AN EVALUATION OF THE ROLE OF THE SCIENTIFIC AND TECHNICAL RESEARCH COUNCIL OF TURKEY FOR THE CREATION OF INDUSTRIAL PRODUCTION TECHNOLOGY WITH PARTICULAR REFERENCE TO THE PROJECT SUPPORTING PROGRAM

A MASTER THESIS

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by
Tevfik Dalgıç
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I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Business Administration.

Muhan Soysal

Supervisor

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Business Administration.

Chairman of the Department

Examing Committee in Charge:

Assist.Prof.Dr. Yalçın Tuncer

Assist.Prof.Dr. Ümit Akınç

Assist.Prof.Dr. Muhan Soysal

Committee Chairman

PREFACE

The role and importance of technology in industrial development has been analyzed and observed since the end of the Second World War.

In Turkey it is rare to find empirical studies which set up a relationship between the technology and industrial development of the country.

This thesis attempts to serve as one of the early studies aimed at trying to find the role of technology in the industrialization process of Turkey.

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INTRODUCTION

This study aims at clarifying the effectiveness of TUBITAK from the standpoint of "Industrial Production Technology Creation."

In the first part of the study, the writer will analyze the basic requirements and conditions for the creation of industrial production technology with reference to the research results drawn from different industrialized countries. At the end of the study the writer tries to analyze the application of TUBITAK for this theoretical frame, with reference to the project-supporting experiments of the institution between the years 1963 - 1973. In order to show the vital importance of the subject for the country, the writer analyzes the industrialization target of Turkey based on the Constitution and Development Plans. In the 3rd Five-Year Development Plan the concept of development was considered to be the same as industrialization. The writer tries to stress the role of the creation of industrial production technology in the industrialization process.

At the end of the study the writer makes some proposals for the development of the system. The transfer of technology and activities related to this subject are not analyzed in this work. The transfer of technology is considered a different subject and is deliberately not included in this study.

The work is based on a normative approach and aims at explaining what should be done as a goal for this study.

PART I

A. BASIC RELATIONS BETWEEN ECONOMIC DEVELOPMENT AND TECHNOLOGY

The role, importance, and factors of technology in economic development began to be analyzed by economists after the Second World War. In an article appearing in the Economic Journal, Nathan Rosenberg says:

> Not too many years ago most economists were content to treat the process of technological change as an exogenous variable. Technological change - and the underlying body of growing scientific knowledge upon which it drew - was regarded as moving along according to certain internal processes or laws of its own, in any case independently of economic forces. Intermittently, technological changes were introduced and adopted in economic activity, at which point the economic consequences of inventive activity were regarded as interesting and important." (1)

The role and importance of scientific research and development in the process of economic development and industrialization has been analyzed by different writers who have stressed the role of technology in industrialization. As indicated by Nathan Rosenberg, the reason for having many research results on this subject is not an accident, but is a product of new investigations of economic sciences into the role of technology in recent years. For this reason the latest research results shed new light on the subject.

Zvi Grilliches (2) and Jacob Schmookler (3) tried to give more concrete examples of the role of technological change in the process of economic development. Due to the results of these similar works, the role and importance

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(1) Nathan Rosenberg, "Science, Invention and Economic Growth," The Economic Journal, March 1974, pp. 90 - 108.

(2) Zvi Grilliches, "Hybrid Corn - An exploration in the economics technological change," Econometrica, October, 1957.

(3) Jacob Schmookler, Invention and Economic Growth, Cambridge, Harvard University Press, 1966, USA.

of Research and Development (R+D), and consequently of technology in the process of industrialization, was understood and clarified.

> The advance of technological knowledge by opening new ways to meet wants and by increasing the productivity of the nation's human and material resources has been one of the most important factors contributing to the economic growth of the country (vs). (4)

After the discussions and research results of the role of R+D in industrialization and economic development, many of the countries started to establish R+D institutions and science councils. Some countries have created new state institutions to deal with R+D activities. Charles Cooper, who is a member of Science Policy Unit of Sussex University, has explained his research results on this issue. In this study he says:

> Most underdeveloped countries support some form of scientific and technological activity. In most, there is a nucleus of research and development (R+D) personnel, working in a network of institutes, there are technicians and engineers. Also, a large number of the underdeveloped countries have National Science Councils or similar institutions, part of whose function is to relate local science and technology to production - often with the more specific objective of generating appropriate technologies. There is a good deal of scepticism about the effectiveness of these science policy institutions and they have had very limited success in creating a link between science and production and there is not much evidence that they have opened up new types of technological options in the underdeveloped countries. (5)

Mr. Cooper explains a common problem of all underdeveloped countries: that is, the failure of the scientific institutions of many of those countries to link science with production. However, newly established or old research institutions of underdeveloped countries could be considered to be a reaction of those countries to the increasing effectiveness and the role of science in industrial production.

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(4) Richard R. Nelson, "Technological Advance - Economic Growth and Public Policy - Perspectives on Economic Growth", Rand Corporation Publication, USA.

(5) Charles Cooper, "Science Policy and Technological Change in Underdeveloped Economies," World Development, Vol. 2 No. 3, March 1974, pp. 55 - 64.

B. MAIN DEFINING FACTORS AND CONDITIONS FOR GENERATING INDUSTRIAL PRODUCTION TECHNOLOGY

As indicated at the beginning of the literature research, many studies about the relations between industrial production technology and economic development have taken place recently. In this second part of the literature research, we will try to analyze some comments of different authors and research people on the subject. Nathan Rosenberg continues his comment saying:

> The vast expenditures on Research and Development made it increasingly obvious that inventive activity was - or could be made to be - responsive to economic needs (or even to non-economic needs if such needs received sufficient financial support.) Clearly much of the search activity of R and D was highly purposive: business firms were looking for new techniques in specific categories of products, they spent much money upon this search, and they were sometimes highly successful. Similarly, government agencies had long directed research into specific problem areas and in some cases had achieved conspicuous success - as in agriculture. (6)

It is observed by some writers that the demand for those technologies is also as important as the industry type, service area, and production categories.

Defined market needs and consumers' necessities could be seen as a promotional effect for generating technology. In a study made by OECD, the following interesting result was achieved: "Approximately 2/3 and 3/4 of technological achievements are generated as an answer for a well-defined market demand." (7)

A result regarding this subject derived by a study by Jacob Schmookler is also interesting. Schmookler's book is an attempt to demonstrate, through the study of several American industries, that demand-side considerations are the major determinant of variations in the allocation of inventive

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(6) Nathan Rosenberg, op. cit. , p. 90.

