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NORWEGIAN AEROSPACE ACTIVITIES - AN OVERVIEW

Government Committee of July 26, 1985
T. Arnesen and G. Rosenberg, Editors

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16. Abstract

Excerpts from a Governmental Investigation concerning Norwegian participation in the European Space Organization (ESA), the implications and advantages of such a move and a suggestion for the reorganization of Norwegian Aerospace activities.

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NORWEGIAN AEROSPACE ACTIVITIES - AN OVERVIEW

Government Committee of July 26, 1986
T. Arnesen and G. Rosenberg, Editors

This report was delivered to the Department of Industry
on January 13, 1986.

To The Royal Norwegian Department Of Industry /1*

A committe was appointed according to a Royal Decree of July 26th, 1985, for the purpose of outlining the main directions of the Norwegian aerospace policy until year 2000, including suggestions for a definite plan of action for the space-related activities during the period 1986-1990.

This committee started its work immediately. Six sessions have been held. Hearings have been arranged with research councils and industries.

The judgement of the committee is unanimous.

Oslo, December 31, 1985

Drude Berntsen	Sverre Bisgaard	Bjarne Gravdal
Olav Holt	Ole P. Haakonsen	Tor-Henning Iversen
Henry K. Johansen	Inger Koppenaees	Finn Lied
Per Maltby	Rolf Skaar	Gunnar Stette

Erik Tandberg Iver Oerbeck

Tor Arnesen Georg Rosenberg

* Numbers in the margin indicate pagination in the foreign text.

Chapter 0.

INTRODUCTION /5

According to a resolution of October 15th, 1982, issued by the reigning Crown Prince, an investigatory committee was appointed for evaluating remote sensing by means of satellites. The committee delivered its conclusions on June 10th, 1984 [1].

In Chapter 5, this committe stated, among others, concerning the guidelines for remote sensing via satellites:

> " Although it exceeds the mandate of this committee, we wish nevertheless to state that it should be evaluated whether or not an interdepartmental council for aerospace activities should be established in Norway with responsibility for coordinating all space activities, basic research, remote sensing, telecommunication, navigation, radio transmission, etc."

The Swedish regulation concerning a "Space Delegation" with responsibilities like those mentioned above was also pointed out.

The Department of Industry states in the Parlamentary Proposition No. 48 for 1984-85 concerning continued Norwegian participation in the satellite-based remote sensing program, ERS-1, of the European Space Organization (ESA) [2]:

> "A national aerospace policy must be based on an effective organizatorial structure with a definite distribution of the duties between the different areas. The national space policy must be made as flexible as possible in order to be able to adjust to new situations and requirements. The Department of Industry will now start working toward the creation of a national space policy in cooperation with the industries and the departments concerned as well as with research councils and organizations."

The Department of Industry stated furthermore that during the spring session of 1986, it would make a suggestion to the Norwegian Parlament (Stortinget) concerning a national space policy, wherein the relation of Norway to ESA would be discussed.

The following is, among others, stated in "Innst. S" no. 148, dated March 25th, 1985, from the Energy and Industry Committee:

> " The committee wants to emphasize the fact that increased attention is given to space activities in the European countries. The meeting of the ESA council at the ministerial level decided recently to increase the budget by 70% during the next years, i.e., from 6 to 10 billion Norwegian Crowns. The committee is of the opinion that it is important that Norway shall form a national space policy such as suggested by this department."

According to the Royal Decree of July 26, 1985, the following persons were made members of a committe for working out a plan for the entire scope of Norwegian aerospace activities:

Drude Berntsen, Director of the Institute, The Norwegian Finance Center;
Sverre Bisgaard, Divisional Manager of the Micro-Electronics Company;
Bjarne Gravdal, Director, Raufoss Ammunition Factories;
Olaf Holt, Director of the Research Foundation, the University of Tromsoe;
Ole P. Haakonsen, Director of Telecommunications;
Tor-Henning Iversen, Professor, University of Trondheim;
Henry K. Johansen, Director of Research, The Research Institute of the Armed Forces;
Inger Koppernaes, Representative of the Norwegian Parlament;
Finn Lied, Director;
Per Maltby, Professor, the University of Oslo;
Rolf Skaar, Director, Norsk Data Co.;
Gunnar Stette, Professor, The Technical University of Norway;
Erik Tandberg, Director, The Esso Norway Company; and
Ivar Oerbeck, Director, Standard Telephone and Cable Factory.

Director Finn Lied was named head of the Committee.

The secretariate of the committee was composed of the following persons:
Tor Arnesen, First Concultant to the Department of Industry; and
Georg Rosenberg, Project Director, the Norwegian Technical and Scientific Research Council (NTNF), the Department of Space Activities (NTNF-R).

The committee was given the following instructions:

"It is the duty of the committee to draw up the main guidelines for the Norwegian space policy until year 2000 including a proposal for a definite plan of action for space-related activities during the period 1986-1990."

"The committee shall consider the space-related activities within research concerning the natural sciences and other basic research, applied research and the industry. The Norwegian activities shall be viewed from an international point of view. The committee shall suggest reasons for Norway to become a member of the European Space Organization (ESA) with full right and obligations as of January 1st, 1987. On the basis of its evaluation of scientific and industrial interests, the committee is supposed to express its opinion concerning which of the voluntary ESA programs in which Norway should participate."

"Norway participates already in several consumer organizations within space-related activities such as INMARSAT, INTELSAT, etc. The committee /6
shall establish how Norwegian scientific and industrial interests can be associated with other interests, basic for Norwegian participation in such organizations."

"The committee is asked to express its opinion concerning the organization of a Norwegian aerospace policy. During this work it shall be assumed that the present section of space activities within the NTNF, i.e., NTNF-R, shall be made a special unit (for instance, in the form of an institute) with the objective in mind of coordinating the national space activities. It is furthermore decided that the Tromsoe Remote Sensing Station shall be organized as a special foundation."

"In addition the committee is asked to evaluate the need for the the extent of Norwegian activities for safeguarding the greatest possible profit for the scientific and industrial areas as well as for the consumer interests from an increased international engagement within the space activities."

"The committe is asked to estimate the size order of public appropriations for the space activities within the 5-year period of 1986-1990."

"As far as ESA is concerned it is assumed that the State shall pay for the expenditures needed for the obligatory program. In respect to the voluntary programs, it will in some cases be a question of joint financing together with the industries. The committee is asked to evaluate which programs shall possibly belong to this category and/or what criteria shall be basic for requesting such joint financing."

"As part of its duties the committees shall make contact with the research councils and other instances involved."

"The committee is supposed to deliver its conclusions before December 31, 1985."

REFERENCES:

1. Satellitfjernmaaling [Satellite-based remote sensing], Norges Offentlige Utredninger, 1983:24.
2. Parlamentary Proposition No. 48 for 1984-85 concerning continued Norwegian participation in the satellite-based remote sensing program ERS-1 of the European Space Organization (ESA).
3. "Innst S", no. 148 for 1984-85 from the Industry and Energy Committee concerning continued Norwegian participation in the sattellite-based remote sensing program, ESR-1, of the European Space Organization (ESA).

Chapter 1.

[Not included in the translation.]

Chapter 2.

[Not included in the translation.]

Chapter 3.

[Excerpts only.]

3.14 SWEDEN

/30

In 1979 the Swedish Perlament decided that the appropriation from the

Government to the Department of Industry in connection with space activities should be tripled in the course of the next three years. This has taken place.

In Sweden, all space activities are coordinated by a Space Delegation consisting of 7 members at a high level and freely appointed. The Space Delegation reports to the Government via the Department of Industry and the Department of Education. The Space Delegation promotes suggestions both for the programs and the budget. The Delegation directs the preparation of prospective analyses. The Delegation has a small secretariate and utilizes three committees for questions concerning research, remote sensing and industrial problems. The executive organ consists of a Space Company with 200 employees. The total Swedish budget amounts to ca. 500 million Swedish Crowns of which ca. 150 mill. are set aside for ESA. Sweden takes part in the majority of the ESA programs. The dominating Swedish national program is the scientific VIKING satellite and the TELE-X. The latter is a joint venture together with Norway and Finland. Sweden is responsible for 82% thereof. Sweden has also, - in part supported by public funds, - constructed a research station near Kiruna, the ESRANGE, used both for launching missiles and for relaying satellite data. The Space Company participates through the firm "Satellite Pictures" in the commercialization of the French-developed SPOT.

The Swedish Space Delegation has drawn up a number of other national projects. It is here mainly a question of further development of the TELE-X. However, a project concerning communication between a satellite and mobile units on the ground (e.g, a train of vehicles, etc.) as well as a project where the intention is an "electronic mailbox" (the MAILSTAR) are also planned. It seems likely that Sweden will invite at least the Nordic countries to take part therein. /31

In Sweden work is also in progress on a launching system (MARIANNE), smaller than the ARIANE, which should be able to launch satellites on the size order of 200 to 1000 kg. Kiruna is expected to become the launch site.

The Swedish industry is actively engaged in the national projects (TELE-X, etc.) as well as those in common with ESA. The companies most heavily engaged are the SAAB Space Company, the Volvo Aviation Engine Company and the Ericsson Radio Systems Company.

The Swedish industry has accepted to pay one tenth of the 7% of the contract sum to ESA and other bilateral projects with joint financing. This amounts to 3 million Sw. Crowns annually. This regulation is under evaluation.

3.15 DENMARK

In Denmark the space activities are coordinated by a space commission with 12 representatives from the industry, the research councils, the departments of civil services and other departments. The commission is at present headed by the Director of Telecommunications. It has a small secretariate as a part of the research secretariate of the Minister of Education.

The total budget amounted in 1985 to somewhat more than 100 mill. D. Crowns. Out of this, ca. 85 mill. are used for ESA and 6 mill. for supplementary research. The "Danish Space Research Institute", which runs the basic research activities, has about 40 employees and a budget of ca. 12 mill. D. Crowns.

Denmark takes part together with ESA in the communication programs ECS, OLYMPUS and APOLLO in addition to the remote sensing ERS-1 program, the microgravity program and phase B of the COLUMBUS project. On the industrial side, where previously "Chr. Rovsing" was heavily engaged, the activities are now distributed on a number of enterprises. This means mainly the Christian Rovsing 1984 Company, the Computer Resources International (CRI), the Terma Electronic Company, the Ticra Company, the Kampsax Company and the Electronics Central.

3.16 THE NETHERLANDS

The space activities within the Netherlands are coordinated by an inter-

departmental commission for space research and technology. The commission is associated with the Department of Economics, which provides the director. In addition four other departments are represented (i.e., those of Finance, Education, Public Works and Culture). The commission controls the finances within the space sector. All participation in the many ESA committees is governed with a firm hand by the secretariate. Two advisers are associated with the commission, one comes from the "Netherlands Aerospace Foundation" (NIVR), who represents the industry and the laboratories, the other from the scientific fields.

The NIVR is a very powerful and competent organization, centrally positioned within the executive activities.

The director of the commission and a representative for the Department of Education represents the Netherlands in the ESA council.

The Dutch management has operated for many years and seems to be quite satisfactory, which is ascribed to the discipline and the seriousness of the secretariate of the commission.

The total budget for the space sector amounted in 1985 to 115 mill. Dutch Guilders of which 85 mill. are spent on ESA.

The Netherlands take part in most of ESA programs and this country has a significant industrial capacity, among others, the Philips Company and the Fokker Company.

3.16 INTERNATIONAL RESEARCH ASSEMBLIES /33

A number of international research assemblies deal with space problems. The "International Council of Scientific Unions" (ICSU) unites a large number of organizations. The most significant one seems to be the "Committee for Space Research" (COSPAR). It was established in 1958 and consists of a number of subordinated interdisciplinary commissions and panels which are very active. In Oslo the Academy of the Sciences selects the Norwegian COSPAR committee.

The "Union Radio Scientifique International" (URSI) runs a significant space activity in a similar manner under the ICSU via many commissions.

The "European Association of Remote Sensing Laboratories" (EARSeL) is an autonomous organization, established in 1976. This organization has well over 200 members (i.e., institutes and observatories) in 22 countries. Its main seat is in Paris, France. At present Norway has seven representatives (the Norwegian Geological Survey, NGU, the Norwegian Water and Electricity Board, NVE, etc.). Every second year this organization holds an international symposium jointly with ESA. Work teams are formed within special fields with several institutes participating.

The largest international forum for research contacts, concerned with all aspects of space research as well as with the peaceful utilization of space, is most likely the annual congress and exhibition arranged by the "International Astronautical Federation" (IAF). This is an independent organization, established in 1950 and consisting of 63 member organizations from 35 countries. Norway is represented by the Norwegian Astronautical Association.

3.20 REFLECTIONS

Space activities arouse the imagination and stimulate especially the younger generation to technical and scientific efforts. A portion of the space technology has now ripened and aquired a considerable economic potential.

The space activities give rise to a large number of international problems, both of military and civilian nature. It is very likely that the international deliberations in this connection will be intense in the years ahead. These discussions will take place within international organs but will be decisive mainly betwen the great space powers, i.e. the U.S.A. and the U.S.S.R.

Central civilian problems will concern question regarding frequencies, fixed orbits, coverage of directly transmitting radio satellites (which do not respect any boundaries on the ground) and efforts in order to establish common standards for radio and TV signals.

It seems likely that certain international consumer interests can be satisfied by new international organs of the type INTELSAT.

The countries surrounding the major space powers must cooperate if they shall be able to hold their own within the different main areas. At present ESA is the only realistic European alternative. However, it is a characteristic trait that consumer organizations such as the EUTELSAT and the EUMARSAT are split off from ESA.

In respect to the Norwegian space organizations, the picture is not clear as far as the pattern of administration is concerned. There is, however, a general desire for establishing organs, coordinated and administered at a superior level with skill and executive efficiency. Three main patterns can be identified:

- space activities under a Department of Research and Development (like, e.g., in West Germany);
- space activities under a powerful and authoritative administration (like, e.g., NASA or CNES); and
- space activities under an interdepartmental, coordinating organ with a considerable status and authority (like, e.g., in Sweden, Japan and Canada).

On the whole the main problems concern the fact that the space activities span over all areas of responsibility of the traditional departments in a modern society and touch upon more than just ordinary research. For instance, in Norway no department can be mentioned, which will not be involved in the years ahead.

