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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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INDUSTRIAL RESEARCH AND DEVELOPMENT, SOME ASPECTS OF THE NORWEGIAN EXPERIENCE 1/

by

T.K. Roderburg*

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* Managing Director, Central Institute for Industrial Research, Oslo, Norway.

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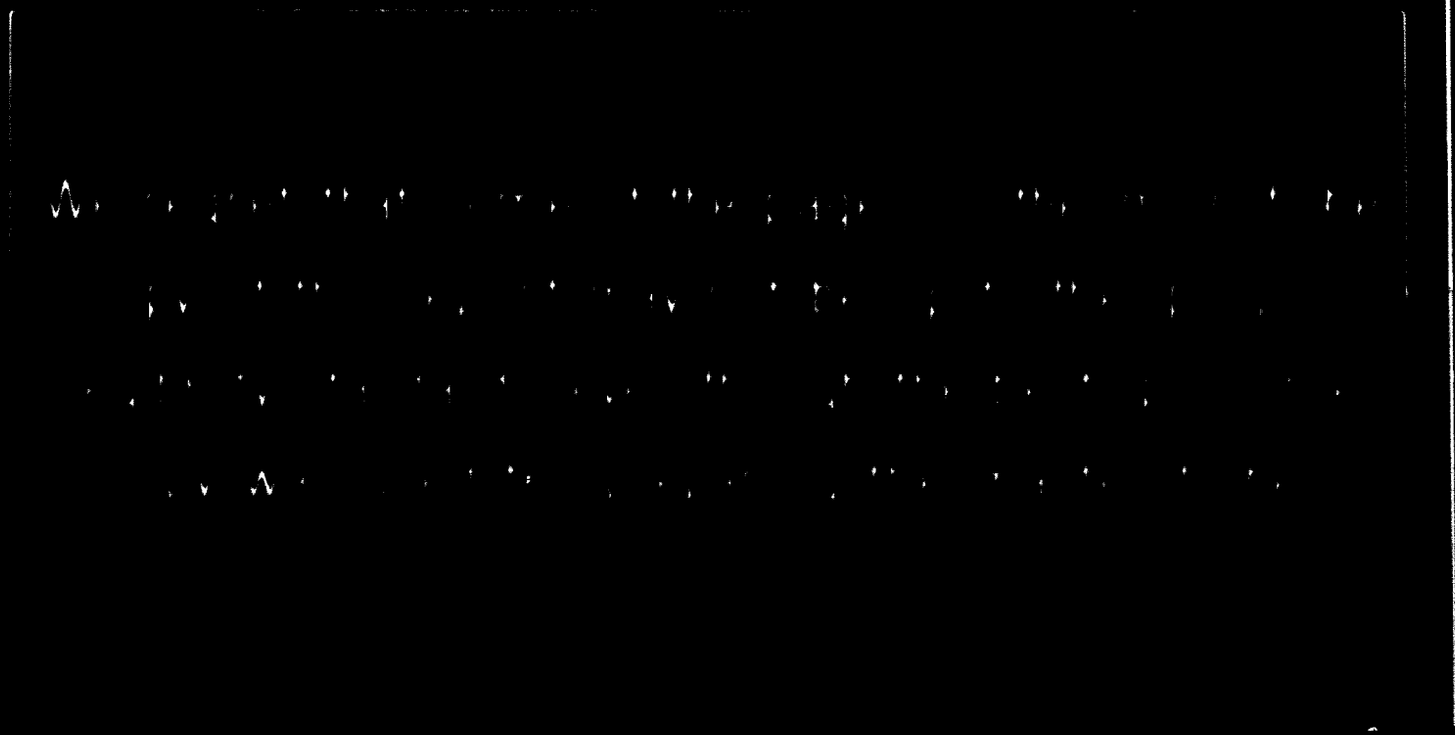

1. INTRODUCTION

Within the overall objective of aiding a rational industrialization process in the developing countries, the proper utilization of research resources through inter-institutional collaboration — on a national as well as international basis — [illegible]. The initiative of UNIDO [illegible] guidelines for improving this collaboration [illegible]

It is important in this context to keep in mind that in all countries industry must adapt itself to the prevailing local conditions, and that this applies in equal measure to the industrial research and development (R&D) efforts. The experience which I and other [illegible] participants may call upon from our own environments will hopefully be both informative and interesting, but is not necessarily appropriate for other and different environments. With this reservation, however, it is no doubt true that there exists a very real opportunity to profit from the experience of others. The establishment of new industrial activities and associated R&D in developing countries will in many respects allow the implementation to proceed unhampered by already established but outdated structures and organizations, [illegible] starting from scratch there is, at least theoretically, the opportunity to avoid some of the mistakes made by others.