(7) OECD, The Conditions for Success in Technological Innovation, Paris, 1971, pp. 11 - 12.

effort to specific industries. In examining the railroad industry, for which comprehensive data have been available for over a century, Schmookler found a close correspondence between increases in the purchase of railroad equipment and components, and slightly lagged increases in inventive activity as measured by new patents on such items. The lag is highly significant because, Schmookler argues, it indicates that it is variations in the sale of equipment which induce the variations in inventive effort. Schmookler finds similar relationships in building and petroleum refining, although the long-term data on these industries are less satisfactory. Schmookler says that "a 1 per cent increase in investment tends to induce a 1 per cent increase in capital goods invention." (9)

If we look at the types of institutions which are performing Research and Development continuously, we can see the important job of private firms in this process. In an OECD study it is said that "More than 90 per cent of R+D activities are carried out by private firms; this percentage is about 77 per cent in the United Kingdom." (10)

In an article that appeared in The Economic Journal, authors Charles Kennedy and A.P. Thirwall found a similar result by analyzing patent registration activities in the USA and in England. They say in the article:

> It is true that over the years there has been a marked shift in the sources of inventive activity from the independent inventor to the corporation. In America in 1900, for example, 80 per cent of patents were issued to individuals compared with 30 per cent today, and the same is broadly true for Britain. (11)

Another author, William S. Comanor, has investigated the effects of competition on the creation of technology and has

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(9) Jacob Schmookler, op. cit., p. 144.

(10) OECD, The Overall Level and Structure of R+D Efforts in OECD Countries, Paris, 1967.

(11) Charles Kennedy and A.P. Thirwall, "Surveys in Applied Economics: Technical Progress," The Economic Journal, March 1972, pp. 12 - 72.

come to the conclusion that "competition had effected the technology generating process in a positive manner, not as a negative effect as believed earlier." (12)

Generally, Research and Development activities play an important role in reaching the targets of those organizations which are carrying on these activities, and shape and direct them according to the targets and goals of these organizations.

This is also true for both basic and applied Research and Development activities. In a book edited by Carl Heyel it is said that "planned R+D not only provides new product development, but also keeps present products competitive through constant product improvement." (13)

On the other hand, another author who tried to analyze the relationships between firm size and market structure and R+D activities concluded that:

1 - Government contracted research and development does not lead to many patents and is concentrated in large firms.
2 - Small firms obtain a higher proportion of their patents from non research and development employees.
3 - Small firms apparently conduct their research with the greatest cost consciousness. (14)

Another writer says that "research may lead to major break-throughs which can only be developed by large firms, because there are substantial economies to scale in maintaining research and development activities." (15)

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(12) W.S. Comanor, "Research and Technical Change in the Pharmaceutical Industry," Review of Economics and Statistics, May, 1965.

(13) Carl Heyel (ed.), Handbook of Industrial Research Management, Reinhold Publishing Corp., 1970, London, pp. 34 - 35.

(14) R. Scherer - "Firm Size, Market Structure, Opportunity and Output of Patented Inventions," American Economic Review, 1965.

(15) Keith Norris and John Vaizey, The Economics of Research and Technology, George Allen and Unwin Ltd., London, 1973, p. 68.

In a book called "Research and Development Management," authors Thomas W. Jackson and Jack M. Spurlock, say: "Small companies should not embark upon Research and Development excursions without accurate market surveys." (16)

Whether there is a relationship between generated technologies and the subject of the science or not is also an important question to be asked, because in some subjects of sciences we have had traditional technologies for hundreds of years, while in others we have had very limited success. Certain researchers have attempted to analyse this fact. They say that "the statistical evidence is backed up by qualitative work; both in the U.K. and in the U.S.A. Research and Development devoted to major advance is concentrated in a few industries - aerospace, chemicals, and electronics." (17)

If we look at the relations between technological development and marketing activities we can see some writers claiming that marketing activities are continuations of Research and Development. One of the authors has commented on this issue by saying that "innovation is capital-intensive, especially in the two crucial phases, the development phase and the market introduction of new products, processes or services." (18)

Another author draws our attention to the fact that R+D activities and marketing activities are going to complete each other as time passes. Michael Shanks says:

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(16) Jackson W. Thomas and Spurlock M. Jack, Research and Development Management, Dow Jones - Irwin Inc., Homewood, Illinois, 1966, pp. 27-28

(17) Keith Norris and John Vaizey, op. cit., p. 68

(18) Peter F. Drucker, Technology - Management and Society, Heinemann, London, 1970, pp. 32 - 33.

> Fortunately, with the improvement in management standards, the use of market research and other modern marketing techniques is growing and there is a much closer integration than that in the past between R+D, design, production and marketing. But though the position is improving, it could still be better. (19)

Author Russel W. Henke accepts that marketing is an important phase of Research and Development activities, and concludes that "marketing considerations may even determine whether or not a product should be developed - quite aside from engineering considerations." (20)

In the study of Zvi Griliches, the role of profit expectations in the creation of technology is explained. He clarifies "the importance of profit expectations as shaped by the market size." (21)

If we summarize the comments of writers and researchers on the issue, we can come to the point of saying that the demands and necessities of the people affect the creation of technology. This means that marketing is an important factor that affects the determination factors of technology generating processes. If we take industrial production technology as a case in point, this relationship can be seen very clearly, since industrial production technology is basically affected by economic factors and determinants. Author J.A. Morton clarifies this point thus:

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(19) Michael Shanks, The Innovators: The Economics of Technology, Penguin Books, USA, 1967, p. 236.

(20) W. Russel Henke, Effective Research and Development for the Smaller Company, Gulf Publishing Company, Houston Texas, USA, 1963, pp. 17-18.

(21) Zvi Griliches, op. cit.