Chapter 4

NORWEGIAN PARTICIPATION IN SPACE ACTIVITIES: BACKGROUND AND OBJECTIVES /34

4.1 GENERAL ASPECTS

It is self-evident that Norway cannot compete with the Major Powers in their desire to guide the development along every scientific and technical front line within the space activities. A country with the capacity of Norway should strive toward contributing individual details to the development and toward utilizing the advancements made by others for its own purposes.

The all-encompassing objectives concerning the cooperation with ESA are significant for Norway not least in respect to the objective of developing the capability of the industries to compete within new areas and to take advantage of all new fields of application opening up.

The international cooperation concerning space within ESA has already become very important for Norwegian space activities and will continue to be so because of its membership. Through a membership and the participation in voluntary programs, Norway will to a certain extent become an equal partner in the major and advanced developmental projects which will form the basis for future utilization.

As already mentioned ESA practices the principle of "fair return". This means that the member countries shall be given duties associated with the activities within ESA which are in relation to the financial contribution in question. In respect to the limited resources of Norway, especially as far as manpower is concerned, it is important that the return demanded by Norway shall be such that it benefits the creation of national values. This requires that the activities shall be concentrated within special fields of activity so that the desired technological exchange and improvement of the competence can be realized.

The capacity for training and education must also be improved in order to avoid that space research shall draw Norwegian scientists, engineers and other professionals away from other fields, where the need for such resources are also great. The field of information technology has been discussed in depth by the Kuvaas Committee, organized by NTNF, and in the "Strategic Plan for Information Technology" (STRAPIT), worked out by the Association of Electronics Branches of the Industries in cooperation with the Industrial Fund, the NTNF, the Department of Post and Telegraph, the ELAB (Electricity Company) and the Norwegian Export Council. That committe is unanimous in respect to the emphasis placed on a greater capacity for education and training.

It should also be mentioned that ESA offers a minor program of education and training. The Norwegians will have access to this via its membership in the organization.

The cooperation with ESA must be given a central position in the future but must also be supplemented by national or, - more likely, - bilateral/ multilateral projects. There is a tendency toward programs, oriented toward practical application, which has made the establishment of operating consumer services feasible. These will be commercialized outside ESA in a national regimen or operated jointly by a small number of participating nations. In Europe, especially France and Germany favor the opinion that ESA shall be an organization for major developmental programs, while programs which are better suited for commercialization should be developed nationally or by a limited number of countries. Which countries will join up depends to a great extent on the consumer interests and the national interrelationship between the industries involved in the ESA programs, where the new commercial opportunities are created.

In essence, the following can be emphasized:

- cooperation with ESA will provide Norway with fresh opportunities within a number of basic sciences;
- cooperation with ESA will stimulate the development of the Norwegian economy within new fields and will further the activites within fields already established;
- cooperation with ESA will prepare Norway for new applications of the space activities; and
- cooperation with ESA will provide a basis for industrial deliveries to the space activites, taking place outside ESA as well.

Below we will further discuss the Norwegian interests at the same time as we will try to develop qualitative criteria for the choices which must be made.

4.2 NORWEGIAN SCIENTIFIC INTERESTS

During the last couple of years, Norwegian research teams within the scientific fields have been invited to take part in scientific satellite programs. This demonstrates the fine reputation created by these professional fields in spite of the limited economical support so far given to Norwegian space research.

Within the field of cosmic geophysics Norwegian teams started to use research missiles already at the beginning of the 1960's. The objective was studies of the upper atmosphere, the magnetosphere and the phenomena related to Aurora Borealis. The first research missiles were launched /35
from the Andoeya missile launching site in 1962. At the end of 1985, a total of 332 missiles in 35 different configurations had been launched thanks to an extensive international interaction. In addition several ground installations have been constructed, among which the EISCAT installation near Tromsoe is the largest. The most extensive project within cosmic physics so far was the participation in the European space laboratory, SPACELAB. It was launched on board the Space Shuttle during the fall of 1983.

Norwegian astrophysicists have entered into competition about observation time on board NASA and ESA satellites. The most interesting acquisition so far is 6 hours of observation time on board the space telescope of ESA and NASA (the Hubble Space Telescope). The largest astrophysical project so far completed is the participation in an American-British-Norwegian solar physics experiment on board SPACELAB-2 during the summer of 1985.

Norwegian Scientific Fields and Interests

It is necessary for a number of scientific fields to utilize instruments on board satellites in order to be able to contribute to the advancement of and to participate to the fullest extent in international research.

Scientists at the following institutes are active within the field of cosmic physics:

- the Armed Forces Research Institute (FFI) at Kjeller;
- the University of Oslo (UiO);
- the University of Bergen (UiB); and
- the University of Tromsoe (UiT).

The research covers studies of the processes in the upper atmosphere of the earth, of the magnetosphere and of the solar wind as well as of the interaction between the processes within these areas. In addition attempts to simulated these processes are made by means of particle accelerators, carried on board satellites or missiles.

This research activity has been financed by the institutes themselves with contributions from the Norwegian General Science Council (NAVF) and the NTNF Research Council.

The Christian Michelsen Institute (CMI) in Bergen is responsible for the technical construction of the research missiles.

A national plan of activities exists for Norwegian astrophysics, according to which the efforts shall be concentrated around solar- and astrophysics and where space research is included as an essential element. Within astrophysics, the consequences of a necessary reorganization have been acknowledged by suggesting that resources in the form of personal funds shall be transfered to space research. A reorganization is going on, among others, at the University of Oslo, involving plans for abandoning the scientific activities at the Harestua Solar Observatory.

Within oceanography, research teams at the University of Oslo and also at the University of Tromsoe as well as the Norwegian Technical University (NTH/SINTEF) are utilizing data from NOAA satellites as a significant means for mapping the physical and biological processes in the sea. A large portion of these data is relayed by and further processed at the Tromsoe Remote Sensing Station. Further processing of such data takes also place at the CMI and the UiB. The ESA Remote Sensing satellite, the ERS-1, will be able to make a valuable contribution to our understanding of the maritime areas.

New methods are being developed within meteorology for collecting atmospheric data based on the new satellite instruments. The Norwegian Meteorological Institute (NMI) has already utilized satellite data for several years. Our participation in the EUMETSAT program assures access to data from future weather satellites.

Research teams, especially at the University of Tromsoe, take already part in the ESA microgravity program in cooperation with other research institutes in Europe. Their contribution is centered mainly around fundamental biological problems. There are definite plans for medical and biological experiments also at the universities of Oslo and Bergen. A mounting

interest concerning the physical sciences and microgravity can also be registered within the technological fields of research in Norway. There is reason to expect that the research within these fields will in the long run give rise to future applications of medical and industrial importance.

Thanks to the Norwegian participation in ESA we hope to be included in the scientific program. This will provide us with an opportunity for influencing this program and for contributing with Norwegian instrumentation to such an extent that we should be able to compete with other European areas. The ESA-planned scientific programs within cosmic geophysics, plasmaphysics and astronomy will present new and challenging prospects for Norwegian research fields. In addition, participation in ESA programs will lead to that the Norwegians will become more interesting partners in the scientific programs of other nations as well.

However, while planning for the Norwegian space-related basic research activities, the industrial interests should also be given due respect.

Preferential Areas of Interest

On the basis of Norwegian traditions, respect for our institutions and the prospectives of the obligatory scientific program of ESA, it is sensible to concentrate Norwegian contributions to cosmic geophysics and astrophysics.

In respect to other ESA programs, the contributions from basic Norwegian research should be concentrated to biology, the physical sciences and remote sensing (including meteorology).

Although some of the Norwegian contributions can be accomplished by reconsidering the priorities, a national, supplementary program is a necessary condition for being able to fully utilize an ESA membership. /36

4.3 NORWEGIAN TECHNOLOGICAL INTERESTS

Space Technology

Technological development is one way of expanding the industry. The technology applied for the sector of space activities concerns mainly the growing field of "information technology." It promotes the application of

advanced technology within such vital areas as microelectronics, data technology, communications technology, measuring technology, etc. In addition it places heavy demands on miniatyrization, light weight, reliability and operating capacity in an extreme environment.

The technical constructions demand a development of the knowledge of modern construction methods and the use of new, light-weight materials.

As far as the ground-based segment is concerned, it comprises advanced stations with an extensive data processing capacity and, depending on the application, a link to public services such as the electrical network, meteorological data systems, rescue and salvage services, etc.

These technological areas are among those given priority in the Government Research Report [1].

Characteristics

The fact that the development must take place within the framework of clearly defined objectives is typical of the development of modern technology within the space activities. Space projects may extend over a 10 year period and be divided into several stages such as mentioned above. Thus, the development of satellite systems demand the use of an extensive systems technology, a highly developed project administration and a close cooperation between national organizations and international ones in order to create successful experimental and operative systems.

In order to be included in the most demanding portions of the space projects, an industry must systematically build up its technological competency and ability to compete. As far as ESA is concerned, this can be achieved by participation in the programs concerning technological development (cf. Appendix No. 2) and by encouraging internal industrial projects of improvement (e.g., the creation of a line of products, qualified for space-related matters, etc.). Competency can be demonstrated via preliminary projects and a willingness to take part in advanced areas of the technology. This demands national supplementary research including financing at the early stages and support for Norwegian as well as international projects, which make it easier to get involved with ESA. Once accepted, the space projects

have the great advantage that results of the research can be transferred to the industry for further development, aiming at delivery of well constructed, reliable products at the same time as contact with consumer interests can be developed.

Front Line Technology

The stringent demands on light weight, low energy consumption, high-level reliability and efficiency in an extreme environment mean that new and advanced technology and new construction methods must be developed for the space systems, which are at the forefront as far as technology and administration of the production are concerned. In many respects this development reminds of the creation of new technology for military systems, which have had a domination position within technical development all over the world.

The characteristics, typical of space technology, make this likely for "next generation" products within other technological fields as well. Through active participation on the part of research institutes and industries in future space projects, we will acquire direct access, without any delay, to the new technology. We will not need to wait until the technology is generally available, which involves the impending danger of being too late. In this connection an active policy must be executed in order to advance an exchange of technology and knowledge between Norwegian space activities and other sectors of the Norwegian economic life.

International Technological Programs

All the major industrial nations have at present started programs concerning information technology and physical research. Within EEC extensive techological programs such as ESPRIT, BRITE and RACE have been started. Great expectations are tied to these programs and the results may lead to an activation of the industry and its products on a large scale in those countries. Here, Norway stands entirely apart. The establishment of a new civilian European technology program such as EUREKA and an eventual European participation in the American military Strategic Defence Initiative (SDI) project is under development or being discussed.

It is the objective of Norway to develop an advanced technological industry, capable of competition. It is therefore of decisive importance to get in touch with the large international technological programs and to obtain information about the results thereof. It is, furthermore, important for the prospects to compete that the industry shall expand its production methods so that it can cooperate with international syndicates when executing major technologically advanced projects. This may, however, be difficult when considering the position of Norway. Other countries may want to reserve the results for their own industries in order to be a step /37
ahead in the competition. Because of this, our participation in ESA is of a major importance. ESA administers at present the best planned and most future-oriented European research and industrial cooperative ventures, open for Norwegian participation. With a membership we will become a partner in the greatest technological program within Europe. The obligatory cooperation with other research fields and industrial associations will give us a reason for bringing home technology from within an extensive prodessional field. It should be emphasized that ESA by practizing its industrial policy also offers small and mediumsized industries a realistic opportunity for taking part in major and advanced international projects. This we could hardly achieve in any other way.

Criteria of Priority

In respect to the transfer of technology to Norway it is selfevident that the participation in projects with the most extensive and useful aspects should be given priority within areas which have already been given priority in Norway, among others, according to the Government Report on research. The space activities are self-supporting and promote technical development within entirely new areas such as, e.g., microgravity.

4.4 NORWEGIAN INDUSTRIAL DEVELOPMENT

Production for Space Systems

The production of major and minor partial systems for complete satellite systems should be a profitable occupation. Investigations made in other

countries confirm this. Even in countries with a very limited space activity such as, e.g., Denmark, the space industry has proven profitable. In addition, there is value in the effects, spreading from it into other areas of productivity within the economic life.

The development of new satellite services will also replace some of the existing services. If somebody wants to become a supplier to any of these services, it will be necessary to radically change the production. An example can be given in the form of the fact that radio telecommunication to ships will gradually be replaced by maritime satellite communication. One of our main suppliers of traditional radiotelephony, the Electric Bureau Co., realized this and was able to adjust to the demands of the satellite age in time. At present this enterprise is the third largest supplier of satellite terminals for ships with a total annual turnover of ca. 100 mill. N. Crowns.

In addition to the technological development for which the space activity serves as a locomotor, it should be emphasized that this activity also develops new and advanced methods for administering multinational joint execution of major projects. High-level technical products for the space activities place heavy demands on quality, reliability and safety. This is so because in most cases it is impossible to repair satellites and space sondes, once they are laucnhed, and in the case of manned space crafts because of the people involved. The requirements for documentation and quality control are therefore extremely stringent and the expenditures for building up a line of production, qualified for space activities, are considerable. In respect to this type of administration routine, the space activities are at the forefront but a similar development can be vizualized within other fields as well. e.g., in respect to the production of airplanes and within "offshore" activities.

Industrial Side-effects of Space Activities

The space activities will give rise to advances within the areas of information technology, physical technology and construction technology. On the basis of the new infrastructure, which is planned for space activities, new missile systems and systems based on knowledge of assembly and main-

tenance as well as new life support systems will also be greatly advanced. The special demands on extreme reliability, long service life in an extreme environment and automatic maintenance mean that this technology will be suitable also for other products of high technology.

Supplies for partial systems belonging to space projects will be characterized by the application of a new technology, the development of light-weight components and demands for an extensively documented reliability. The work must be done within the framework of international syndicates, which will administer the integration of the partial systems into complete ones. By using experiences from space projects, the industry will have acquired a foundation when it comes to obtaining contracts for supplies to other international advanced technology systems. One area of interest is the production of airplane parts. The organization of that type of work reminds a great deal of that concerning satellite products. It is especially interesting that the production of parts for airplanes can be developed into a very extensive serial production.

The advantage, - technologically as well as administratively, - of an early mastering of high-technology products can become the one most important in respect to competition, when it is a question of gaining markets for improved products. The situation of the Electric Bureau Co., which has systematically built up its competency within the sector of satellite communication, is such that the high-technology products developed by themselves are those most cost-efficient, while the components which have to be purchased, contribute to a great extent to an increase in the level of cost.

