually beneficial instructional activities in the academic institutions. Industry should utilize the facilities of the universities, requesting that they offer refresher courses on new discoveries that may become applicable in their organizations; industry might lend the services of their engineers and scientists for the purpose of conducting special lectures on the operational and application problems which may have academic features.

2. Employ academic personnel during the summer months to work in industry. Both industry and faculty would benefit almost immediately from such an arrangement.

3. Give direct aid to the academic institutions for training professional industrial engineers, until these industries are able to set up industrial-education-training departments of their own. Especially valuable would be programs whereby the student alternates time spent in industry and in the academic institution, perhaps spending a semester at each.

4. Sponser research. The university's role as recipient of research grants should be to select deserving students and to keep strengthening the avenues of co-operation with industry.

5. To show faith in the technical abilities and know-how potentials of the universities by using the "system" as a consultant. If the university cannot provide know-how on a specific problem from its won resources, it should procure it from outside.

6. To encourage faculty and students who have contributed very greatly in the development of new devices and manufacturing processes by giving special prizes and citations.

7. To support and actively participate in the yearly conference of the professional societies and set up exhibitions at these conferences.

M.E.T.U. - INDUSTRY COOPERATION

The school of engineering of M.E.T.U. has initiated university-industry cooperation programs for nearly fifteen years. In the initial periodthe programs were more less in an accidental basis. The specific problems brought to the attention of the concerned faculty member by the industry or the government organization through personal contact. A new by Law of M.E.T.U. will systematize this aspect of the operation.

In the civil engineering department several harbour and dams model projects have been completed since 1959. Several hundred thousands of dollars have been saved by this cooperation and construction time for these projects have been reduced considerably. The descriptive lists of projects completed in M.E.T.U. is published in the engineering school progress reports.

In the electrical engineering department most of the thesis work in M.S. and Ph.D. level were selected amongst the industrial oriented problems. Some are specified by the industry in the form of suggestion and specific request and others have been initiated on the basis of the wants of the faculty members. On the basis of such an attitude, the Turkish industry has gained two new members in the instrument transformer manufacturing field. The current and voltage transformer manufacturing technology has been recreated in the country. The families of communication equipment for state power system company has been developed through the cooperation of M.E.T.U. and TEK (State Power Company) the acceleration of the technology oriented industry in the country has taken important momentum through the applied research conducted in the university. Some of the system oriented researches in the electrical engineering department has found practical application in the improvement and expansion of the Turkish power transmission and distribution systems.

In the chemical engineering department several industrial oriented projects jointly or only on the support of M.E.T.U. have been completed. Amongst these the following four projects will be mentioned because of their importance and financial impact on the economy of the country.

1. Smokeless lignite project
2. Bricketting of the lignite dust
3. Calcination of celemenita in fluidized bed
4. Beneficiation of Kincal

The first two projects are also important because of their impact on the airpollution problem of Ankara which is known to be the one of the worst city in air pollution. The contribution of these project to the economy of the country is estimated to be around 4 million dollars per annum.

In the mechanical engineering department a sugar beat machine has been developed and successfully being used by the sugar industries M.E.T.U. has obtained a patent for this machine, but it is not transformed into a commercially available product. One reason for this is that no one has come out to follow up this particular product. Another reason is that the university could not turn overthe patent right to any private machine industry. The acceleration of the transformation of the primitive Turkish agriculture into a modern industry requires more agricultural machines which may be developed through the research and development work in the university. This aspect of the Turkish agricultural problem must be considered in a "bold" program. The new "Land reform" law in Turkey also requires modernization of the agricultural structure which can only be done by developing or transforming an agricultural industrial technology into the country.

The collaboration between the industry and the Department of Mech. Eng. has developed rather slowly due to the problems indigenous to a rapidly growing industry. Because of the large gap between the demand and supply, the private industry is after quick results which cannot easily be responded to by an institutions which is basically an academic one, and the government establishments, with the specific problems of their own, are not able to capitalise on an idea and persevere to the end.