> Now we are not talking about all research. Rather we are talking about relevant research in industry. This, plus development is essential to the demonstration of new technology. But, by themselves, R+D are not enough to yield new social benefits. They, along with capital resources, must be effectively coupled to manufacturing, marketing, sales and service. When we coupled all these activities together we have the connected specialized elements of a total innovation process. Uncoupled from the rest of the process, R+D can be alarmingly wasteful. (22)

C. BASIC PHASES WHICH DETERMINE GENERATION OF INDUSTRIAL PRODUCTION TECHNOLOGY

In the first part of literature research in this study, we have tried to see the main ideas and observations of different authors on the generation of manufacturing technology. In this part of our study, we would like to look at the views of some research people about the basic phases which determine manufacturing technology. Some writers and research people claim that the generation of manufacturing technology is determined by certain phases of activity. Two engineers who have been employed by the Scientific and Technical Research Council of Turkey say that in order to generate manufacturing technology, the following steps must be followed:

1) R+D or innovations
2) Design of the product
3) Preparation for production
4) Beginning of production (Marketing Research included)
5) Marketing (23)

In another study the same opinion is accepted and more detailed steps and phases are explained:

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(22) J.A. Morton, Organizing for Innovation, McGraw Hill, U.S.A., 1971, p. 4.

(23) Yük. Müh. Kismet Burian, Yük. Müh. Turgut Uzer, "Endüstri Kesiminde Teknolojik Yenileşme Ihtiyacinin Yaratılması ve Yenileşmenin Hizlandirilmasi", TBTAK, 1973, (Mimeograph).

1) Idea
2) Consultation and agreement
3) Marketing research
4) Pre-technical research and determination of feasibility of the subject
5) Evaluation of the subject from cost - marketing power - quality and value points of view.
6) Research
7) Product development
8) Limited production
9) Pioneer marketing (Penetrating marketing)
10) Manufacturing
11) Distribution (24)

D. CONCLUSIONS DERIVED FROM LITERATURE RESEARCH AND THE WRITER'S OWN VIEW

In the literature research we have looked at the main ideas and observations as well as research results that analyze the process of technology creation in the industrialized countries. In conclusion we could see the main determinants and views that are observed for the creation of technology.

First of all, it is accepted that the generation of technology requires different jobs and activities. These activities could be considered to be a "chaim of works" or "group of works" starting from the basic research and coming to the marketing activities. Different people call these activities by different names and may analyze them in a more detailed way, but generally speaking we have four main scientific and technical activities that determine the creation of manufacturing technology. These are:

1) Basic Research
2) Applied Research
3) Technological Development
4) Economic Development (25) (26)

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(24) Roman D. Daniel, Research and Development Management - The Economics and Administration of Technology, Appleton Century, Crofts, New York, USA, 1968, pp. 4-6.

(25) "The Measurement of Scientific and Technical Activities," OECD, DAS, SPR/70/40, Paris, 1970, (Frascati Manual).

(26) Tuncer Yalçın, Some Aspects of Science-Based Technological Promotion, METU, Ankara, 1974.

Human resources, machines and tools, managerial techniques and scientific, technical, and economic capabilities are united in these phases for generating a new product, a new technology of production, or a better usage of a product. These results affect the goals of human beings and industrialization of the countries.

The second observation for determining the creation of manufacturing technology is the positive role of demand and market reflecting to the laboratories and affecting the subject, direction, and content of the Research and Development activities. The dynamics of R+D come from the real world based on the investigation of cause-and-effect relations of economic conditions and technological development. It is not possible to ignore the role of demand and the socio-economic conditions of the country in the process of generating technology. The market may affect the R+D activities in the following way:

1) Competitive Effect - (Product - different good - price - cost - shape - usage)
2) Profit Expectations
3) Reaction to the Demand in the Market (New products - new usage styles)
4) Market Development Activities (Geographical distribution)
5) Other Special Expertise (Leadership - brand etc.)

There is a third observation that technology generating activities generally give positive results in science-based industries. These industries are aerospace, electronics and chemistry. In a study made by OECD, industries are classified according to their science-based characteristics. This is given in Table Nr. 1. (27)

There is a similarity between this tabulation and the findings of Keith Norris and John Vaizey. (28) This similarity may reflect the fact that the probability of generating

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(27) "Analytical Report on Technological Gaps," OECD, Paris, 1967, p. 29 - 30.

(28) Keith Norris and John Vaizey, op. cit.

(29) Yalçın Tuncer, op.cit. p. 8.

manufacturing technologies in the industries of aircraft - missiles - electronics - chemistry and petroleum is considerably and comparably higher than that for the other industries. Because the other industries that are classified as non science-based are traditional industries and everything is known about them, this decreases the probability of success in the creation of technology.

Fourthly, R+D activities are highly expensive functions, which leads us to the conclusion that only big firms should deal with these activities. There is a great possibility of reaching unsuccessful solutions at the end of R+D programs. (29) This reflects the reality of why big firms can afford to deal with R+D.

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(29) Yalçın Tuncer, op. cit., p. 8.

TABLE 1

CLASSIFICATION OF MANUFACTURING INDUSTRIES
ACCORDING TO SCIENCE-BASED CHARACTERISTICS

A) CLASSIFICATION IN 4 GROUPS:

GROUP 1	GROUP 2	GROUP 3	GROUP 4
1) Aircraft-missiles	7) Machinery	10) Non-ferrous metals	14) Textiles
2) Electronics	8) Fabricated metal goods	11) Ferrous metals	15) Paper
3) Pharmaceutical industry	9) Petroleum	12) Other transport equipment	16) Food-Drink
4) Electrical machinery		13) Stone, clay, glass, rubber	17) Different production
5) Chemistry			
6) Instruments			
SCIENCE-BASED INDUSTRIES	MIXED INDUSTRIES	AVERAGE	NON SCIENCE-BASED INDUSTRIES

B) CLASSIFICATION IN 3 GROUPS

SCIENCE-BASED	MECHANICAL	OTHER
1) Aircraft-missiles	4) Machinery	7) Chemical Related (Rubber, Textile, Food-Drink)
2) Electronics (Instruments included)	5) Basic Metals (Fabricated goods included)	8) Other manufacturing industries
3) Chemistry (Pharmaceutical industry and Petroleum included)	6) Other Transport Equipment	

(27) "Analytical Report on Technological Gaps," DAS/SPR, 67.98, OECD, 1967, Ch.A (II), pp. 29 - 30.

D) HYPOTHESES OF THE STUDY

After five years of experience as an expert in the Scientific and Technical Research Council of Turkey (TUBITAK) and in light of the literature research, the author of this study would like to present the following hypotheses:

1) The application of the Project-Supporting Program (PSP) of TUBITAK is directed at satisfying the research needs of academic institutions and universities of Turkey instead of at long-term economic goals and targets of the country as stated by the Development Plans.
2) For this reason, the application of PSP covers mainly traditional subjects and the scientific areas that are not related to science-based industries.
3) Supporting projects in traditional subjects and old scientific activities led TUBITAK to be unsuccessful in generating manufacturing technologies, and this means that TUBITAK has less possibility of obtaining new economic sources.
4) The PSP application does not cover the necessary phases of creation of manufacturing technology.