In addition, knowledge of new space technologies will be able to improve the possibilities for invading the industry so that new, technically advanced products can be developed and form the basis for other new lines of production. /38

Investigations made on behalf of ESA indicate that providing supplies for satellite systems will amount to a total benefit for an industry, two to four times as large as that of the ESA contract itself. The benefits pertained according to those investigations to income from supplies delivered outside the space activities [2].

The technological interaction between widely separated areas can be greater than believed at first glance. It seems, for instance, that the development of systems producing oil and gas from the bottom of the sea can make use of space technology. Many systemic solutions of robot assembly and maintenance as well as of systems for making it feasible for humans to stay and work below the surface of the sea remind very much of the systems for the space station being planned. Because of this the Department of Industry and the NTNF have already established contact with the Norwegian off-shore interests and the German space industry. We can also point to the cooperation between STATOIL (the Norwegian State oil enterprise) and the Boeing Aircraft Company.

Internationalization

Supplies of partial systems for satellites are in most cases delivered to a syndicate, which through a network of industrial contracts governs the development of the satellite systems, which ESA has specified in agreement with the membership nations.

The principle of a just distribution of the industrial contracts on the participating member nations, the so-called "fair return", means that the competing syndicates are forced to establish contact with competent industries in the individual countries at the same time as the industries are assisted by ESA and their national representatives when writing promising contracts. This process makes it feasible for new industries, - or such with new products and services, - to make contact with interesting industrial partners. This applies to small as well as medium-sized enterprises which are, thus, offered an attractive opportunity for cooperation at an international level. When the enterprise in question has obtained a contract and has completed its commission satisfactorily, this can be the beginning of a close cooperation also on other projects outside ESA and space activities.

A successful delivery to a space project means a stamp of approval for the enterprise in question and an internationally acknowledged reputation,

which can ease further advances on the open market. Just the ability to work out international agreements makes it easier to get ahead in the stringent competition.

Satellite projects could lead to the establishment of a foreign space industry in Norway and to the creation of "joint venture societies" where foreign and Norwegian competency is united into a new association, initiated by a particular satellite project. Attempts to create such establishments have already been made and should be positively evaluated.

Norwegian Manufacturing Interests

At present Norway is a netto importer of equipment for satellite services. No doubt this can be blamed on the low level of engagement which Norway has previously had in connection with the development of new satellite systems. Our activities concerning maritime satellite communication are an exception.

Thanks to our participation as a fullfledged member of ESA, Norwegian industry will be stimulated to spend much more on space-related products and services than so far done. The fact that we actively enter an obligatory cooperation and obtain continuity within our space programs, - both as far as research and development are concerned, - make the space activities less precarious as a bussiness venture. How extensive the industrial activity will be depends largely on the contribution of the government to this area, on the conditions under which this industry will develop as well as on the willingness of the industry to give priority to human and economic resources in order to make an effort within the space activities. Especially the need for internal-industrial preparatory development (expansion of the infrastructure, conference activity, drawing up of tenders, etc.) will demand considerable capital expenditures by the companies themselves. In this connection it should be mentioned that the cost of drawing up a tender can amount to 10 to 15% of the contract sum within this sector.

At present the Norwegian industrial activities within the space field are very limited although growing. The number of persons presently engaged

in space-related activities within research and industry amounts to ca. 300. The increase during the last couple of years has been ca. 20% annually. Some 10 industries and 5 to 6 research institutes are at present engaged in space activities, so far mainly with the ground-based segment but increasingly more also with the space segment as well.

The British consultant firm, the General Technology Systems (GTS), has evaluated our research fascilities and a number of our enterprises in view of an engagement, if possible, within the space activities. The report of this firm [3] concludes that several of our Norwegian enterprises could offer conditions necessary for developing into suppliers of partial systems for the space segment while contributing a relatively limited effort.

Our industrial contribution has so far been related mainly to the ground-based area. If the industry shall come along as a supplier of major systems components, it will be necessary to develop areas which master important portions of the space segment itself. Which functions shall be ascribed to the space sector and which to the ground-based sector will /39
constantly vary. The trend points clearly in the direction of a simplification of the consumer systems by placing several functions within the space segment so that the ground-based system (i.e., the earth-stations in the case of telecommunication, etc.) will be simpler and easier to operate.

What possibilities for deliveries can our industry develop or does it already possess? Delivery of satellite systems are made mainly to governmental, national or international organizations. This makes it feasible to assure a certain favoring of a national industry. That could mean that Norwegian industry should have a market balancing the investments and expenditures made within national and international organizations. Concerning the ground-based segment, the competition is more open within certain fields (e.g., telecommunication). There, the conventional criteria for competition (price, quality, etc.) are to a great extent dominant.

It is also possible to start an export of space-related products to other organizations than those of which Norway is a member, e.g., to the third world. On the basis of our participation in the TELE-X, which is

concentrated especially to the ground-based sector, a satisfactory basis has been established for export of complete telecommunication systems outside Norway as well. Cooperation with other European space industries can, similarly, result in deliveries to extra-European markets.

Nothing should prevent our developing Norwegian industry from growing so that we could have a netto export of space-related products and services on par with Denmark and Canada if the correct conditions can be created and the industry itself is willing to give priority to the space activities.

Criteria for Priority

The objective from the point of view of industrial policy should be such that the space activities can pay off and open up opportunities for further deliveries to other sectors where corresponding systems technology and production methods can be utilized.

A target for the future should be to make such extensive deliveries to the space sector that they balance our purchases of space services.

In order to reach such a goal the following must be observed when selecting the space projects in which to take part:

- The contribution shall be concentrated to certain important projects and not be spread out all over the field. It is important to make an effort within areas which are scientifically and commercially related to each other.

- The space projects selected should provide opportunities for continuity within the research and the industrial activities.

- Projects offering opportunities for Norwegian industries to become responsible for the delivery of major systems should have priority over research and engineering tasks performed for foreign suppliers and systems.

- When searching for actual space projects, consideration must be given to competency and to the capacity already existing within research and engineering. In order to gain a foothold within the international competition

for the most interesting comissions, we must demonstrate that the necessary competency exists.

- Space projects which can have side-effects on other production areas of importance for Norway should be given high priority.

- It is important to get involved with projects which can create advantageous constellations in respect to research or industrial cooperation. This could create opportunities for jointly made deliveries to other space projects and often to other sectors as well.

- It is necessary to establish a balance between, on the one hand, deliveries which can create new technology and new products or such which are more of the type standard products which can get a broader distribution on the market and, on the other hand, the reputation created when making deliveries to a space travel organization. Both these alternatives are important.

- When negotiating about Norwegian participation in scientific space projects, consideration must be taken also to the interests of the industry without letting this affect the demands on the scientific quality of the project.

4.5 NEW SATELLITE SERVICES OF INTEREST FOR NORWAY

The position of Norway and the sea and land areas for which it is responsible mean that quite a few of the new satellite services will provide economically favorable solutions for Norway. Some important points shall be made below.

Telesatellites

Norway was a pioneering nation within the development and the establishment of an international system for maritime satellite communication. Norway was the first country in western Europe to use satellite systems for communication with fixed installations of the oil industry in the North Sea. At present a number of new application areas are planned and established for covering purely national needs as well as for the establishment of an efficient

international communication. Satellite systems make it feasible at an early stage to offer advanced telecommunication to consumers over the entire country. In respect to our thinly distributed population, our county policies and our foreign trade, satellites will in many cases offer economically favorable solutions. Satellite-based systems will, thus, be an important element in the current and the future build-up of a telecommunication network, nationally as well as internationally. /40

It is generally assumed that in the long run satellite telecommunication systems will play the most important role within the areas of radio as well as mobile and ad-hoc types of services. Thus, our thinly dispersed population and the special interests for mobile services put Norway in an interesting position as a user of such a system also in the future. In this connection, the TELE-X project represents an important and future-oriented contribution.

Position-finding and Emergency Satellites

Because of the capacity for exact localization built into the new position-finding satellites, many of the needs of the shipping industries, the fisheries, the off-shore industries, the aviation, the surveying system and the Armed Forces can be satisfied and Norwegian industries will get a chance to obtain contracts for equipment or special services. Again it is important to get involved in the development and testing of such systems at an early stage.

Norwegian rescue services have to control large areas at sea and widespread, thinly populated land areas. The new emergency services operating via satellites, which make it possible to locate and identify people stranded or in an emergency, will essentially improve the rescue services. In respect to the relaying of emergency services at the Tromsoe Remote Sensing Station and the industries constructing receivers and emergency buoys, Norway has assumed an advanced position within this field.

Satellite Services for Meteorology

Several satellite services are already in use in Norway. Geostationary

satellites furnish images of the cloud cover, something which provides valuable information also at our high latitudes. Polar-orbit meteorological satellites provide further information concerning the atmospheric conditions via radiometry. Data-gathering satellites relay data from meteorological buoys and unmanned stations in the mountain areas. The relatively few, fixed and manned weather stations, which we have at our high latitudes, cannot provide adequate data for modern weather services and therefore the satellite systems have become indispensable. Norway has beeome a member of the international satellite organization, the EUMETSAT, and the Norwegian Institute of Meteorology and the Tromsoe Remote Sensing Station relay the satellite data. New remote-sensing satellites will provide the meteorlogists with additional valuable data. An active contribution from Norway will be necessary for assuring access to data and in order to get the data transferred in a purposeful and safe manner.

Datagathering via satellites is at present executed by means of our own transponders on board meteorological satellites. As mentioned above these are at present used mainly for gathering data from weather buoys and unmanned weatherstations. In addition to the capacity for transmitting measuring data at fixed points in time or when alerted by a groundstation, the position of a target can be located to within 1 km via the metering platform. This fact can be utilized when measuring data shall be recorded, for instance, from drifting buoys in the sea or enclosed in ice. A Norwegian-developed system for such position-finding is installed at the Tromsoe Remote-Sensing Station.

In addition to relaying weather data, this type of satellites can be used for transmitting a number of various environmental and resource-related data from unmanned instrument platforms. The satellite system has also been used for tracking valuable goods equipped with simple transponders.

One possibility is to use this technology as an "electronic flag" on board a vessel. For instance, by requiring special transponders for fishing vessels with consessions within regulated areas, reports on catches

as well as of position and identity can be obtained. This could fascilitate the duties of the Coast Guard to a considerable extent.

This type of satellites can, thus, have many areas of application which are of interest to Norway in addition to those, mentioned above.

Surveying Satellites

As discussed above, radar-based imaging instruments are of special interest to Norway because of their all-weather capability and their independence of light and darkness. Concerning the economic value of remote sensing via satellites we refer to Norges Offentlige Utredninger 1983:24. Because of our participation in the ESA shore, ice and sea surveying satellite, the ERS-1, we will be involved in developing methods for the determination of the conditions of wind, waves and currents at sea and for the detection of icebergs and of oil pollution. Norwegian industries have received commissions in connection with satellite instruments and data equipment for processing the data received. By the reading of satellite data at the Tromsoe Remote Sensing Station, we can assure national access to and processing of these tracking data which are of such importance for Norway.

Research Satellites

In addition to the scientific satellites mentioned earlier which cover a wide range of interests, satellitesfor geodesic experiments are also imagined. These could possibly be used for earthquake warnings or for determining geodesic parameters and could also be of value for mapping ore and oil resources. They are of great interest to Norway.

Experiments in an almost weightless environment together with the development of more efficient materials such as semiconductors for the electronics industry or of materials for pharmaceutics and gene technology have become /41
areas given priority by the large organizations. Among others, the space stations such as planned will have room for laboratory experiments and will make it feasible to further develop the production processes for such purposes in space. This can lead to commercially interesting products in the future.

It is important that Norway shall keep well informed about the opportunities which may develop within this area.

Infrastructure

The extensive infrastructures, being built up around the space activities, such as control or ground stations, space transportation systems with pay-load missiles and space shuttles as well as, by time, an extensive maintenance infrastructure in space, can provide interesting delivery opportunities for the industry.

The many new satellite services can be of great economic interest to Norway from the point of view of security policy as well. Just because of this, it is important to get a foothold within the new services so that Norwegian needs can be covered as far as possible and in order to safeguard our right to data. In addition there are opportunities for the industry to participate in satellite projects and satellite organizations.

Norway As a Consumer Nation

During the last 10-year period we have seen a rapid increase in the satellite services of which our country is making use, mainly in connection with teleservices, meteorology and emergency signalling. In the previous sections a number of new services and activities were briefly mentioned. It will be of significance for Norway to participate in the development and expansion of several of these.

One way of estimating our needs for satellite services is to assume that we will use them to the same relative extent as other European industrial nations. One reason for this could be that the industrial nations will utilize satellite services on the same order of mangitude in order to keep the modern society-machinery operating. Based on such an hypothesis it can be expected that Norway shall use the same percentage of its gross national product for satellite services as all other industrial European nations will do.

In respect to most of the satellite services, the consumption will, perhaps, depend more on the area covered and the distribution of the activities to be served than on the economical status of the country.

Norway with its thinly distributed population and large maritime areas and activities could turn out to be a more important consumer of satellite services than many other nations in Europe. In addition, our topography and widely scattered people mean that the use of satellites will be more cost-effective than the land-based solutions, which may be more attractive in countries more densely populated. On the basis of this reasoning, Norway may become a relatively seen greater consumer of satellite services than most other European countries.

If Norway shall become a relatively major consumer of satellite services, this will for several reasons demand an active engagement. We should participate in space organizations in such a manner that we will have an actual influence on the development of those services of which Norwegian consumers will make use. This means that we must create a professional environment at home, so that we can behave with the proper emphasis within the international organizations. Where our share in the consumption is large, we should contribute an equal share so that we can safeguard Norwegian interests.

Within certain areas satellite systems may be used as auxilliary means when executing Norwegian jurisdiction. Our extensive maritime areas, the thinly populated land and our interests in Arctic and Antarctic areas can make us more dependent on satellites than most other nations. It can, therefore, be in the interest of Norway that we shall secure a reasonable influence on the management of the satellite services in question by contributing more than our minimum share.

Satellite services will become important elements for the utilization or our economic zones. The economic importance for Norway of the activities supported by satellites could be so great that it is important to secure the necessary influence through increased participation.