As an industrialized country Norway has a comparatively brief history, industrial R&D to a significant scale was initiated in the post war years. In this paper I will, with a background of some relevant facts about Norwegian industry and R&D in general, describe the organization and implementation of industrial R&D as seen from the vantage point of a contract research organization. The paper concludes with some personal observations on the nature of suitable inter-institutional cooperative programmes which could enhance the impact of industrial R&D in developing countries.

2. INDUSTRY IN NORWAY

Norwsy is a small country. The population is 4 million - about 1 % of the total European population. The area of the country exceeds 4 % of the total area of Europe, of this only about 3 % is agricultural land and about 20 % productive forest.

As in other countries there has been a gradual shift of the working population from agriculture, forestry and fisheries to industry and service-related activities. To-day about 10 % of the working population is employed in agriculture, forestry and fisheries, while industry, construction and transportation account for about 40 %. The corresponding contributions to the national product are about 6 % and 50 %, respectively.

The most important natural resources of Norway are wood, mineral ores, fish and hydro-electric power. The discovery of oil and gas on the Norwegian continental shelf will provide a basis for a new and important industrial development. At present the electro-chemical industry plays an important role. The hydro-electric power has for instance allowed us to become one of the world's greatest exporters of aluminium, despite the fact that the raw material is imported.

Most of the industrial firms in Norway are small. Only about 300 firms or 2 % employ more than 200 people, and 77 % have less than 20 employees. The 2 % "large" firms (with more than 200 employses) do, however, employ about 40 % of the working population.

The geographical factors have had a definite influence on the structure of Norwegian industry. The population density is low, and although industrial development has led to an increased concentration of the population in cities and towns, the government tries to implement a policy which encourages industrialization and improved employment opportunities in the out-lying districts.

3. RESEARCH IN NORWAY

In 1974 Norway used a total of about 300 million US dollars, or about 1.3 % of the GDP, for R&D in all sectors. Financing was 61 % from government funds and 31 % from industry. About 60 % of all the research money is used on technological subjects, and about 55 % of this type of research is funded by industry. Table 1 indicates the distribution of the total research activity by sector and source of funding.

Funding

Sector	Industry	Government	Other	Sum	
1	32.2	10.2	1.8	44.2	133 mill. dollars
2	0.7	20.3	2.9	23.9	72 " "
3	0.4	30.3	1.2	31.9	95 " "
Sum	33.3	60.8	5.9	100.0 %	300 mill. dollars

Table 1 - Distribution of total research expenditure (in percent by sector and funding source, 1974).

The sectors referred to in Table 1 are: 1 - The business enterprise sector, 2 - The government and private non-profit sector, and 3 - The higher education sector. The greatest expenditure, about 44 %, was in the business enterprise sector which comprises private enterprises, government business enterprises, industrial research associations, discipline oriented institutes, and multi-disciplinary contract research institutes.

The bulk of what one may consider industrial R&D is carried out in the business enterprise sector, and as is evident from the table about 1/4 of this work is financed by the Government. About 2/3 of this R&D is carried out in industrial firms and 1/3 in research institutes of various types. The financing of these institutes is shared about equally by industry and the Government.

The number of institutes involved in industrial R&D in Norway is large, more than 40, and many of them are small. They fall into three mai categories:

1) Institutions serving and mainly controlled by a particular industry, e.g. the paper industry. They correspond roughly to what in the UK is called "Research Associations".

2) Institutes working within a particular scientific area, e.g. geotecnnical research or electronic data processing.