In conclusion, the aim of this study is to evaluate the available data in light of the above hypotheses and develop the suggestions and proposals so that TUBITAK may be an efficient national institution for generating manufacturing technology.

PART II

As mentioned earlier, one of the main concerns of this study is the nature of TUBITAK, which is a public organization. For this reason it is expected to perform certain duties in the direction of the goals of the Constitution of the Turkish Republic. The Turkish Constitution and Development Plans, as well as the Establishment Law, require certain services and duties from TUBITAK. In order to clarify the roles assigned by the Constitution and Development Plans, we have to analyze the relations between these organs.

The Turkish people, in accepting the Constitution, have also accepted the fact that the main concepts, rules and general regulations of the Turkish State were stated in the Constitution as the principal philosophy of the nation. For this reason, the Turkish Constitution is a document of the rules, goals, and regulations of the people. The Turkish Constitution requires certain defined organizations for fulfilling the targets and goals of the people. One of the main requirements of the Constitution is planned development and the establishment of an office to prepare this planning.

Article 129 of the Turkish Constitution states that "economic, social and cultural development is controlled by planning. Development has to be realized according to this plan." (30) Certain articles require that an institution called "The State Planning Organization" be established; development plans should be prepared by this organization for proposal. The Constitutional Committee of the Turkish Parliament explains the main idea of the planning concept for Turkey in the following words:

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(30) Turkish Constitution, 1961, Art. 129.

> It is a generally accepted fact that underdeveloped countries are in need of planning for development. The world is going to apply the planning concept of development because this is the most rational way of reaching its goals. (31)

In these words, the committee that prepared the Constitution accepts the fact that, in order to develop, Turkey must use all resources in the most efficient way for the sake of productivity. The utilization of the resources and potential of the country in the most productive and rational way is also one of the main objectives of modern science. This fact is accepted by the Turkish people and is documented by the Constitution.

Today Turkey is applying the Third Five-Year Development Plan in order to reach these goals. In the Third Five-Year Development Plan, the long-term goals of the Turkish people are stated as follows:

1) To increase the living standard of the people
2) TO INDUSTRIALIZE
3) To decrease requirements from foreign resources
4) To solve the employment problem
5) To have better distribution of income (32)

This means that in the long run, the Turkish people will have a better standard of living, will be an industrialized nation, will depend less on foreign resources, and will have a better income. As is seen, industrialization is the second long-term target of Turkey and it is indicated in the Development Plan as having been ordered by the Constitution. The Third Five-Year Development Plan has explained these targets in more detail.

As stated above, the long-term objectives of the Third Five-Year Development Plan not only envisage a fully industrialized economy and a higher standard of living for the community, but also encompass an industrial structure and technology. These objectives are set by the governments

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(31) Turkish Constitution, Constitutional Committee Report, Paragraph 2.

(32) New Strategy and Development Plan, Third Five Year 1973-1977, State Planning Organization, DPT, Pub. Nr. 1272, p. 119.

of Turkey which are elected for the Turkish nation by the members of Parliament. As seen in the plan, industrialization is in the long run Turkey's second most important objective. This objective is further clarified in the plan as follows:

> To increase the standard of living of the Turkish community requires an economic growth based on industrialization that adds to the national income. The added value created by industrialization and increased standard of living will solve the demand problem for industrial goods and will consequently create an opportunity to solve the problems of foreign trade. As a result, employment opportunities will be constantly growing, and distribution of income between rural and urban areas will be better and productivity will increase. All of these objectives will be realized through industrialization. (33)

As is clearly seen in the plan, economic development means industrialization for Turkey. For this reason we have to explain the meaning of "industrialization." A dictionary of sociology contains the following explanation of the word:

> Industrialization: The process of technological development by the use of applied science characterized by the expansion of large-scale production with the use of power machinery, for a wide market for both producer's and consumer's goods, by means of a specialized working force with division of labor, the whole accompanied by accelerated urbanization. (34)

In this definition the use of applied sciende for industrialization is more stressed and it is accepted that industrialization is a technological process. The main cause of production of goods and services of an economy in a given period of time are explained in the following way by Besim Üstünel:

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(33) Third Five-Year Development Plan, Part 2, p. 210

(34) Pratt Henry Fairchild, Dictionary of Sociology, Littefield Adams and Co., Paterson, New Jersey, 1961, USA, p. 155.

1) The quantity and quality of the resources used by the country.
2) The technological level known and used.
3) The social system applied (35)

For the industrialization of a country, technological knowledge is necessary. Technological knowledge is the use of scientific knowledge for production. According to Üstünel, "Without knowledge of production technology, and without experience, other factors of production cannot produce useful goods and services."(36) This means that the use of applied scientific knowledge is necessary for industrialization. The acquisition of scientific knowledge requires Research and Development activities.

THE ROLE AND LEGAL DUTIES OF THE SCIENTIFIC AND TECHNICAL RESEARCH COUNCIL OF TURKEY

TUBITAK was established by Law number 278, accepted by the Grand National Assembly on July 17, 1963. TUBITAK was authorised to deal with R+D activities on a national level. According to the Law Concerning the Establishment of TUBITAK, the functions of the organization are stated as follows:

- Functions -

Article 2:

The functions of the Scientific and Technical Research Council of Turkey shall be:

a) To carry out assigned duties, promote and

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(35) Besim Üstünel, Ekonominin Temelleri, Doğan Yayinevi, 2. Baskı, Ankara, 1972, p. 42.