Within certain areas we can have internationally acknowledged consumer

areas, able to compete, which means that we should contribute a considerable amount in order to, thus, safeguard our share in the market and our influence on it.

On the other hand, the major space travelling nations have produced a number of prestigious space projects such as the lunar programs and the magnificent planetary voyages. Norway should hardly participate to the same relative extent in such programs as the Great Powers do. The Norwegian engagement within space activities must be industry- and consumer-oriented and not prestige-oriented.

Criteria for Priority

The objective must be that Norway shall have access to cost-effective space services and must safeguard due influence and control over them. In order to reach this objective the following facts must be basic for the choice of projects in which we shall take part:

- Space projects which are able to offer services to help secure life and health in a manner more efficient than other systems should be evaluated for participation; and
- projects which can present more cost-efficient services for the economy /42 and the management should also be evaluated for participation.

When selecting space projects adequate consideration should be taken to installations already existing in the country. Competency within the research areas and the industries making deliveries to the projects/systems must be given due regard just like the need for education, equipment and the effect on potential consumer groups.

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Chapter 5

NORWEGIAN ENGAGEMENT UNTIL YEAR 2000

5.1 BASIC GUIDELINES AND OBJECTIVES /43

A sketch of the general prospectives for the space activities was drawn up in Chapter 1 and in Chapter 4 the Norwegian interests and opportunities were presented. On the basis of purely geographic and physical conditions as well as the technological and industrial level of ambition in our country it can be soberly stated that the interests of Norway in the space sector should, when measured in relation to the GNP, amount to at least what is average within the industrialized world.

When trying to establish the level to be reached by the official contribution until year 2000, a number of ways are open. Some projects, already started or being planned and open for Norwegian participation, could be used as examples when explaining Norwegian objectives and appropriations. However, such a method may lead to a contribution of personnel and resources which is unrealistically high. The committee has found it purposeful and realistically well founded to use the membership in ESA as a starting point. The activities in that connection shall be the mainstay for the entire Norwegian activity up to year 2000.

It should be a sensible and sober objective that before year 2000 Norway shall have reached a standard level of appropriations for ESA which can be measured in relation to the GNP. This means that Norway, to begin with, should contribute ca. 1.9% to the ESA activities. There are, however, countries which do not participate to the fullest extent in the voluntary programs, while others participate more than their GNP-based share indicates. The figures as of 1990 are assumed to become like those illustrated in Table 5.1.

If before year 2000, Norway aims at a total aprticipation in ESA, amounting to 70% of what a GNP-based share of 1.9% indicates, the economic contribution of our country will mean 1.33% of the ESA budget, i.e., ca. 150 mill. N. Crowns (at the 1985 course) per year.

TABLE 5.1 PARTICIPATION IN ESA IN RELATION TO THE GNP-BASED CONTRIBUTION SUCH AS EXPECTED BY 1990. (Regarding the GNP share, cf. 2.4.)

Country	Expected contribution (in %) by 1990 in relation to the GNP-based contribution (100%).
Belgium	110
Denmark	70
France	130
West Germany	110
Ireland	50
Italy	120
The Netherlands	70
Spain	80
Sweden	80
Switzerland	60
Great Britain	70

The obligatory portion will amount to ca. 46 mill. N. Crowns. This covers the general budget, expenditures associated with it (operation of the Kourou launch site, etc.) as well as the scientific program. The expenditures for the obligatory programs will commence with full force already during 1987. An active participation in the basic technical studies and the scientific program is, thus, necessary from a point in time as early as possible. Because of the expenses for these programs in Norway we must strive for full utilization thereof before year 2000. Not least because of the fact that it is relatively modest on a European scale, the allocation mentioned must be considered a very sober objective but, of course, only if it will result in an adequate and practical content, adjusted to our needs and purposes. According to the point of view of the committee this is the case and we will return to this viewpooint later on.

In addition to the participation in ESA, experiences gained in other countries points to the circumstance that it is necessary to set aside national funds for operating a national executive apparatus, for supplementary research and for putting the scientific area and the individual enterprises into a position to participate in the international projects as well as funds for operating national fascilities such as launch sites, relay stations, etc.

The funds for supplementary research should according to the point of view of the committee be raised to at least 25% of that used for the international participation, i.e., to about 40 mill. N. Crowns (at the 1985 level) by year 2000. The other national committments should, at the same point in time, be allotted ca. 30 mill. N. Crowns annually.

By year 2000 the total operations within and in connection with ESA should require ca. 220 mill. N. Crowns (at the 1985 level) according to the suggestions by the committee. This will most likely correspond to 0.04% of the GNP and to ca. 5% of the total official contribution to research and development. Sweden has at present set a target for space activities to between 0.05 and 0.08% of its GNP when the expenditures for the TELE-X should have passed the maximum level. In comparison it can be mentioned that the U.S.A. at present sets aside 0.47% (for military as well as civilian purposes), France 0.08% and West Germany 0.04%. The accepted increase for the ESA programs (70% during the period 1986-1990) will raise these figures. Obviously, the actual figures reflect a quite different aspect on the contributions and these represent very large expenses for a country as small as Norway. /44

In view of the fact that the committee has been very modest in its suggestions and has systematically selected the lowest defensible level of contribution, it wants also to emphasize that it expects a rapid build-up toward the level suggested. This is necessary not least because of our late start and because our activities must be adjusted to ESA programs being rapidly developed. Norwegian industry should also be given the stimulation that a concerted effort represents.

Public service departments such as the Post and Telegraph Department, the Norwegian Meteorological Institute, etc., must themselves budget their participation in the international organs, however, in agreement with the guidelines provided by the government. On the basis of purely commercial estimates within these departments, the engagement mentioned can become more extensive than the activities which will develop within and in association with ESA.

It is very likely that towards year 2000 real bilateral and/or multilateral projects outside ESA will come into question. There are possibilities for a further development of the TELE-X. In Sweden work is in addition going on on other interesting telecommunication projects. NASA has a large number of projects under development, among others, within astronomy and for utilization in space stations. The Canadian RADARSAT project has interesting prospect for our country as well. Such projects outside ESA should be considered on an ad-hoc basis. They could be commercially interesting or provide such cost-effective solutions for the public service departments that an investment could be defended.

Projects outside ESA concerning basic research must also be handled on an ad-hoc basis. It should be possible to participate in projects of advanced scientific standard, although strong commercial interests are not involved.

Below the internal structure of a program in relation to the total framework considered will be discussed.

5.2 PARTICIPATION IN INTERNATIONAL CONSUMER ORGANIZATIONS

Norwegian participation in such international consumer organizations as INTELSAT, INMARSAT and EUTELSAT has led to that, in 1985, Norway had an equity in these ventures amounting to a total of 123 mill. N. Cr. This equity provides a yield in the form of interests, covered by the income from operating these organizations. In 1985, ca. 42 mill. N. Crowns were invested by Norway, while in 1984 this amount was 10 mill. N. Crowns. The sum total will increase for some time due to the enlarged scope of the services. The variations can be blamed on the point in time when new satellites are purchased by the organizations.

The EUMETSAT finds itself in a somewhat different situation.

The Norwegian contributions to the international organizations have not yet led to any Norwegian deliveries in connection with the space segment. There are two main reasons for this. First of all, the contracts with the organizations in question do not contain any "fair return" clausul, because of

the fact that the application of this principle would lead to considerably higher total costs for the consumer organizations. This is an attitude which is definitely to the advantage of the fields established. As far as industrial problems are concerned the Norwegian representatives have adopted a neutral position. Secondly, by standing apart from ESA, Norway has to a great extent been cut off from the opportunities for the Norwegian industries to become qualified and to establish the industrial relationships which have led to the creation of the industrial international syndicates.

The growing flora of international organizations have led to a greater awareness of this problem and the development indicates a strengthening of the trend away from a market seemingly completely free of competition and into an economy regulated by negotiations, where public and political interests operate together with the marketing mechanisms.

At the level of the syndicates one is aware of this and attempts (e.g., in connection with tenders for another generation of EUTELSAT system) to form groups in relation to the consumer shares of the countries participating. It is worth noticing that during an open international invitation to tenders concerning second generation INMARSAT satellites, only two quotations were offered. Both were dominated by British and American industries which represent the two largest investors in Norway.

A Norwegian objective must be to "standardize" these contributions so that the "fair return" principle shall be valid as a national condition for our participation in international consumer organizations. An active utilization of the membership in ESA, augmented by a planned national supporting activity, should be an effective method for reaching this goal. An active attitude and a positive cooperation by the Norwegian representative in respect to the organizations in question are also necessary.

The third generation INMARSAT system, which should be in operation by the middle of the 1990's will because of the large Norwegian share in the venture be a test of this policy. The participation in this project will /45
be a touchstone for Norwegian space activities.

5.3 PARTICIPATION IN ESA

Norway will enter ESA as a fullfledged member at the same time as the European space activities enter a new stage of growth. This can be favorable and will make new opportunities develop. It should be considered as likely that before year 2000 the ESA programs will comprise such projects as HERMES and HOTOL and that the annual budgets will increase beyond what has alreday been programmed (cf. Table 2.1).

5.3.1 The Obligatory Program

Norway must contribute to the obligatory program on the basis of its GNP. In 1987 this will mean a share amounting to 1.83%. The program consists, as already mentioned, of two parts, i.e., the general budget and the scientific program.

The General Budget

Basic technical studies will also be conducted within the framework of the general budget. Norway should participate actively in these. Such a participation will lead us on to subsequent activities in a purposeful and systematic manner. As mentioned above, this includes in addition a minor educational program. Norway should make use of it.

The Scientific Program

This program amounts as far as Norway is concerned to ca. 18 mill. N. Crowns in 1987 and will increase to ca. 25 mill. N. Crowns by year 2000. Norway has demands on ca. 70% in return for its industries out of this amount.

Because of the long time required for developing a satellite project, - about 10 years from the first idea to the completed project, - the CLUSTER and the SOHO are the first projects given priority within the main fields (i.e., solar and geophysics) of ESA, where Norway will be able to assert itself scientifically as well as industrially. From a scientific point of view, both projects have priority within Norwegian basic research. Scientific instrumentation for both CLUSTER and SOHO must be constructed in cooperation between national indestries and the research tems taking part and

be financed by national funds for supplementary research. The level of the Norwegian contribution must be established during 1986 and funds must be allocated up to 1995. From an industrial point of view the projects are interesting since we can collect industrial returns from them over several years and obtain commissions for 50-60 mill. N. Crowns for a single project. This will provide the establishments participating with a reasonable volume, something which is very important for the "beginner's stage" at which the Norwegian Space activities stand.

In the long run there will also be interests for Norwegian basic research within the major part of the ESA scientific programs, including the other three main fields, i.e., planetary physics, X-ray spectography and heterodynamic spactrography; cf. 2.3.1. Here priority shall not be decided until it is definite which Norwegian basic scientific interests relate to the practical programs of ESA.

5.3.2 Voluntary Programs

The main emphasis in respect to the ESA programs shall be placed on that category which is of the greatest interest for the consumers and the economy. We have been assured industrial returns in connection with these programs, since the distribution of the duties and the contributions are usually adjusted to each other.

The Telecommunication Programs

From the point of view of applicability and that of the industry, the telecommunication programs offer the most clearly defined and obvious interests. Here, Norway must safeguard both traditional and future interests. Our position is strong, especially within the field of maritime communication, where we as a nation represent the largest consumer and where our industry has gained a solid position on the world market in respect to the ground-based section.

In order to further develop these interests, which were initiated by our participation in the MARECS program, we are as mentioned above at present able to take part in a number of minor technical and systematic programs

such as TPP, ASTP, PROSAT and APOLLO. In 1986 our entire share amounts to ca. 7 mill. N. Crowns. These programs are important for developing the special skills, the technology and the contracts on which the participation in future satellite-developing projects will depend. A somewhat broader industrial participation should be prepared for.

The next major projects being prepared are the "Payload and Space Development Experiments" (PSDE) and the "Data Relay Satellite System" (DRS). As far as the former is concerned, advanced pay-loads for various purposes for communication satellites will be developed. The first one under preparation is a third generation mobile communication system, directed toward aeronautic and/or maritime use (INMARSAT). This one must obviously be given priority and will during 1988-1995 on an average cost 9-11 mill. N. Crowns per year at a 2% contribution. The DRS with its many lines of communication and its enormous amount of data is interesting from a technical point of view and a minor participation in it should be evaluated on the basis of the extent to which the industrial interests are reflected and to which the technology can be developed in the form of a further expansion of maritime and mobile communication.

Other new projects should be evaluated on the basis of applicability /46
and industrial interest when they are being presented. Since the field of telecommunication to a great extent is covered by national and regional programs such as the TELE-X, it seems sensible that our contribution to ESA should be fixed to 2% of that of the telecommunication programs at the end of the period. An exception should be made for the DRS, for which a smaller allocation is recommended.

The Remote Sensing Programs

This is a field of minor, still not fully developed consumer interests but of very interesting and steadily increasing industrial interests. Norway contributes 0.5% to the METEOSAT. This appropriation will from the turn of the year, 1985/86, fall under the EUMETSAT and the responsibility of the Norwegian Meteorological Institute. We contribute ca. 1.3% to the ERS-1 program, which runs up to 1992. The committee recommends a share in ERS-2 at 1.7%, i.e., the same GNO proportion as given by Canada. That means ca. 4.5 mill. N. Crowns annually.

Participation in EOPP, the improved geoobservation program, should be given high priority. There, a foundation can be laid for future programs. Norwegian participation based on the GNP is recommended. This means at present 1.7%, corresponding to a total of 6.0 mill. N. Crowns for 1986 - 1991, i.e., up to 1.4 mill. annually.

It is the opinion of the committee that in the long run the development of operative systems for maritime purposes should be given priority alongside meteorological satellites with polar orbits. Advanced geo-observation satellites can be interesting when in polar orbits and should be evaluated when more definite plans become available.

Our contribution to maritime and polar orbit telemetry programs should, on the whole, be dimensioned in proportion to our GNP, i.e., to ca. 1.7 to 2%, depending on participation of non-members.

The Payload Satellite Program

The interest in and the production of the payload satellite ARIANE 5 together with the HM-60 engine is motivated from a Norwegian point of view because of technological and industrial concerns. The development comprises technology, construction and processing methods in addition to guidance and control systems as well as other electronic systems. The tasks are particularly interesting for systems-oriented workshops and have definite side-effects for the aviation and the "off-shore" industries. There is a need for considerable amounts of data equipment and programming materials for the test- and control infrastructures.