3) Multidisciplinary contract research institutes. Of these there are three, one each in the three largest cities in the country.

Let me end this brief general review of industrial R&D in Norway with a few words about how the government support of this activity is organized. Although many of the various government ministries will support R&D projects within their respective jurisdictions, the bulk of the industrial R&D support is the responsibility of the Ministry of Industry and Handicrafts. The administration and distribution of the support is delegated to the Royal Norwegian Council for Scientific and Industrial Research, one of four such research councils in Norway. This research council has representation from government, industry and the research community. It has a small administrative staff and relies very heavily on advisory committees for the formulation of a research policy and the distribution of project funds within the various subject areas. There are 16 such advisory committees on subjects ranging from continental shelf technology to chemistry. The members are appointed by the research council for fixed periods of 3 years. To a large extent the members are recruited from appropriate industrial firms, research institutes and universities. In 1976 about 50 million dollars will be distributed through the Council for scientific and industrial research.

4. THE CENTRAL INSTITUTE FOR INDUSTRIAL RESEARCH

The institute, of which I am the director, CIIR, was created by the research council 25 years ago. It is one of the three multidisciplinary contract research organizations mentioned previously. The staff is about 320 strong, and our budget this year is about 10 million dollars.

Our activities may be divided into three categories based on the type of financing:

1) Work on contracts with industry and other agencies. The work is usually closely controlled by the customer and the results become his exclusive property. This accounts for about 55 % of the income.

2) Research council projects. Proposals for such projects are submitted to the council each July for the following year. The results are made available to all interested parties. They account for 25 % of our income.

3) The institute controlled programme, comprised mainly of pilot projects, staff training, and information. For these purposes we get a general grant amounting to roughly 20 % of our total income.

We work within the subect areas of electronics, data processing systems, industrial and environmental chemistry, and materials research.

Our greatest challenge is to maintain a R&D facility that satisfies the demands of industry and society. The fact that our income to a great extent depends on our ability to interest the potential clients in our services, is a very powerful incentive to respond readily to the ever changing needs of industry. To achieve our purpose a very close contact with industry is required. The absolutely most efficient type of contact is the one which takes place through cooperation with a client organization on specific projects. The contact during the project work

often identify further needs for R&D work and lead to new projects. Our best sales promotion is a successfully completed project.

Despite the fact that we have a fair amount of "repeat business", we also see the need for active marketing by our research staff. This is carried out by visits to potential client firms where we try to present the relevant capabilities of our institute and through discussions with the technical staff of the firm try to identify areas where project proposals may be in order. The arrangement of seminars with industry participation on specific subjects where the institute has a special competence is also seen as a valuable marketing device.

Preparation for the future needs of industry should ideally take place by means of our research council projects. The advisory committees, being largely staffed with industrial representatives, are very sensitive to the anticipated needs of industry in their project selection. The research council projects have a dominant influence on the research aimed at future industrial applications in our research institutes.

While our clients normally pay the total direct costs associated with a project plus overhead charges which cover the indirect costs, the existence of the research council projects may be regarded as an indirect way of subsidising the contract research. This point of view is justified by the fact that quite often the specialized competence required to execute a client project has been acquired through a project financed by the research council. We believe this to be a better mechanism than direct subsidy through reduced hourly rates.

I think I am justified in saying that those industries that use our services are reasonably satisfied with our projects. Otherwise, they would have taken their business to our competitors. We are, however, far from reaching all of Norwegian industry. A recent analysis indicates that of all the industrial firms with more than 50 employees only about 20 % state that they spend money on R&D, and less than 20 % of the research money spent by industry is used in external research institutes. Representatives from firms which are not our clients have expressed the

view that we are too "advanced" in our approach and that communication with our staff is difficult for the average industrialist. Personally I see it s a major challenge to each new segments of industry, but I do not regard the criticism of lack of interest in practical problems to be justified. We are proud to be able to point to many industrial product lines which are the result of R&D at our institute. I consider the major obstacle to a more extensive collaboration with the smaller firms to be an economic one. R&D is expensive - $ 35 per scientist hour is a typical rate. Many of the firms simply do not have the economic base to support a development activity or with or without justification fail to see it as a wise investment.