(36) ibid.

encourage fundamental and applied research in positive sciences; to set up institutes for work in this field.

b) To assist the Government in formulating the national policy to be followed in the field of fundamental and applied research in positive sciences.

c) To formulate basic policy and procedures for education in the fields of positive sciences and research, and to give advice to the institutions concerned.

d) To express its opinion on requests pertaining to scientific and technical research submitted by public institutions and organizations, municipalities, individuals, and private institutions.

e) To provide means of training and advancement for scientists and researchers in the fields of fundamental and applied science; to follow up young people with high talent who have proved successful in the course of their education, postgraduate work and career in order to help them in their further advancement and progress, and for this purpose to provide scholarships within the country and abroad, to organize contests, and issue publications.

f) To provide the Government with necessary information for the preparation and negotiation of international agreements on subjects related to the field of activity of the Council.

g) To establish contact and to cooperate with domestic and foreign research institutions and persons, and follow their work closely.

h) To initiate and help organize courses, conferences and seminars in order to propagate the idea of research.

i) To publish or sponsor the publication of material related to the fields of activity of the Council, and to establish a center of documentation.

j) To engage in all kinds of activities necessary for the achievement of the above-mentioned

purposes and for the fulfillment of their functions. (37)

As can be understood from the previous explanations and citations, the main concern of this study is an attempt to investigate the role of TUBITAK in light of the Constitution and the Development Plan, with special reference to the Project Supporting Program.

B. BASIC CHARACTERISTICS OF THE PROJECT-SUPPORTING PROGRAM OF TUBITAK

We will try to analyze the application of the Project-Supporting Program of TUBITAK. The question of whether or not the other activities of TUBITAK are productive is not included in the scope of this study. The Project-Supporting Program is the main activity of TUBITAK, according to the degree of importance and amounts of funds spent by the organization. Between the years 1963-1973, TUBITAK spent 38,430,078 TL. for the Project-Supporting Program. The research groups in TUBITAK that are formed to carry out research programmes are named as follows:

1) Engineering Research Group (ERG)
2) Mathematical, Physical and Biological Sciences Research Group (MPBSRG)
3) Medical Research Group (MRG)
4) Veterinary and Animal Husbandry Research Group (VARG)
5) Agricultural and Forestry Research Group (AFRG)
6) Committee for Training Young Scientists (CTYS)

As indicated in the earlier parts of this study, the main objective of this research is to evaluate the activities

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(37) Law Concerning the Establishment of the Scientific and Technical Research Council of Turkey, Nr. 278, Official Gazette, July 24, 1963, Nr. 11462.

of TUBITAK for the creation of a manufacturing technology with special reference to the Project-Supporting Program. The Project-Supporting Program is a kind of financial support for scientific and technical projects that are submitted by researchers, scientists, groups and teams, or institutions or firms. These applications for support are evaluated by the Executive Committees of the Research Groups. The applications for financial support of projects are accepted or rejected by these committees according to the criteria of TUBITAK. These criteria are documented in a booklet called Guide to Research Projects. According to this document, a project proposal must meet academic standards, then must be evaluated according to whether or not its methods are scientific, its subject matter, the project manager's qualifications, and its legal and financial conditions.

Then the project proposal:

a) should contribute to science and technology
b) should realise, or help to attain, the economic, social, and cultural objectives of the Development Plans and of National Defence and Public Health
c) should create opportunities for training researchers
d) should use the result of any TUBITAK project as data for further studies
e) should coordinate the activities of different research institutions and scientific branches
f) should not have enough financial and other support from within its own organization
g) should finish in a short period of time (37)

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(38) TUBITAK, "Guide to Research Projects, Rules for Project-Supporting," Ankara, 1973, p. 4-5.

C. FINDINGS

A. DISTRIBUTION OF PROJECTS SUBMITTED AND ACCEPTED

During the period of 1963-1973 a total of 1237 projects was submitted to the Scientific and Technical Research Council of Turkey. The distribution of these projects per research group, applicant, or sector concerned is as follows:

TABLE II

Distribution of Total Projects Submitted for Support Per Research Group:

Research Group	Number	Percentage
Engineering Research Group	372	30.1
Medical Research Group	274	22.2
Agricultural and Forestry Research Group	203	16.4
Veterinary and Animal Husbandry Research Group	201	16.2
Mathematical, Physical and Biological Sciences Research Group	187	15.1
TOTAL	1237	100.0

TABLE III

Distribution of Togal Projects

Per Sector

Sector	Number	Percentage
University	909	73.5
Public	294	23.8
Private	34	2.7
TOTAL	1237	100.0

Of the projects submitted for support, the distribution of the ones accepted is shown below:

TABLE IV

Distribution of Projects Accepted

Discipline	Number of Projects: Accepted	Submitted
Fundamental Sciences (Mathematical, Physical, and Biological Sciences)	75	187
Veterinary and Animal Husbandry	85	201
Agriculture and Forestry	80	203
Medical Sciences	134	274
Engineering	236	372
TOTAL	1237	1237

B. DISTRIBUTION OF PROJECTS SUPPORTED AND CONCLUDED

Of the 1237 projects submitted to the Scientific and Technical Research Council of Turkey during 1963-1973, 610 were accepted. 15 projects supported and concluded by the Council's Group for Training Young Scientists have not been included in the above figure. The reason for this is that these 15 projects are related mainly to education. Out of the 610 projects accepted, 419 projects were concluded by August, 1973, i.e. the tenth anniversary of the Council. (As already mentioned, TUBITAK was established om July 17, 1963.) The distribution of the research projects per disciplinary field is taken up below.

TABLE V

Distribution of Projects Concluded

Discipline	Number of Projects Concluded
ERG	148
MRG	76
AFRG	53
VAHRG	77
MPBSRG	65
TOTAL	419

F

C. DISTRIBUTION OF PROJECTS CONCLUDED IN THE FIELD OF SCIENCE-BASED INDUSTRIES

The distribution of projects accepted and concluded in the field of science-based industries with technology production possibilities may be enumerated as follows:

TABLE VI

Concluded Projects Related to Science-Based Industrial Branches

Industrial Branch	Number of Projects
Electrical-Electronics	15
Chemical-Petrochemical	28
Medicine	-
Missiles-Aircraft	-
TOTAL	43

D. PROJECTS DIRECTED AT INDUSTRIAL PRODUCTION

Of the 419 projects supported and concluded during the first ten years of the Council, 33 projects may be described as directly aiming at a production target and carrying characteristics identified with applied research rather than theoretical research. 28 projects were accepted by the Engineering Research Group and five belong to the Agricultural and Forestry Research Group. Data on the projects related to direct industrial production may be seen below.

TABLE VII

Projects with a Direct Industrial Production Target

Discipline	Number of Projects
Engineering	28
Agriculture and Forestry	5
TOTAL	33

E. PATENTS OBTAINED AS A RESULT OF THE COUNCIL'S WORK

The Scientific and Technical Research Council of Turkey has applied to the Ministry of Industry and Technology and obtained 2 patents during the period of 1963-1973. One of these patents is for a project on a chemical method supported by the Engineering Research Group. Its subject is "Separation of Arsenic from Kolemanit."