ARIANE is especially important since this program can lead to serial production and thus provide continuity.

On the basis of Norwegian industrial interests, the committee suggests participation in the preparatory program by up to 0.5%. The size of the contribution to the main program, - if realized, - should be viewed in connection with the space station program and be evaluated on the basis of the actual commissions given to Norwegian industries. It should possibly be a question of 1%.

Participation in the HERMES, - if included among the ESA programs, -

should also be taken into consideration since industrial interests can be seen in connection with the competition, possibly arising from the COLUMBUS and ARIANE programs.

The Space Station Program

The space station COLUMBUS is a large and complex program, comprising all the elements of space activities which, consequently, will be run by both scientific and user-friendly interests such as technological and industrial ones. Norway will participate in the B-phase, the planning stage, by ca. 1.5% in order to better be able to evaluate the opportunities arising. The special relations between space technlogy and submarine technology will be explored.

Although the user-friendly prospectives in connection with microgravity and telemetering are enormously interesting, it has not been decided whether these applications of the space station shall be managed by any of the practical programs. The scope of the participation in the C and/or D stages of COLUMBUS will therefore largely be decided on the basis of technological and industrial interests. A collective evaluation concerning participation in ARIANE 5 will be executed in the same manner. A level of 1% may come into question.

The Microgravity Program

The microgravity program is the starting point for a basic research program which has definite consumer aspects. A contribution to stage 2 at 5%, corresponding to a total of 4.5 mill N. Crowns annually during 1985-89, is suggested. Norway possesses top competency within the biological field and is also able to offer technically-oriented services.

Fresh opportunities for metallurgy and medicine (pharmaceutics) must be actively included.

It is suggested that Norway shall continue in the same manner in this case as before until the program becomes integrated with the COLUMBUS program.

TABLE 5.2 LONG-TERM BUDGET FOR NORWEGIAN PARTICIPATION IN ESA. ALL SUMS ARE GIVEN IN MILLIONS OF NORWEGIAN CROWNS. THE ECONOMIC CONDITIONS OF 1985 AND A 1986 CONVERSION FACTOR (1 AU = 6.45987 N. Crowns) ARE VALID.

Year	1986	1987	1988	1989	1990	1991	1995	2000
Obligatory programs:								
General budget	5	13	13	14	14	14	15	15
Operation of Kourou and other costs related to the general budget	-	5	5	5	5	5	6	6
The scientific program	-	18	19	20	21	23	25	25
The obligatory program, total:	5	36	37	39	40	42	46	46
Voluntary programs in which Norway already participates:								
Telecommunication	7	4						
Remote sensing	10	13	7	7	3	1		
The space station	1	1						
Voluntary programs, total:	18	18	7	7	3	1		
Statutory expenses, total:	23	54	44	46	43	43	46	46
New voluntary programs:								
Telecommunication	2	10	16	16	21	21	22	25
Remote sensing	1	4	6	12	16	16	19	22
Technology demonstration				1	1	1	2	3
Payload missiles	3							
The space station		21	38	43	44	44	50	54
Microgravity	1	2	3	3	3	3		
New programs, total:	7	37	63	75	85	85	93	104
For ESA, in total:	30	91	107	121	128	128	139	150

5.3.3 TOTAL EXPENDITURES FOR ESA

Table 5.2 illustrates how the appropriations, suggested by the committee, will look from the point of view of allocations up until year 2000.

The sum total by year 2000 will amount to 150 mill. N. Crowns and the committee has staid within that limit by being extremely moderate. Conditional priority has been given to telecommunication and remote sensing in which a participation by up to 2% is recommended. A charge, including the operation of the launch site at Kourou, is also included as well as a minor amount, set aside for new activities. /47

5.4 COOPERATION WITH SWEDEN AND OTHER BILATERAL ARRANGEMENTS

An extensive cooperation has been introduced mainly with Sweden but also with Finland through the Norwegian participation in the development of the communication and television satellite, the TELE-X. TELE-X represents a brave and important venture to which Sweden contributes 82%, Norway 15% and Finland 3%. The total cost is estimated to 1250 mill Swedish Crowns (at the January 1982 -level). The first stage in this program will be completed by the launching in 1987. The Norwegian participation is discussed in Governmental Proposition no. 98 for 1982-1983.

The cooperation in connection with TELE-X is managed within the framework of a syndicate by the name" Nordiska Telesatellitekonsortiet" [The Nordic Telesatellite Syndicate). This is, in turn, split into two companies, the Nordic Satellite Company (NSAB), which will purchase the TELE-X and the Nordic Telesatellite Company (NOTELSAT) which shall manage it. NOTELSAT represents the Post and Telegraph Departments of Norway and Sweden. While the development of TELE-X is technically satisfactory, some disagreement has arisen concerning the use of the satellite during the operating stage. From the Swedish side, a special company (NORDCOM) has, among others, been suggested, which should be able to use the satellite independently of the Post and Telegraph Departments.

At present the committee can only hope that the disagreements existing shall be settled and that TELE-X will be fully utilized for the entire spectrum of services planned. In any case, the project must continue to be financially supported through consumer interests. /48

There are plans in Sweden for an extension of the TELE-X program (into TELE-Y and TELE-Z). It is at present not possible to recommend any appropriations for these plans; the prospects for the operation of TELE-X must first be elucidated. Any extension must be subjected to commercial evaluation by the tele-administrations as well as by private enterprises.

A number of other projects are also under consideration in Sweden. The project MAILSTAR is actively studied by the Swedish industry. The idea concerns the use of small satellites in non-geostationary orbits. The principle is to relay messages to satellites passing by. The messages can be stored. When the satellite is called from a ground-station somewhere else in the world, the stored message can be relayed to the addressee.

Another project being studied aims at using three satellites in elliptical orbits at an altitude of 40,000 kms. One satellite would always be visible high in the sky from a land area several thousand square kilometers wide on the earth. This system could be used for, among others, land-based mobile services.

The idea of a "Peace Satellite" is also being evaluated at a very preliminary stage, i.e., a surveillance satellite relating to arms control agreements.

It is the opinion of the committee that it is not at present feasible to suggest any position to be taken in relation to new projects for Swedish and Norwegian cooperation. New projects must be given a sober evaluation on an ad-hoc basis from the points of view of consumers as well as industrial interests.

In Canada there is active planning, among others, in connection with the sea and ice observation satellite, the RADARSAT, which could cover Norwegian interests as well. A cooperation with NASA and with Great Britain has also been introduced.

It is not possible to suggest any specific attitude or any possibly future participation in connection with the suggested partnership in future remote sensing programs within ESA. The development of the RADARSAT must, however, be closely watched.

5.5 NORWEGIAN SUPPLEMENTARY PROGRAMS AND THEIR INFRASTRUCTURE

A country which conscientiously utilizes cooperation in space as a means for modernizing its society and developing its industry will use more of its resources for national purposes than for ESA. If Norway shall be able to enter the environment which has developed around ESA, Norwegian industry and Norwegian institutes must be put into a position by means of supplementary programs to take part in the competition for commissions.

The committee has suggested that the national supplementary programs shall be built up toward year 2000 at a cost of ca. 40 mill. N. Crowns annually. It is the position of the committee that this shall be considered as definitely target-oriented funds, relating to current and future programs within ESA. They must not lead to obliteration of any general programs within the information technology, physical technology, etc. It could also come into question to use the same funds for preparing for entrance into commercial programs (e.g., INMARSAT, etc.), if that cannot be done satisfactorily via ESA. It is assumed that the research councils shall continue to support space-related tasks not included in the ESA programs with their own resources. The committee wants to point out that it could be realistic and purposeful to channel a portion of the supplementary funds through the research councils at the same time as these shall be represented in the committee structure, which evaluates the research- and development-oriented questions within the new structure of organization. We refer to Chapter 7.

Due to the late Norwegian entry into ESA, a major effort must be exerted in order to bring the industry into a competitive position by means of supplementary funds. This will not be an easy task. The formal demands on tenders, project administration and quality control are very stringent. However, the industries must first and foremost promote scientific and technological solutions which can arouse interest.

It seems sensible to assume that 20% of the supplementary funds shall be spent in connection with the scientific programs in areas where not only ideas and personal resources can be set in but where they can also, themselves, pay for the development of the instrumentation. The priority given by ESA during 1986-1995 to the two scientific areas, where Norway is capable of making a contribution, means that the share of the supplementary funds must be brought up to full scale by 1991-1992.

In connection with Norwegian space activities a certain expansion of the infrastructure will be necessary. In Chapter 7 the committee has outlined its suggestions for an organizatory structure consisting of a "Central Committee for Norwegian Space Activities" and the formation of a "Norwegian Space Center". A number of operating elements will be necessary as functional parts of this centralized structure.

The Andoeya launch site should be utilized for international cooperative ventures. The level of activities concerning man power should be adjusted to the commissions which the site can obtain. In 1985, the operating expenses (i.e. above the NTNF budget) amounted to 1.4 mill N. Crowns; the total cost was 8.4 mill. N. Crowns. About 20 persons are employed at this site.

As far as the Tromsoe Remote Sensing Station is concerned, a principal /49
decision has been made concerning expansion, among others, of the relay station for the ERS-1 but also for other purposes (e.g., SARSAT, COSPAS). This expansion was evaluated on behalf of the Department of Industry to ca. 42 mill. N. Crowns in Government Proposition no. 1 for 1985-1986. There is a plan for financing as far as until 1990, when it is assumed that the daily operation of the station shall be self-supporting on the basis of sales of services.

The question concerning establishment of further infrastructural arrangements will become increasingly obvious toward the turn of the century. At present we can only assume that test installations as well as a link-up with the ESA network of information will come into question.

The committee assumes that the expenditures for the operation of the central organization suggested, the launch site, the relay station(s) and

other facilities will amount to ca. 30 mill. N. Crowns annually up until year 2000.

5.6 JOINT INDUSTRIAL FINANCING

The question of joint industrial financing of the public engagement within the space sector has first of all led to a desire at an international level for distinction (privatizing) of those portions of the activities which from a commercial point of view will be able to manage by themselves. This has to a major extent already occurred within the tele-sector and in connection with remote sensing as well as, to a lesser extent, in respect to the launching of space ships. Obviously, the individual nations consider the investment in the space sector as a contribution to the modernizing of services and a contribution to the strengthening of the industrial potential.

Competition for industrial commissions is very hard and it cannot be denied that some tenders are subsidized just because the commissions are considered important. Considerable, direct income from space activities can be gained by application of the technology but not through industrial deliveries only.

The agreements made between the Swedish Government and certain Swedish industries (i.e., the SAAB Space Company, the Ericsson Radio Systems Company and the VOLVO Aviation Engine Company) concerning joint financing of the Swedish space activities is, as far as the committee has been able to learn, an exceptional case. Through an agreement of June 3rd, 1982, these three enterprises will undertake to pay 7% of the total invoice for the preceding year in connection with the bilateral and multilateral projects in which Sweden partakes through the "Government Delegation for Space Activities".

Apparently, the idea is that the companies shall contribute from their gains. The amounts realized in this manner are small, about 3 mill. Sw. Crowns, annually.

In December of 1984 the Swedish Government took a new initiative when discussing joint financing by appointing a one-man commission (in the person of Director F. Engstroem). His duty was to arrive at an agreement with the

industries concerning suitable forms for cooperation and joint financing of future space activities. A report was delivered on Nov. 1st, 1985 but has still not been further processed. The main attitude in the report is that joint financing is purposeful only when agreeing to "royalty" regulations but mainly by forming managing companies for the purpose of commercial utilization of the space technology. In this connection F. Engstroem suggested the establishment of a part governmental (40%), part private telecommunications company (the NORDCOM) for utilizing the TELE-X. A major conflict is expected.

Our committee considers that the question of joint financing represents a problem situation, worthy of observation. However, it is the utilization of the space technology which first and foremost will create a gain, not a one-time opportunity for delivery of specially developed capital goods. The delivery of standard products (e.g., data machinery) and parts for launching missiles constitute a quite different situation. In principle the committee has nothing to object to a "royalty" regulation in cases where the industries have acquired serial deliveries on the basis of fundamental commissions, financed by public funds.

The Swedish regulation concerning a 7% contribution does not seem to be of interest for Norway at present. The Norwegian industries have to accept a considerable burden in order to get in touch with ESA.

The committee recommends that in respect to this form of joint financing we should wait and see and postpone the matter to some years hence.

5.7. SUMMARY

The objective of this chapter has been to broadly suggest the level to which the public contribution should reach up until year 2000 and to indicate the main objectives both from scientific and industrial points of view.

The suggestions of the committee are compiled in Table 5.3.

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TABLE 5.3 LONG-TERM BUDGET FOR NORWEGIAN SPACE ACTIVITIES. ALL SUMS ARE GIVEN IN MILLIONS OF NORWEGIAN CROWNS. THE ECONOMIC CONDITION OF 1985 AND THE 1986 CONVERSION FACTOR OF AU (1AU = 6.45978 N. Crowns) ARE VALID.

Year	1986	1987	1988	1989	1990	1991	1995	2000
Obligatory programs:								
General expenses	5	18	18	19	19	19	21	21
The Science program	-	18	19	20	21	23	25	25
Obligatory expenditures, total:	5	36	37	39	40	42	46	46
Voluntary programs:								
Telecommunication	9	14	16	16	21	21	22	25
Remote sensing	11	17	13	19	19	17	19	22
Technology demonstration				1	1	1	2	3
Payload missiles	4	22	38	43	44	44	50	54
The space station								
Microgravity programs	1	2	3	3	3	3		
Voluntary programs, total:	25	55	70	82	88	86	93	104
For ESA, in total:	30	91	107	121	128	128	139	150
Supplementary programs	4[1]	22	24	27	30	34	37	40
Infrastructure	10[2]	14	16	18	19	20	24	30
National activities under the Central Committee, total:	14	36	40	45	49	54	61	70
Sum total for ESA and Norwegian activities:	44	127	147	166	177	182	200	220

1) These are funds allocated to NTNF via the Department of Industry. These funds are ear-marked for the supplementary programs, oriented toward participation in ESA.

2) These are funds which in 1986 shall be allocated via NTNF, the department of space activities.