Changing an idea into a commercial or useful useful engineering product passes through the three main stages such as; design, development and production. For an industry, which on the whole, is not up to the technical sophistication of the

advanced countries, or when it cannot truly be said to be a competitive industry, this sequence is, more or less, in the reverse order. Thus, the main problem is one of production, in which case the transfer of production know how with the idea becomes much more appealing to the investor due to the short-cut it affords in sharing the market. When the envisaged product does not require much engineering skill, the existing models since the quality and efficiency do not, as yet, play a dominant role as would be in a competitive industry. Consequently, the development of the collaboration has been hindered mainly due to these factors causing a stalemate at times.

However, the Dept. of Mech. Eng. made a broad move to promote the collaboration by starting an extension campus at Cazianten, which can be said to be the capital of Turkey in unorganized small industry. This province is a typical example of the state where the small industry has reached to the peak with their means and know how, but needs a fresh impetus for break-through. This provides a promising chance to animate many of the projects developed but not materialized by this department. It is indeed lucky that Cazianten's unorganized industry is at the moment the subject matter of a unique U.N. project under the supervision of UNIDO. The cooperation between UNIDO and the METU would yield results which will bring a new dimension to the collaboration between the industry and the universities, particularly, in the developing countries.

In the mining and geological engineering departments several nationally important projects have been considered. Among these, the determination of the Devrigi, Iron are parameters can be mentioned. Because on the basis of the research work at M.E.T.U. the stated organization have initiated 40 million dollars mining facilities project in the Divrigi iron are region.

The youngest department of the faculty is the industrial engineering department. This department has engaged with industry in several industrial engineering problems. The industrial engineering and industrial management field is wide open in the country. The development of a competancy in these field will bring many more problems to the University from the industry.

Lastly the metallurgical engineering department of the faculty has also been engaged in industrially oriented problems. The rapid development of the metal industry and the quality requirements of the existing machine and metal industries will result in more collaboration with industry.

Another field where M.E.T.U. has cooperated with industry is the field of personal assistance from the faculty members. One faculty member was appointed as director general of Turkish Petroleum Organization. Another one acted for nearly two years as director of the 3rd steel plant which is the biggest industrial project in the country.

Since the foundation of M.E.T.U. in 1957 the faculty of engineering has offered 2641 B.S., 855 M.S. and 8 Ph.D. degrees. In the degrees of M.S. and Ph.D. the faculty requires M.S. thesis and Ph.D. Dissertations. Many of these work can be transformed into commercial proposition if a supporting industry and organization can be found. Many faculty members including the author of this paper has also acted as consultant to the state planning organization. The formulation of the 3rd five year development plan reflects in part the ideas of the faculty members. Partly, on the reccmmendation and special research of the M.E.T.U. faculty the 3rd five year plan will give more weight to the development of technologically oriented industries. Therefore the cooperation with industry will be expanded many folds and thus vitality of the University will be strengthened during the plan period 1973-1977, of the 3rd plan.

Conclusion

University industry cooperation plays an important role in the development of an economy of a country in the developing countries. It is true that much lip service is paid to the idea of cooperation. But unfortunately there exists no single formula for formulating a cooperation programs in fact each problem due to its peculiarity must be handled by itself and cooperation program must be designed accordingly, perhaps on a contract basis.

The important point is that the attitude of the administrators and faculty members must be right for such a collaboration. Compulsory summer work in industry will help the faculty member to acquire keen interest in industrial problems. The support of the research and development work in the universities by all concern parties will produce desire result.

The importance of the cooperation idea can be proved by the fact that on the basis of M.E.T.U.'s approach Turkish industry and industrial infrastracture has gained facilities costing more than 3 billion Turkish pounds and that yearly contribution of the industrial organizations created or improved upon by M.E.T.U. - Industry

Cooperation exceluling trained engineers is amounting more than 200 million Turkish pound.

Development of the industrial research laboratories, therefore should be recommented and should be supported whenever possible.

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