The second patent is for a single-axis garden-type tractor, a project supported by the Agricultural and Forestry Research Group.

The above two patents are the only ones out of the 419 projects supported and completed by the Council. Both of these are patents relating to industrial production technology.

F. DISTRIBUTION OF PROJECTS PUBLISHED AND PRESENTED AS PAPERS

292 concluded projects were presented as papers. Out of these, 235 were presented in Turkey and 31 in foreign countries. Of the 224 projects concluded, 72 have been published abroad.

The distribution of all the projects presented as papers or published is given in Table VIII. (39) As will be understood from this table, 31 of TBTAK s projects were presented abroad in ten years and the total number of projects in three years reached 261. While TUBITAK had 235 projects within the Council in ten years, this figure rose to 694 for Turkey in three years. From the publication point of view, the number of projects published in ten years is 224 for TUBITAK and 234.6 for Turkey.

G. INCOME TO THE COUNCIL FROM PATENTS

The right of use of both patents obtained by the Council has been transferred to the production institutions under agreements made. The patent on Kolemanit has been sold to Etibank. In accordance with the preliminary agreement, TBTAK will receive 2 TL. per ton of ore obtained, but the payments due will not exceed 100,000 TL. per annum. Etibank is setting up a production unit in Bandirma to operate using this method.

(39) Türkiyenin Araştirma Potansiyelini Tesbit Etmek Amaciyla Yapilan Envanter Çalişmalari Hakkinda Ön Rapor, 3 Baski-BPÜ, TBTAK, 1969, Ankara

TABLE VIII

Distribution of Supported Projects Published or Presented as Papers (Projects of TBTAK for Ten Years; Total Projects in Turkey during 1965 - 1967)

Papers Publications / Research Groups	Presented as Papers						Publications									
	In Turkey		Abroad		Total		By the Council		By the Project Director		In Turkey		Abroad		Total	
	No	%	No	%	No	%	No	%			No	%	No	%	No	%
MPBSRG	-	-	-	-	24	8	-	-	-	-	-	-	-	-	33	15
ERG	122	52	15	48	137	47	-	-	-	-	16	24	14	19	30	13
MRG	9	4	8	26	17	6	-	-	-	-	47	69	58	81	105	47
VAHRG	53	23	2	7	55	19	-	-	-	-	-	-	-	-	38	17
AFRG	51	21	6	19	59	20	13	100	-	-	5	7	-	-	18	8
TOTAL	235	100	31	100	292	100	13	100	-	-	68	100	72	100	224	100
Total for Turkey during 1965-1967 (3 years)	694		261		955		-	-	-	-	2436				2436	100

As for the second patent, it has been sold to the Aid Foundation of the Union of Agricultural Credits Co-operative. The single-axis garden-type tractors, following the completion of pilot experiments, have been produced and placed on the market under the name "Fidan". Under the agreement made with this institution, the Council will receive 1.5% of the net profit per tractor. The Council will pay 30% of this income to the scientist who did this research.

EVALUATION

A. STUDY OF THE PROJECTS SUBMITTED FOR CONSIDERATION AND THOSE ACCEPTED.

During 1963-1973 there were 1237 projects submitted to the Scientific and Technical Research Council for consideration and support under the Project Support Program. When we have a look at the distribution of these projects, we observe that most of them are in the engineering research discipline. In fact, these projects amount to 30.1% of the number of projects submitted for support. In a way, this may create the opinion that these projects are directed towards implementation, since the projects submitted to the Engineering Research Group cover aspects of engineering. The second place in projects submitted is occupied by medical projects. These amount to 22.2% and reflect the importance attached by research workers to medical subjects.

Projects related to agriculture and forestry come third with a total of 16.4%, i.e. 0.2% more than those submitted in the field of veterinary science and animal husbandry. The projects submitted in the field of mathematical, physical, and biological sciences number the least with 15.1% of the total.

The majority of projects submitted in engineering may in a sense be a reflection of the research potential in Turkey until the establishment of the Scientific and Technical Research Council of Turkey.

The distributions of projects from the point of view of Sectors introduce another or a different aspect of the subject. Most of the projects submitted to the Council come from the University Sector. To put this more clearly, out of the 1237 projects submitted for support, 909 projects, that is, 73.5% of the total projects, came from the University Sector. Public sectors (outside the Universities) submitted 23.8% and the private sector 2.7% of the total number of projects. This means that most of the projects submitted to the Scientific and Technical Research Council of Turkey for grant are of academic nature.

Another possible reason for the scarceness of submission of research projects by public and private institutions may be their direct concern with daily problems and unwillingness to carry out activities that fall within the strict limits of a scientific project. Still another comment may be made thus:

> It may be that Turkish Industry is a producer's market, which means that anything produced is marketed easily. Thus, in consequence, Turkish Industry at this stage does not need R and D activities for further marketing. In fact, with the exception of the textile industry in Turkey, production tends to be less than demand, a fact which supports the above statement. That is why the industrialists are satisfied with basic production methods. It is clearly see, then, that the immediate or urgent concern of the Turkish Industry is not to create new technologies, but to produce more goods in an effort to meet the existing demand.

In a study documenting this view, it has been established that the Turkish Industry does not yet attach importance to R and D activities. (40)

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(40) Ergün Türkcan, Türkiye'nin Araştırma Potansiyelini Tesbit Etmek Amaciyla Yapılan Envanter Çalışmalari Hakkinda Ön Rapor, 3. Basi, 1969, BPÜ, TBTAK, Ankara.

As for the distribution of the projects accepted, we observe identical characteristics as seen in the distribution of the projects submitted to the Council for consideration. Most of the projects accepted are also in the field of engineering. These engineering projects number 236 and amount to 38.7% of the total number of projects accepted. The second place is occupied by projects in the field of medicine, as is the case of projects submitted for consideration. These are 134 in number and 22% of the total projects accepted. The projects supported in the field of veterinary science and animal husbandry were 85 in number, those in agriculture and forestry 80, and projects supported in basic sciences 75.

As can be seen, most of the projects submitted for consideration and accepted are projects in engineering. This means, without going into great detail, that about one third of all the projects were directed to applied science. On the other hand, as most of these projects in question came from the University, they tended to deal with theoretical and academic aspects of engineering. As will be seen further on, only 28 of the 236 engineering projects accepted were directly aimed at industrial production. The rest are concerned with theoretical problems rather than with production.