Chapter 6

PLAN OF ACTION, 1987 - 1991

6.1 GENERAL

In Chapter 5 a program was outlined for the period up until year 2000. /51
It was suggested that the Norwegian contributions to ESA at that point in time should be standardized and that this, soberly estimated, would require ca. 150 mill. N. Crowns annually (at the 1985 course).

There are a number of conditions which in particular make a relatively rapid build-up necessary:

- Norway will join a well established organization. As a nation, we are stepping on board "a train at full speed and rapidly accelerating."
- Due to the operating manner of ESA, the nations participating must disclose their interest (in %s) at an early stage of the decisive phase concerning the individual projects. This percentage cannot be gradually increased.
- Several new and extensive programs will be started during 1986 and 1987.
- Norway must strengthen its organizatorial apparatus and its infrastructure.

Norway will enter the obligatory activities concerning the science program with full force, starting from 1987. If Norway shall get a foothold also within the voluntary programs, it is inevitable that there must be a considerable increase in the expenditures during 1986 and 1987.

Below a budget for the period 1987 - 1991 is shown. This harmonizes with the long-term prospectives discussed in Chapter 5. The committee must warn against the fact that programs and contributions must be considered as already fixed. Within ESA there is a constant adjustment of the total budget, the programs and the technology, This can result in the advancement of individual programs and in postponement of others. Changes in priority can also be made. Some major and inportant programs (e.g., HERMES, HOTOL) are still at the discu-sion stage.

6.2 TENTATIVE BUDGET FOR 1987 - 1991.

TABLE 6.1 TENTATIVE BUDGET FOR 1987 - 1991. ALL SUMS ARE GIVEN IN MILLIONS OF NORWEGIAN CROWNS. THE ECONOMIC CONDITION OF 1985 AND THE 1986 CONVERSION FACTOR (1 AU = 6.45978 N. Crowns) ARE VALID. FOR SOURCES OF THE FIGURES, CF. TABLE 2.1 [not included in this translation].

Year	1986	1987	1988	1989	1990	1991
Obligatory programs:						
General budget:						
Administration		6.0	6.1	6.2	6.2	6.3
TRP		3.2	3.5	3.8	3.9	4.1
EARTHNET		1.9	1.9	1.9	1.9	1.9
General research		1.6	1.6	1.6	1.6	1.6
Sum total for general budget:	5.1	12.7	13.1	13.5	13.6	13.9
Costs associated with the general budget:						
Operation of Kourou (1.37%)		4.2	3.8	3.8	3.8	3.8
Loss due to exchange/pensions (1.83%)		1.1	1.2	1.3	1.4	1.5
Sum total of general expenditures associated with the obligatory budget:		5.3	5.0	5.1	5.2	5.3
The science program:		18.4	19.3	20.2	21.3	23.2
Sum total for obligatory expenditures:	5.1	36.4	37.4	38.8	40.1	42.2
Voluntary programs:						
Voluntary programs where Norway already participates:						
ASTP 2 (1.4%)	1.6	1.2				
PROSAT, phase 2 (12.2%)	4.0	2.2	0.1			
TPP (1.7%)	0.7	0.5				
APOLLO (1.9%)	0.3	0.05				
ERS-1, phase C/D (1.26%)	9.6	13.1	6.9	5.6	0.3	
ERS-1, phase E (1.56%)			0.3	1.8	2.9	1.0
COLUMBUS PP (0.5%)	1.5	0.7				
Fixed expenditures for voluntary programs, total:	17.7	17.8	7.3	7.4	3.2	1.0
Obligatory expenditures, total:	22.8	54.2	44.7	46.2	43.3	43.4

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[cont.]

[cont.]

Table 6.1 TENTATIVE BUDGET FOR 1987 - 1991.

Year	1986	1987	1988	1989	1990	1991
New voluntary programs:						
PSDE (2%)	1.2	8.7	11.2	9.7	9.7	9.7
ASTP-3 (2%)			1.8	1.5	1.6	
TPP (2%)		0.6	0.6	0.6	0.6	0.5
In orbitdemonstration (o.5%)			1.2	2.1	1.4	
New telecommunication programs (DRS, 1%)	0.3	0.5	1.1	1.6	7.3	10.3
Telecommunication programs, total:	1.5	9.8	15.9	15.5	20.6	20.5
EOPP (1.7%)	0.8	1.4	1.4	1.4	1.0	
ERS-2 (1.7%)		2.5	3.8	5.1	4.8	4.2
Adv. polar orbit EO mission (1.7%)				1.9	5.8	6.1
New remote sensing programs			0.6	3.8	5.1	6.0
Remote sensing programs, total:	0.8	3.9	5.8	12.2	16.7	16.3
Technol. demonstration, phase 2, (1%)			0.5	0.6	1.4	1.4
ARIANE 5 and HM-60 PP (0.5%)	3.1	4.7				
ARIANE 5 (1%)		5.6	21.8	25.7	26.6	24.0
HERMES PP (0.5%)		0.4	0.7	1.4	1.7	
New payload missile program						5.0
Payload missile program, total:	3.1	10.7	22.5	27.1	28.3	29.0
COLUMBUS (0.75%)		10.3	15.4	15.4	15.4	15.4
Microgravity, phase 2 (0.5%)	1.1	1.6	1.5	0.3		
Microgravity, phase 3 (0.5%)			1.4	2.4	2.8	2.8
Microgracity programs, total:	1.1	1.6	2.9	2.7	2.8	2.8
New voluntary programs, total:	6.5	36.3	63.0	73.5	84.9	85.4
Sum total for ESA:	29.3	90.5	107.7	119.7	128.5	128.8
Supplementary programs:						
Basic research		4.4	4.8	5.4	6.0	6.8
Technology and product development	4.0[1)]	17.6	19.2	21.6	24.0	27.2
Supplmentary programs, total:	4.0	22.0	24.0	27.0	30.0	34.0

[1)] Means allocated to NTNF via the budget of the Dept. of Industry. These funds are earmarked for supplmentary programs.

[cont.]

[cont.]

TABLE 6.2 TENTATIVE BUDGET FOR 1987 - 1991.

Year	1986	1987	1988	1989	1990	1991
Infrastructure:						
The Norwegian Space Center	4.4[1)]	8.0	10.0	12.0	13.0	14.0
Tromsoe Remote Sensing Sta.	4.0	4.0	4.0	4.0	4.0	4.0
Andoeya Launch Site	1.6	2.0	2.0	2.0	2.0	2.0
Infrastructure, total:	10.0	14.0	16.0	18.0	19.0	20.0
National activities, total	14.0	36.0	40.0	45.0	49.0	54.0
Sum total for space activities:	43.3	126.5	147.7	164.7	177.2	182.8

1) At present the NTNF, Department for space activities.

6.3 ESTIMATES

The present proposition indicates a total contribution of ca. 180 mill. /53
N. Crowns by 1991. About 70% of this amount will be used through ESA. The obligatory portion for the ESA programs will amount to ca. 23% of the total contribution, while the voluntary programs will be covered by the remainder, i.e., ca. 47%. According to the opinion of the committee, this is a sensible distribution, valid for the introductory stage.

In addition the committee wants to emphasize that other joint ventures, e.g., together with Sweden, the U.S.A. and Canada, can become actual during the period in question. In this connection the committee has pointed out that such suggestions must be evaluated on an ad-hoc basis and must be interesting either from a commercial point of view or provide such cost-effective solutions for our institutions that the expenditures can be defended.

In the proposition covering the period up until 1991, conditional priority has been given to telecommunication and remote sensing. Special emphasis should be placed on participation in the "Payload and Spacecraft Development and Experiments", the PSDE. If in that case opportunities arise for a particularly interesting participation by the industries, a higher priority rank should be considered.

Chapter 7

ORGANIZATION OF THE NORWEGIAN SPACE ACTIVITIES

7.1 CHARACTERISTICS

As we have seen, the space activities were at the beginning motivated /54
both from a military as well as a prestige point of view with basic research as a legitimizing side-effect. At present the space activities continue to be of great military importance but are, outside the Great Powers, in general motivated from a civilian interest. They have acquired an importance spanning over a wide spectrum of the society. The research element is unique and of considerable value but requires only 10 to 20% of the resources allocated. It is the application within communication, remote sensing, navigation, rescue systems, space transport and the space-based infrastructure which mainly warrant the enormous expenditures. The space activities, including the ground-based as well as the space-based segments, have contributed to the development of new technology, new industrial enterprises and new services. Space activities are an important sector within the economic life of the industrialized society and they grow by more than 10% annually.

A characteristic trait of the space activities is that the application thereof spans right across the traditional division of the activities within our society. This concerns, - as discussed, among others, in Norges Offentlige Utredninger 1983:4 in connection with remote sensing by satellites, - practically all the departments of our country and will gradually acquire a more dominating position. Communication satellites of various kinds are already at the center of the activities within the Department of Communications as well as the Norwegian Broadcasting Department. Every application, including those concerning purely basic research, create opportunities for interesting industrial engagements in the future; this means, of course, the Department of Industry. The scope of the problems created by the space activities is therefore unique and ranges from intricate new problem situations involving international jurisdiction to concrete industrial problem situations of great complexity and long-term prospects. A future form of organization must encompass the whole range of these problem situations.

Another characteristic of the space activities is that the unit cost per system is very high from the traditional point of view at the same time as the capacity and the area covered must be viewed from a global perspective. This means that the smaller nations must look for solutions through cooperation. Such a cooperation must be dealt with under a superstructure of agreements, worked out by governments.

The time constants in relation to space projects are long, frequently more than 10 years. At the same time, decisions of far-reaching proportions must often be speedily made. Dynamics as well as long-range policies are characteristic traits which affect the form of organization.

7.2 EXPERIENCES GAINED IN OTHER COUNTRIES

It is evident from Chapter 3 that many nations work, - just like Norway, - toward a purposeful form of organization in connection with their space activities. Within the civilian sector the activities started in the form of research and one or more research councils acquired, naturally, a central position at the managerial and financial level. When, gradually, the applied and the industrial aspects became dominating, it was evident that the activities must be managed and coordinated at a higher level, covering the entire range of the problem situations and concerned with the total scope in addition to having the executive power.

The major nations have united the activities under departments of technology or national directorates (agencies). The smaller nations have looked for guidance and coordination under a highly placed committee, responsible to the government for the budget as well.

A characteristic statement, encompassing experiences from many countries, was made by Mr. Geoffrey Pattie, Minister of State for Industry and Information Technology in Great Britain, in January of 1985:

"In establishing the British National Space Center we have recognized the need for a longer term space policy and one which accepts that the dividing line between basic science and applications can often be rather arbitrary. Hitherto the responsibility for space has been scattered around Government

departments, academic institutions and industry and there is clearly a need for a much sharper focus for Britain's space effort. It was also obvious that the range of applications would be likely to multiply especially in the field of earth observation and remote sensing."

In general the experience seems to be that the coordinating organ must /55
be responsible for the budget in order to have the authority to give priority and assure a concentration of the efforts at a sensible treshold level.

Among the minor nations, the Swedish model has attracted international interest. It consists of a "Space Delegation", subordinated to the Government as a guiding and coordinating organ, and a "Space Company" functioning as the executive organ. Both keep an intimate contact with research councils and departments but do not replace these.

7.3 EXPERIENCES WITHIN NORWAY

The initiative toward Norwegian space activities was taken in the 1950's by the Research Institute of the Armed Forces (FFI) and was concentrated around cosmic/geophysical investigations of the upper atmosphere. Research was conducted, among others, with missiles and in this connection the Andoeya launch site was established in 1962. Teams from the University of Oslo, the University of Bergen and the Chr. Michelsen's Institute took part in the work. The responsibility for the coordination of the resarch activities was gradually assumed by the Norwegian Technical and Scientific Research Council (NTNF) and during the period 1960 - 65, the activites were coordinated by a committee for Space Research. When ESRO was established in 1964, the relations with that organization were excellent in spite of the fact that Norway was not a member.

The Tromsoe Remote-Sensing Station was established in 1966 and operated five of the ESRO satellites (i.e., ESRO-1A and 1B, ESRO-2, ESRO-4 and TD-1).

In addition, the NTNF Department of Space Activities (NTNFR) was responsible on behalf of ESRO for the construction and operation of the Kongsfjord Remote Sensing Station at Aalesund during 1966-74.

When ESRO abandoned the missile research program, i.e.,"the ESRANGE

Special Project" was established in 1972. Several European nations made an agreement with ESRO and Sweden concerning access to ESRANGE and the launch sites at Kiruna (Sweden) and Andoeya (Norway). The Norwegian participation was assured through a bilateral agreement with Sweden. This agreement has been prolonged twice and the present one secures considerable funds for the operation of the launch sites until the end of 1990.

At the middle of the 1960's, the importance of a practical application of the space activities became more obvious. This resulted in that the NTNF in 1965 changed its advisory structure for the activities so that the "Committee for Space Activities" was established. This committee had representatives from the Department of Foreign Affairs and the Post and Telegraph Department. It operated through subcommittees for scientific and applied research, respectively. A number of applied projects were started within the areas of emergency navigation and remote sensing systems. The MARSAT (MAritime SATellite Communications) became the most important project in this connection.

When the importance of the practical application had been grasped by the ESRO countries and ESA had been established in 1975, Norway joined in the voluntary program MAROTS (MARitime Orbiting Test Satellite). This was later renamed MARECS (MARitime European Communications Satellite). That program resulted in two satellites, which at present are included in the INMARSAT system.

In 1982 the NTNF committee structure was changed again and the space activities were then placed under a new "Committee for Electronics and Data Technology". This committee in turn established two program-directorates for space research and technology, and for the practical use of satellites, respectively. During the period since 1982 there has been a distinct lowering of the priority for the area of space research while that of practical application has grown considerably, mainly within the area of remote sensing. In 1981 Norway became an associate member of ESA and during the subsequent years Norway has been a participant in a number of programs such as discussed in Chapter 5. At present Norway is involved with:

- the remote sensing satellite, ERS-1;
- the technology program "Advanced Systems Technology Program" (ASTP);
- the PROSAT telecommunications program for preparing future mobile communication;
- the preparatory telecommunications program, "Telecommunications Preparatory Program" (TPP);
- a minor program concerning information relaying, "APOLLO"; and
- phase B of the COLUMBUS space station program.