The Central Institute for Industrial Research was organized to provide research services to Norwegian industry. This does, however, not mean that we in any way have a restrictive policy when it comes to international cooperation. There are several examples of current projects involving cooperation with institutions abroad, and we have from time to time had visiting scientists and students from developing countries working with us.

The University of Oslo is a very close neighbour to our institute. While there is a certain amount of cooperation with respect to utilization of equipment and student thesis work, there is practically no cooperation on project work. This is partly due to the fact that research and education on subjects of direct industrial interest have traditionally been very scarce at the University of Oslo. At the technological university in Trondheim the situation is quite different in this respect, and our sister institute there was created by the university and operates on campus with a significant number of the professors active in the institute's project work.

5. SOME CONCLUSIONS BASED ON NORWEGIAN EXPERIENCE

The "Aid Memoire" sent out in preparation for this conference makes the point that a catalyst is needed to enhance the industrial research activity in developing countries and in particular to activate the talent in the universities in this process. I believe this is correct. There is a tendency for universities and industry to ignore each other. Some external stimulus may be very beneficial for the development of industrial R&D. In Norway this came through a cooperative venture by the government and industry which resulted in the creation of the institute sector. We believe that this sector has proven itself as an effective supplement to industry's "in house" R&D and as an efficient vehicle for public support of industrial R&D.

In retrospect I believe we have made a mistake in fragmenting the institute sector too much in our country. We have too many units with a consequent duplication of scientific equipment and infrastructure. Greater reliance on larger multidisciplinary units rather than small specialized institutes would be beneficial. The larger industrial research institutes provide the greatest flexibility, the best utilization of the scientific staff, and enhance the possibility of technological transfer among the various sectors of the economy.

After the start up phase it is essential that a significant part of the institute programme is based on paid contract research. Without these projects sponsored by the users of the results, it is in practice impossible to achieve the required close contact with the industrial users of the research.

The industrial research institutes should, if possible, be established in close proximity to universities teaching technological subjects. This is a prerequisite for close cooperation. Active participation by university staff on projects at the research institutes is probably the most effective vehicle for engaging the resources of the university or industrial problems.

In the execution of projects we have found it extremely beneficial and some times essential for a good result to have the active participation of client personnel in the project team. This ensures adequate attention to the conditions in the client firm and allows a more efficient and complete transfer of results to the client.

6. ASSISTANCE TO DEVELOPING COUNTRIES

Through the years a great number of students from developing countries have studied at universities in the industrialized nations, and a great many visiting professors from these nations have worked at academic institutions in the developing countries. This has strengthened the educational systems of the developing countries and has probably been a strong motivating factor in encouraging academic research. The benefits to industry in the developing countries have perhaps been less than one might have hoped.

I am aware of the fact that UNIDO has assisted in the establishment and operation of industrial research institutes in a number of developing countries, and I should think that the dissemination of information about the practical development of industrial research organizations such as that contained in the UNIDO publication "Industrial Research Institutes" from 1975 would be very useful to a country engaged in developing such an activity.

Countries, which like Norway, have developed systems for industrial research could certainly lend valuable assistance in developing similar systems elsewhere. I believe, however, that something more than receiving students from developing countries at our universities and having brief visits from scientists at our institutes is needed. Perhaps long term cooperative programmes involving a developing country interested in promoting industrial research and an industrial research institute in a developed country already exist. I am not aware of any. However, I

am convinced that this is an approach which, if carefully designed, could prove effective.

The details of such a programme and its financing must be adapted to the specific situation. I do not consider it impossible that the Norwegian development aid programme could finance a well designed cooperative scheme of this nature. My institute would be interested in participating in a programme of this nature, and I believe this would be the case for other Norwegian institutes as well. What we could offer is for instance:

1) "On the job" training in industrial research work, if desirable combined with theoretical courses at universities or other institutions.

2) Cooperation with institutions in developing countries on specific projects.

3) On site consultancy by CIIR scientists in the developing countries.

Each of these suggestions have been implemented on several occasions, but what I have in mind is an integrated sustained programme. The details need to be adapted to the specific situation and the collaboration partners.