B. STUDY OF PROJECTS CONCLUDED

Of the total 610 projects accepted by the Council, 419 projects were concluded by the end of July, 1973. Again most of these projects were in the field of engineering and the least were in agriculture and forestry. Out of 236 engineering projects, 148 were concluded, but 88 are still in progress. 76 projects of the Medical Research Group have been concluded, 58 are going on. The number of completed research projects for the Veterinary Science and Animal Husbandry Group is 77 and that of the Agricultural and Forestry Research Group 53.

The study of the completed projects from the point of view of science-based industries presents an interesting problem from the basic theory standpoint.

Of the 148 projects taken up and concluded in the Engineering Research Group, only 43 projects are related to science-based industries. Of these, 28 projects come under the basic title of chemistry. The remaining 15 projects are related to electrical engineering and electronics. During a period of ten years, no project on guided missiles or in aircraft industry has been supported. We have no evidence as to the reasons why the science-based industrial projects have been so few in number. One reason for the scarceness of applications made for grants in this field may have been the lack of existence of such industries in Turkey. Another reason should be the resulting lack of innovations. It may be rather optimistic to expect that many R and D projects will be submitted to the Council on the newly-developing industrial branches or production units that have not yet completed their set-up, since such a project activity by its very nature greatly depends on the project-owner or individuals who come up with projects for a grant.

As subjects related to production are given weight in this study, it is necessary to consider the characteristics of the projects directed at production. Only 33 projects of the total 419 projects concluded in the ten-year period have production as the target. Those mainly directly towards industrial production number 28.

On the total projects concluded, it is observed that those directed at industrial production are 6.6%. These are seen as 2.2% of all the projects submitted for consideration and constitute 4.6% of the projects accepted consequently.

C. EVALUATION OF THE PATENTS OBTAINED FROM THE POINT OF VIEW OF THE DISTRIBUTION OF PROJECTS

The Council has obtained two patents at the end of the project support program within ten years. While one of these covered a chemical subject, the other concerned a mechanical subject and was realized following the activities of the Agricultural and Forestry Research Group. Of the 610 projects accepted out of 1237 projects submitted, 2 of these could be subject to patents from the concluded 419 projects. Both of these patents have an industrial production target. This can be interpreted as 321 in one hundred thousand when comparing it with the number of projects accepted. If we compare this with the number of total projects submitted, it comes out to be 162 in one hundred thousand.

D. EVALUATION OF THE TEN-YEAR PROJECT SUPPORT FROM THE POINT OF VIEW OF THE DISTRIBUTION OF SCIENTIFIC PAPERS

We have no specific data on the publication of the Council's supported activities or on presentation of these as scientific papers. Information has already been given in Table VIII, based on the unpublished study of the Council's Science policy Unit. It is point out in this table that a total of 235 projects has been reported in Turkey, while 31 projects have been presented in foreign countries. Again, most of these projects reported were in the field of engineering. In fact, 52% of the ones presented in Turkey and 48% of those presented abroad were on engineering. From the presentation point of view, the engineering projects came to 137 out of 292 papers; in other words, these had the highest ratio of 47%. The Medical Research Group presented the least number of scientific papers in Turkey: 4%. Its project-reporting amounted to 26% abroad. The Veterinary Science and Animal Husbandry Research Group reported the least number of projects abroad, i.e. 7%. From the presentation point of

view, the lowest rate of project-reporting on the whole is seen in the case of projects of the Medical Research Group (6%) and the Basic Sciences Research Group (8%).

As for the evaluation of the publication of the projects, the engineering research projects in this case show a distribution contrary to the scientific reports. Of the 224 projects published, only 30, that is 13%, are in engineering. The Medical Research Group enjoys the highest number of published projects: 105 projects, i.e. 47%. The percentage of the engineering projects shows a rise. In any case, projects published abroad are only in two disciplines: engineering research and medical research. 72 projects have been published abroad: 14 projects in the field of engineering and 58 in medicine. Of the projects published in foreign countries, those of the Engineering Research Group constitute 19%. The remaining, i.e. 81%, belong to the Medical Research Group. A total of 29 engineering research projects has either been reported or published abroad. As for the number of science-based engineering research projects, 43 projects were directed to production while 33 had a relationship with production. It can be said that these figures are not much different. We are not in a position to evaluate the whole of the publications and papers supported by TUBITAK and presented by Turkish research workers both in Turkey and abroad during 1965-1967. The reason for this is that the studies on this subject available for Turkey only cover the activities of three years. (41)

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(41) 1967 Yılı Araştırıcılar Envanteri, Istatistiki Tablolar, TBTAK, Bilim Politikasi Unitesi, 1970.

EVALUATION OF THE PROJECT SUPPORT PROGRAM FROM THE POINT OF VIEW OF OUR HYPOTHESES

A. FROM THE POINT OF VIEW THAT MOST OF THE PROJECTS SUBMITTED WERE OF UNIVERSITY ORIGIN

During the first ten years, TUBITAK has 1237 projects for which grants were requested, and 909 of these came from universities. When this figure is interpreted in terms of percentage, it is seen to be 73.5%. It is thus clear that the projects of university origin occupy a great place in this activity. These projects, on the other hand, covered theoretical and academic topics. Therefore, the author tends to think that there is sufficient evidence that TUBITAK is answering the research requirements of the universities and scientific circles rather than "exercising efforts to reach the defined targets of the Turkish Community as described by the Constitution and the Development Plans."

B. FROM THE POINT OF VIEW THAT THE PROJECT-SUPPORT ACTIVITIES ARE RELATED TO CONVENTIONAL SCIENTIFIC DISCIPLINES

Of the 610 projects accepted to be supported by TUBITAK, only 43 (7%) are science-based projects. If it is borne in mind that TUBITAK is an institution expected to be most responsible for technological production in the public sector in Turkey but has supported only 43 science-based projects (7%), then one rightly tends to think that the Council has not given the required attention to this subject. This also supports our second hypothesis that the project-support activities of TUBITAK are directed towards traditional and conventional scientific disciplines.