Within NTNF all space-related problems are at present handled by the Department for Space Activities (NTNFR). This is almost autonomous but is responsible to one of the four departmental managers, subordinated to an administrative director. The department has the following mandates:

- to direct the daily operation of the Andoeya launch site and the Tromsoe remote sensing station;
- to identify and plan for the most important Research Council (FoU)-tasks together with the committee, the program manager, the economic instances and the official organs as well as to work toward a solution of the problems;
- to contribute toward a development of the total research resources in such a manner that they shall correspond to the tasks within the sector in question;
- to follow the development within space activities abroad and to elucidate the usefulness of Norwegian cooperation, - if feasible, - with other nations; and /56
- to work for an efficient Norwegian participation in international cooperation, among others, within ESA, and for a satisfactory as well as purposeful coordination of the national activities and a purposeful distribution of the commissions on the national research organs and the Norwegian industries.

The changes within the NTNF in 1982 represented a weakening, especially as far as space research was concerned. However, the Department of Industry exhibited a more efficient engagement, using funds ear-marked for new ESA programs and, among others, also for the Tromsoe Remote Sensing Station. In

addition, the Department of Industry took the initiative to the development of TELE-X.

The Norwegian activities in connection with ESA have been budgetted to 33.8 mill. N. Crowns in 1986. Ten million Norwegian Crowns out of public funds are set aside for the Tromsoe Remote Sensing Station. In addition NTNF will use ca. 2.2 mill.of the unrestricted funds for research and 7 mill. for technlogy and for methods toward the utilization of satellites as well as 10 mill. for operating the infrastructure and the Department of Space Activities (NTNFR).

The Norwegian General Science Research Council (NAVF) has at an early stage little interest in space research. Lately, - i.e., from 1980 on, - NAVF has in general assumed a strongly positive attitude toward Norwegian participation in ESA [1]. At present NAVF supports the ESA/NASA projects with ca. 1 mill. N. Crowns. If related activities are included, the sum grows to 3 millions. The NAVF was very active during the establishment of EISCAT. Among others, NAVF established a center for image processing at the University of Oslo. This scientific field is of importance for, among others, remote sensing and astrophysics.

The Research Policy Council has also evaluated and recommended Norwegian membership in ESA [2].

As far as its departmental engagement is concerned, the Post and Telegraph Department assumes a central position because of its participation in INTELSAT, INMARSAT and EUTELSAT as well as its support for Norwegian participation in TELE-X. The three first-mentioned organizations have established their acquisition procedures without any "fair return" principle and so far the Norwegian industry has not made any deliveries to them. However, the Post and Telegraph Department has shown a strong natioanl initiative toward the establishment of ground-based stations and the use of satellites.

When it comes to the participation of other departments in the space policy, a development with rich prospects concerning satellite-operated remote-sensing such as discussed in Norges Offentlige Utredninger 1983:4 has been started. As stated, this is not a question of some individual, dominating applications of remote sensing but it concerns the wide range of

engagement which is decisive although the prospects of maritime surveillance is particularly intriguing. The Norwegian Meteorological Institute will most likely become the main partner together with the "off-shore" industries and the Defense.

In the form of a general evaluation, this committee wants to express that laudable initiatives and enthusiasm have been shown by a number of personalities within many institutions. The NTNF Department of Space Activities was established at an early stage and has represented continuity during the attempt to coordinate Norwegian interests within this field. In the beginning the research interests were dominated by cosmic geophysics. The organiztory model functioned satisfactorily with the "Committee for Space Research" within NTNF as the superior organ. The expanded activities during the middle of the 1960's were tentatively safeguarded by the establichment of the "Committee for Space Activities" within NTNF. This committee was of importance for taking new initiatives and as a coordinating organ also in respect to projects with prospects beyond those of pure research. Thus, e.g., the increased engagement of the Post and Telegraph Department concerning the use of communication satellites was reasonably well handled and it was during this period that the industrial engagement (especially in respect to maritime communication) started to grow.

Due to the new comittee structure within NTNF from 1982 on, the space activities lent in a much more precarious situation, especially as far as cosmic geophysics was concerned, although this continues to be an important scientific field in Norway. The responsibility for that field was moved to the new "Committee for Electronics and Data Technology". Suggestions for projects will, however, of necessity also include activities somewhat beyond the scope of what that comittee considers its area of competency and responsibility. A desire was expressed at an early stage that a portion of the activities should be transferred to NAVF. However, an elucidation of the relationship between NAVF and NTNF has constantly been postponed while waiting for a high-level evaluation of the organization of Norwegian space activities.

Thus, the distribution of responsibility between these two councils continues to be unsettled. It seems also doubtful whether a definite division

of roles could have been made; experience shows that it is necessary to evaluate all the individual projects simultaneously, - and not try to split them up into basic and applied research. This is valid not only for cosmic geophysics and astrophysics but also for a number of projects concerning telemetry. A future model of organization must preserve the need for such an over-all evaluation.

It is the opinion of the comittee that the entire activity has now outgrown the existing pattern of organization both in scope and importance. In the present situation it is a question of activities which far exceed what can be easily coordinated and directed by a research council (being the strategic organ).

At present there is no development of any central objectives or a co- /57
ordinated issuing of priorities on the basis of a total aspect, where widespread public interests must be taken into consideration simultaneously with a concerted effort made toward utilizing the economic-political opportunities in respect to services and deliveries. The assignment of responsibilities between NAVF and NTNF remains obscure. A conscientious application of the new opportunities such as a membership in ESA will open up demands in the opinion of our committee a more distinct and stronger organization, including elements for the development of proposals concerning the space policy vis-à-vis the authorities. Necessary firmness and authority are required for the executive functions and there must, not least, exist executive power to act and to make the desicions necessary quickly and efficiently.

7.4 PROPOSAL FOR A NEW STRUCTURE

It is the opinion of this committee that Norwegian space activities must in general be directed by a central organ, responsible to the Government for programs and budget and with executive repsonsibility below the governmental level vis-a-vis international organs (among others, ESA) as well as national agents for research and industry. The major consumer departments such as the Post and Telegraph Department and the Norwegian Meteorological Institute, the Department of Defense and others, should themselves program and budget

their participation in international organizations and take the initiative within their own areas toward developmental tasks and national investments. However, the central organ should have advisory responsibility for the indutrial participation on the basis of the rights and opportunities, which an international cooperation can make feasible.

The research councils, mainly NAVF and NTNF, should be utilized by the central organ within their own areas of responsibility so that synergy vis-a-vis related fields can be realized.

In principle that question is of importance whether the central organ should be associated with the Office of the Prime Minister (like in many other nations) or with a special department. This committee accepts the fact that it is not traditional to link organs of the type in question to the Office of the Prime Minister and suggests, therefore, that the central organ shall be placed under the Department of Industry, which is the one most intimately concerned because of the present wide range of interests on behalf of the economic life. The organization proposed will therefore in principle have a structure such as the one illustrated in Fig. 7.1.

The comittee suggests that the Central Comittee for Norwegian Space Activities shall consist of 7 persons, appointed by the Government. It is presumed that persons with acknowledged competency and integrity shall be selected. One of them should be named according to suggestions from the NAVF, one according to proposals from the NTNF and one on the recommendation of the Post and Telegraph Department. Norwegian industrial interests must also be represented. The director shall be appointed by the Department of Industry and he should have executive powers.

The Central Comittee for Norwegian Space Activities shall be responsible for the budget to the Government via the Department of Industry and shall control the total range of resources put at its disposal by the authorities for the internal Norwegian activities. A portion of the supplementary funds shall be used on a general basis for research and promotion of technical development, shall be channeled through the NAVF or NTNF, respectively, and shall be allocated by them according to the conventional criteria used by these councils. It is assumed that the research councils

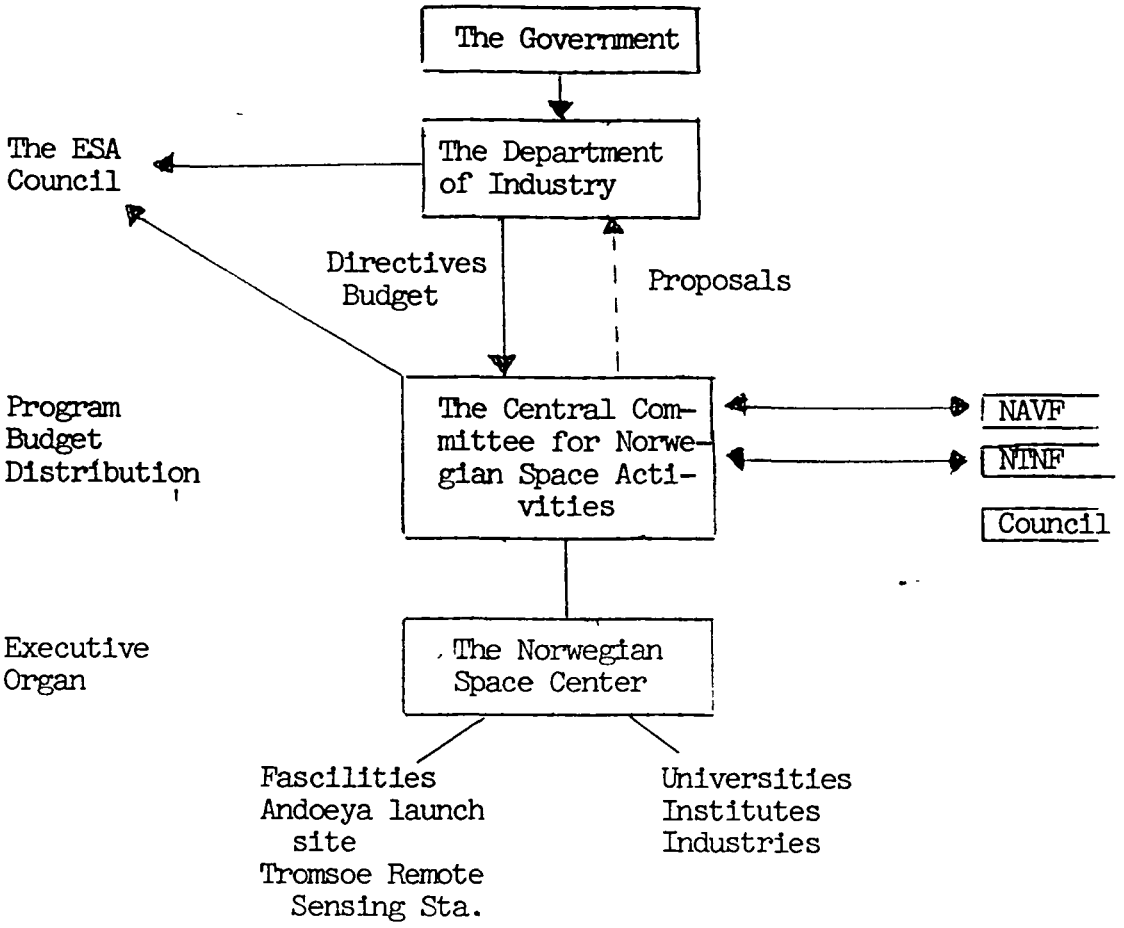

Fig. 7.1. Proposal for an organization of the space activities in Norway.

shall continue as usually to support the space-related projects not included in the ESA program, while using their own means. The committee considers it important that a relationship, free of friction, shall be established with the NTNF and the NAVF. The remainder of the supplementary funds shall be channeled through the executive organs of the participating institutions or shall be prepared for participation in ESA projects or projects together with other partners. The funds for national organs and fascilities shall be channeles through the executive organ concerned.

At least during the initial stage the executive organ shall manage the secreterial duties of the Central Committee for Norwegian Space Activities by selecting the secretary of the committee and by executing the preparative functions according to specific agreement.

The executive organ, - to be called, for instance, the Norwegian Space Center, - shall be organized as a foundation with a director, an institute manager and a staff. The committee is aware of the fact that a form of /58
company (the Space Company) has been chosen in Sweden but considers that, as far as Norway is concerned, a foundation organized in accordance with the needs of a commercial foundation fits better into the total picture. The task concerning the disengagement of the NTNFR has been fulfilled and this department will now be included in the foundation. It is assumed that the executive organ shall develop knowledge in depth and an understanding of the system. In addition this organ shall have executive responsibility for the completion of active programs and for the operation of the fascilities. It should, among others, have an office for research, industrial activities and for the infrastructure.

It is assumed that the present Department of Space Activities within NTNF (i.e., NTNFR) shall be part of the new organization.

Figure 7.1 illustrates only the purely principal organization without any links to departments or various levels of the ESA. Figure 7.2 furnishes a fuller but still not complete picture of the most important lines of communication.

It is important to make it clear that it is not a question of establishing a new research council or an organ which shall take over the duties at present intended for the established structure of research councils and independent institutes. It is assumed that the Central Committee shall utilize the research councils within their own, traditional areas of responsibility. The research councils shall, in addition, provide professional advice and give support to the scientific and technical areas oriented toward the space field without themselves being participants in the programs established according to the plans defined by the Central Committee.