I am certain that similar opportunities could be made available in the industrialized countries. Perhaps UNIDO may play a role in ascertaining which opportunities exist and informing the authorities in the developing countries about these.

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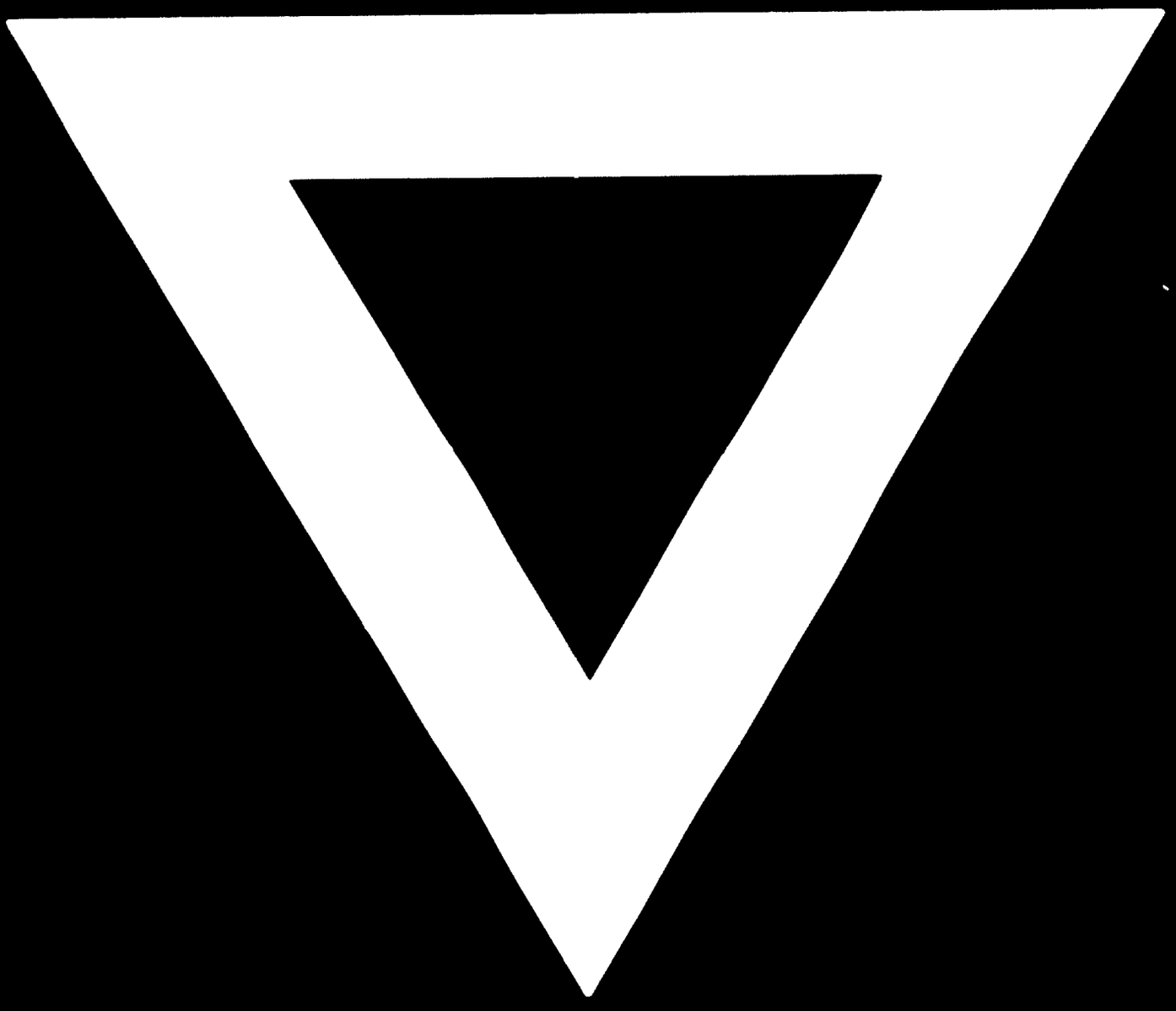

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