C. FROM THE POINT OF VIEW THAT SUPPORT OF RESEARCH IN CONVENTIONAL AND TRADITIONAL SCIENTIFIC DISCIPLINES DOES NOT YIELD ECONOMIC RESULTS

It has already been stated that only 33 projects out of 610 projects (5.4%) supported by TUBITAK were directly related to industrial production. It was also pointed out that only 2 of these 33 (6%) projects resulted in obtaining patents. Even though it may be assumed that these 33 projects aimed at developing patents, we can say that the rate of success was 6%. Besides, it is impossible to establish the economic outputs of these patents developed. However, it is without doubt certain that the income these patents are to provide will be much below the expenditures made in this respect. As a result, it is possible to support our third hypothesis that support of research activities in conventional and traditional scientific disciplines has not been able to secure a technological production which will yield economic results.

C. FROM THE POINT OF VIEW THAT PROJECTS SHOULD PASS THROUGH THE DEFINED CHAIN OF PHASES MARKING THE PRODUCTION OF INDUSTRIAL PRODUCTION TECHNOLOGY

We already noted that 33 projects supported by the Scientific and Technical Research Council of Turkey were directly related to production. Five of these projects were concluded after "pilot work". During the proposal of projects related to production, their economic uses to the country upon their conclusion were generally discussed. However, we are not in a position to evaluate whether the owners of these projects prepared a full marketing research or did any cost-benefit analysis. Furthermore, it is not possible to determine whether or not the research results given to researchers outside the Council did contribute to the economy of the

country in cases where no patents were obtained.

The four basic activities defined as basic research, applied research, technological development and economic development are not all found in these projects. Those remaining outside the supported industry-linked projects of the Engineering and Agriculture and Forestry Research Groups are directed towards procuring data to serve as a basis both in basic and applied research. As for the projects directly related to production, they call for applied research and technological development activities. But even though "pilot work" and "prototype" application may have been made in the case of projects related to production outside those resulting in patents, no effort was spent in determining the results related to marketing. To put it more appropriately, no such work was carried out by the Council. No information was compiled about the sale of goods produced if this activity was carried out by people outside the Council. It is also not known up to what extent activities relating to economic development were concerned with the projects resulting in patents.

As a result, if we consider that none of the accepted and concluded projects passed through the four basic phases, it is possible to support our fourth hypothesis that the project support activities of TUBITAK do not cover the whole chain of phases marking the generation of a production technology.

OUR RECOMMENDATIONS IN LIGHT OF THE FINDINGS AND EVALUATIONS

Considering the hypotheses which we have proved, if the project-support program of the Council is carried out in accordance with the initiative of project-makers, results may not be yielded which contribute to the progress of an industrial production technology under existing conditions in Turkey. As a matter of fact, at the end of a ten-year project

support program only 2 patents could be obtained and 33 projects aimed directly at production in ten years. Since the Development Plans envisaged by the Constitution for the industrialization of Turkey have long-term targets, it may be necessary for a different approach to be taken in project-supporting activities. If the aim is industrialization and if it is desired to achieve this in the shortest period of time, and particularly if it is desired to create an industrial production technology, it may be thought that TUBITAK should have a more effective role in these activities. Because the technology produced should be evaluated as less dependent on foreign sources, there should be less loss of resources and factors increasing production. For this reason, the approach in project-support programs should first of all be changed and sponsored projects should be preferred to the system under which projects are proposed. In other words, the Council should determine the subject. At present the number of projects sponsored by the Council is increasing and more expenditures are being made in this direction. Effective cooperation with the State Planning Office concerning the selection of subjects should be carried out. The sponsored projects should be based on the priorities established by the SPO as long-term targets in industry, taking into consideration the available technological and economic potentialities in Turkey as well as the research manpower and facilities. The bottlenecks of the country should be identified from the technological standpoint and a policy for applied research be formulated in order to solve them. Research in connection with the defence requirements and in accordance with the geopolitical conditions should be taken up and at least efforts be made so as to decrease dependence on foreign countries.

The principles of the Project Support Program accepted by the Council's Science Board and applied by TUBITAK should be modified in accordance with these requirements.

The results of the projects accepted by the Council and concluded may be studied with the purpose of determining the work to be done in the future. Thus it will be possible to develop a concept of "science for economy" or "science for production" instead of "science for science". The activities of the Council's Industrial Relations Unit may be developed for a more dynamic relationship with the Turkish Industry. It may also be possible to determine the nature of technical advice to be given to and solution of problems of the industrialists through cooperation with the State Planning Office. The SPO and the Council may jointly decide on the required type of research through inquiries and enlighten the Industry. Such needs may be taken up as subjects of sponsored projects in the second phase.

In our opinion, the Council should also house economics so as to be able to create an industrial production industry. Thus a healthier economic evaluation of the R and D activities will be possible. In addition, it will be possible to make "preliminary feasibility" and "feasibility" studies so as to create facilities for preparing projects relating to production. A unit may also be established to execute the necessary activities concerning the data obtained as a result of the Council's activities, follow up the economic application of the patents obtained, sell these if required, and see to production of "model-prototype-pilot works" if favourable facilities exist. Such a unit may also investigate facilities in order to introduce the Council's research results into economic life.

CONCLUSION

The Council under its Establishment Law has not been directly assigned to the duty of the creation of an industrial production technology. However, it may be argued that such a meaning can be derived from the whole duties of the Council as seen in Law. No. 278. It can be said that during the ten-year implementation of the Council, efforts have been spent towards the creation of an industrial production technology, though this requires interpretation from the point of view of such a duty in this field. Meanwhile, the patents and the results of research obtained may be shown as results of such an activity. TUBITAK's R and D activities in the beginning show characteristics of the establishment of the theoretical aspects of the R and D activities, preparation of the infra-structure in this field, and provide the necessary education - all somewhat communal and cultural in character. (42) What are important are the future work of the Council, the making of a new comment on its activities and duties and planning in accordance with these targets. The Council has, under Law No. 278, been assigned to the duties of "undertaking, promoting, encouraging, and fostering fundamental and applied research in positive sciences and assisting the Government in formulating the national policy in this field." It seems that the Council has to determine its priorities and direct its activities towards long-term research work. It is also necessary that the basic principles of a national science policy should be determined in harmony with the Constitution, Development Plans, and Government Policy. Thus the responsibilities of the Council in industrialization will be made clearer.

In our opinion, the Council has to make the necessary moves to provide facilities for the creations of an industrial production technology in Turkey.

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(42) Harvey Brooks, "Models for Science Planning," Public Administration Review 31, May-June 1971, pp. 364-374.

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