The committee wants to emphasize that the Central Committee for Norwegian Space Activities shall be composed so that there is a willingness and a capacity for assigning priority and for insisting on a fair return for the Norwegian areas. In addition the executive organ shall have authority to assure the necessary concentration of and active inclusion of Norwegian

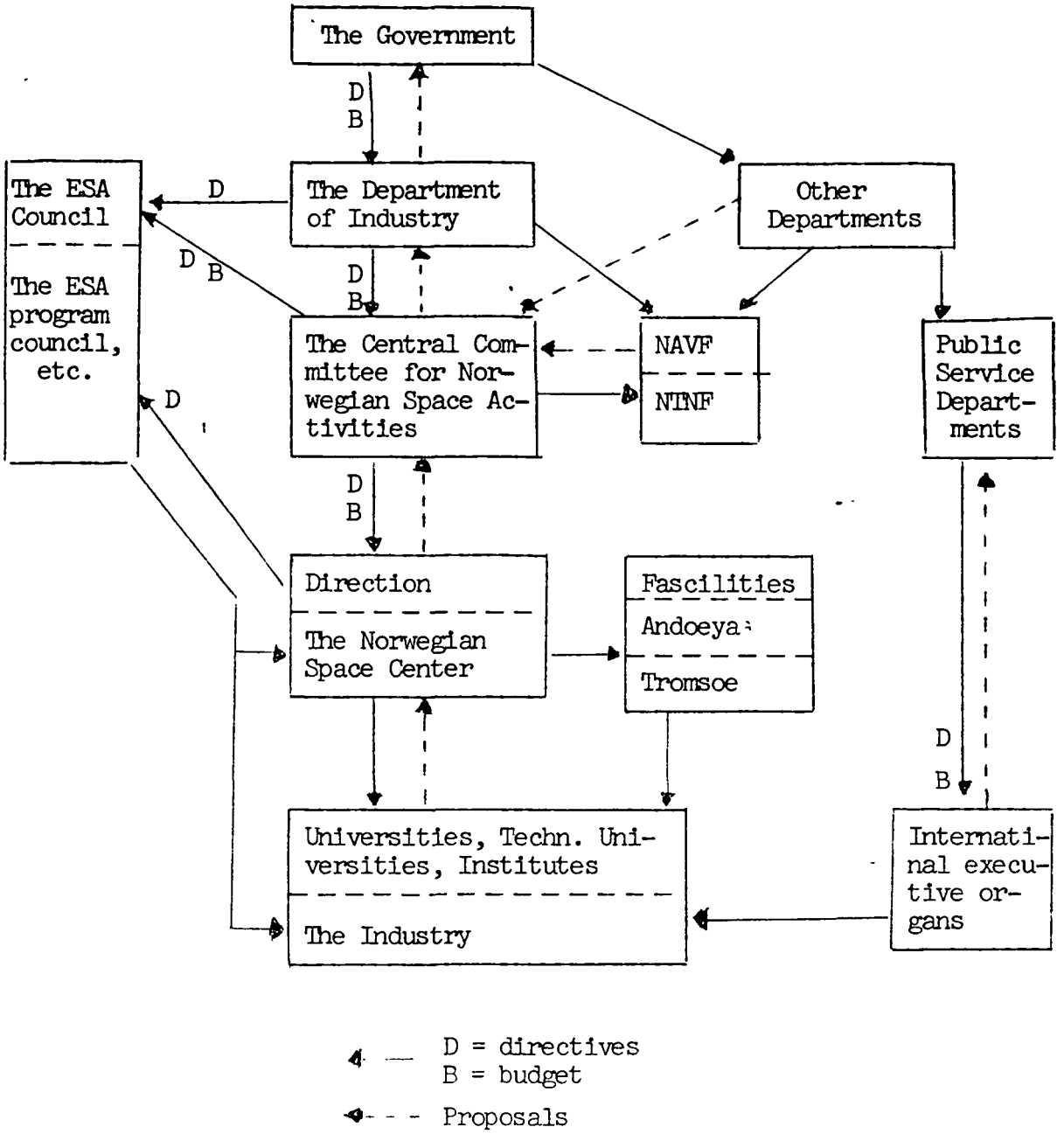

Fig. 7.2. Proposal for an organization and its lines of communication.

industries. Norwegian representatives must be oriented before international meetings and shall have to bring back a report. They must be instructed in the fact that they represent Norway and not their own department or company (or themselves). A transfer of technology on the widest possible basis shall

be strived for. This can most satisfactorily be accomplished through a wide-ranging engagement on behalf of the industries.

7.5 OUTLINES FOR THE DISTRIBUTION OF RESPONSIBILITIES AND DUTIES

The Central Committee such as proposed for the Norwegian space activities shall first and foremost be given a direction and a composition providing it with authority for deciding the conditions of responsibility and the distribution of duties within an area, where the delegation of responsibility and the scattering of the areas concerned are large. It is self-evident that the Central Committee shall have subcommittes for research and industry, including applications thereof. Both NAVF and NTNF must be represented in the research subcommittee.

The main duties of the Central Committee should, for instance, comprise:

- drafting of prospective analyses;
- proposing long-term plans to the Government via the Department of Industry;
- drafting budget proposals;
- establishing work programs and delegating duties on the basis of a fixed budget;
- contacting all public service departments which engage in or utilize space technology and keeping them informed;
- keeping in contact and entering into general cooperative agreements with international and national space organizations, especially with ESA;
- drafting the annual executive instructions to the executive organ (i.e., the Norwegian Space Center); and
- supervising that the presedent instructions of the Government and the Department of Industries are followed and, especially, that the interests of the economy are consistently and forcefully satisfied.

As mentioned above, it is self-evident that the executive organ shall manage the secretarial duties during the initial stages of the Central Committee for Norwegian Space Activities.

As far as the area of responsibility and the organization of the executive organ are concerned, the following main duties shall be decisive:

- identifying and proposing the most important research and development tasks suited for a wide-ranging national and international cooperation;
- initiating, following up and reporting on the results concerning programs which the Central Committee has included in its budget; /59
- contributing through information and supplementary funds to institutes and industries so that they can be prepared for participation in the international cooperation;
- establishing contact with other space organizations and making agreements about cooperation concerning projects within the superstructure;
- participating as needed in the ESA choice of programs and in its advisory council;
- providing information to the Norwegian area about future space projects and arranging contacts with foreign space-related areas;
- coordinating the cooperation between research and industry, where this is self-evident;
- conducting surveys in connection with major space projects;
- building up competency within areas of importance, which cannot be done more effectively within the areas existing;
- furnishing proposals for the expansion of a new infrastructure in Norway and assuming responsibility for a further expansion, possibly occurring;
- guiding the operations of infrastructures, subordinated to the executive organ; these consist at present of the Andoeya launch site and the Tromsoe Remote Sensing Station; and
- accepting commissions paid for by the industry, the public service departments and the institutions within the space activities and associated activities where this can result in a favorable utilization of the resources.

It is considered selfevident that the executive organ, i.e., the Norwegian Space Center, shall be established in the form of a foundation, led by a director. From an administrative point of view the institute shall have a manager of the institute and/or an executive manager as well as a staff.

In particular there should be an office for the research activities, another for contact and cooperation with the Norwegian industry and one for the infrastructures. The foundation should gradually be able to accept commissions from the industries as well as contributions for the services rendered. In other respects we refer to the Swedish regulation stipulating "fair return" from the contracts with ESA; cf. section 5.6.

In respect to the responsibility of the executive organ for the infrastructural installations, a pragmatic attitude must be assumed concerning the choice of an organiztorial model. In some cases the form of a foundation can be acceptable as, for instance, in the case of the Tromsoe Remote Sensing Station. It must, however, be assured that the total aspect shall have decisive power as far as the delegation of duties is concerned.

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Chapter 8

REVIEW

A committee was appointed according to Royal Decree on July 26, 1985, /60
with instructions to draw up the main outlines for a Norwegian space policy up until year 2000, including a proposal for an actual plan of action for space-related activities during the period 1986 - 1990.

The committee delivered its unanimous judgement in January, 1986.

Chapter 1 discusses the prospectives for the development within the field of space activities. Initially, military and prestigious conditions

were central. Gradually research aspects, prospects for civilian utilization and the industrial interests contributed to forming a sound and realistic basis for the space activities. These have now reached considerable dimensions internationally with a constant trend toward socially effective applications. Matters which, initially, were purely governmental have during the last couple of years to an increasing extent become commercialized and have been given over to private interests.

Chapter 2 furnishes a review of the "European Sapce Agency" (ESA) of which Norway shall become a fullfledged member on January 1st, 1987. ESA was established in its present form in 1975 by uniting the already existing organizations of ESRO and ELDO. The present organization is established as a convention with a council, a committee structure, a general director and 8 directorates. The budget amounted in 1985 to ca. 6 bill. N. Crowns and an increase by 70% has in principle been accepted for the period 1986 - 1990. The general activities and the scientific program are obligatory for the member nations. These amount to ca. 30% of the total. The rest of the program is voluntary, each country participating according to its own wishes although in a certain balance in respect to other interests (à la carte, variable geometry, etc.).

ESA practices the principle of "fair return", i.e., the individual countries can largely expect that 70% of their contribution to ESA will be returned in the form of orders for goods or services at a high technical level. The long-term programs of ESA are illustrated in Fig. 2.3 and in Table 2.1.

Chapter 3 furnishes a review of international, regional and national space organizations. It is characteristic for the entire space activities that they concern every country and that within each individual country they are of importance for most of the sectors within the society.

The launching of the first SPUTNIK in 1957 led to a discussion concerning the international aspects in the United Nations with emphasis on efforts to prevent a militarization of space. Later on, a number of international consumer organizations were formed, especially within the telecummunications area (INTELSAT, INMARSAT, etc.).

Regional organizations were also established. ESA is the most outstanding example but EUTELSAT and EUMETSAT belong also to this category.

National organizations of various kinds have been established within the individual countries in order to utilize the wide range of space activities existing. Three main patterns can be identified:

- space activities placed under a research and development department (such as in West Germany);
- space activities placed under a powerful and authoritative directorate (such as NASA, CNES, etc.); and
- space activities directed by an interdepartmental, coordinating organ of considerable status and authority (such as in Sweden, Japan and Canada.

On the whole the main problems are connected with the facts that the space activities span within modern society over the areas of responsibility belonging to all traditional departments and that they have developed into something considerably more than research.

Chapter 4 discusses on a general basis the Norwegian interests and the criteria for priority within the field of space activities. It is necessary to procede from the fact that Norway has limited resources in relation to the total international contribution. We must try to devote the individual contributions to areas of priority but otherwise strive toward a wide-ranging transfer of knowledge to institutions and industries. Norway has definite scientific interests in some areas of priority within ESA. Norwegian technological areas, especially those concerning information technology, have much to learn. The space field has opened up a new and interesting market both in relation to the space element and to the ground-based element. Norway is already well established within the latter area. The field which appears to be growing fastest is satellite services of various kinds. Initially tele-services will dominate but various forms of remote sensing will by and by supplement or replace the methods already existing within geo-technology, including maritime surveillance and meteorology.

Chapter 5 aims at outlining the main area and dimensions of the Norwegian engagement up until year 2000. The committee has found it purposeful to take /61
the sober attitude that, by year 2000, Norway shall have standardized its participation in ESA. ESA will be the mainstay of the Norwegian space engagement. This means that our membership in ESA by year 2000 will amount to ca. 150 mill. N. Crowns per year. (All figures are based on the economic condition of 1985.) In addition experience from other countries shows that supplementary funds will be required for making it feasible for Norwegian interests to participate. The level of supplementary funds should, according to the opinion of the committee, be built up to 40 mill. N. Crowns annually by year 2000. It is also necessary to count with an expansion of the infrastructure (missile launching sites, relay stations and the managing infrastructure). The committee assumes that this will require 30 mill. N. Crowns annually by year 2000.

The committee therefore proposes that until year 2000 an activity requiring ca. 220 mill. N. Crowns annually must be built up. Out of this amount ca. 70% shall be used through ESA as a consequence of our membership there.

As far as the scientific priority is concerned the Norwegian participation in the science program will be dominated by the Norwegian traditions of geophysics and astrophysics but will involve new and exciting instrumentation.

Within the technical programs conditional priority will be given to tele-technology and remote sensing. In its report the Committee emphasizes the importance of the experiences and the knowledge which can be gained internationally and be transferred to the Norwegian areas. The committee views this as a condition for taking full advantage of the membership in ESA.

Chapter 6 furnishes a detailed breakdown of the program proposed by the committee for the period 1986 - 1991, including cost limits. The committee points out the fact that because of the late start our country must " jump on board a train running at full speed." This requires a rapid build-up of the efforts for catching up. A detailed program is proposed and presented in section 6.2. Together with complementary programs and funds for infrastructures this will require a total of 126.5 mill N. Crowns in 1987, increasing to 182.8 mill. in 1991.

Chapter 7 deals with administrative problems. The committee states that the activities have already at present outgrown the existing, discordant pattern of organization and suggests a new organ, - the Central Committee for Norwegian Sapce Activities, - placed under the Government and with responsibilities for the budget and the programs to this superior authority. An executive organ under the Central Committee, - the Norwegian Space Center, - is also proposed. These suggestions are based on experiences gained in other nations which have led to corresponding organizatorial forms. The committee assumes that the presently existing Department of Space Activities within NTNF shall be included in the Norwegian Space Center. In this chapter the committee emphasizes also the fact that the organs established must be staffed with competent and dynamic personalities. Norwegian representatives with international duties must be carefully and soberly selected. This is a condition for that Norway shall be able to make its voice heard and that interesting commissions shall be channeled to Norwegian areas and industries.

In its report the committee also emphasizes that membership in ESA represents something new within Norwegian research and the development of its economic life. ESA is one of the technological locomotors in Europe and the only one with which Norway is associated. Norway must go along with full force and take full advantage of the consequences of this action.

APPENDIX 2

ESA, A SKETCH OF ITS FUNCTIONS

In Chapter 2 the interest was concentrated mainly around the administrative structure of ESA, its program elements, etc. In this appendix the interest will be directed toward a description of ESA from the point of view of function and operation. The objective is to find an answer to questions concerning: /66

- how the decisive process operates within the ESA science program;
- how ESA plans and executes the development of the kind of technology for which this organization has a need;
- how the research and development institutes and the industries can cooperate in and affect the process of technological development; and
- the nature of the industrial policy of ESA and how the business relationship between ESA and the industries as well as the research and development institutes operates.

1. THE DECISIVE PROCESS WITHIN THE ESA SCIENCE PROGRAM

The choice of projects for the ESA science program is delegated to a "Science Program Committee" (SPC; cf. Fig. 2.1), where the member nations are represented by delegates, well qualified from a scientific point of view. In practice most of the decisions are made on a scientific basis by a lower-level committee (the "Space Science Advisory Committee" SSAC) following preliminary scrutiny by one of two subordinate working groups, the "Astronomy Working Group" (AWG) or the "Solar System Working Group" (SSWG). Mutual priority is given by both these working groups to project proposals concerning either the solar system or the astronomy field. The project proposals from the working groups are then ranked by the advisory committee (the SSAC), which recommends the proposals of the scientific program committee on the basis of scientific importance, cost limits, etc.

The Solar System Working Group consists at present of 16 members, whereof 4 from each of the scientific fields of geophysics, spatial plasma physics,

planetary science and solar physics. The Astronomy Working Group has at present 14 members and studies all project proposals concerning astronomy where the study object lies outside the solar system. The members of a working group are elected (for a period of 3 years) by the Director of the Science Program on the basis of suggestions from the working groups themselves in respect to half the number of the new members. The advisory committee, the SSAC, which has 7 members, is appointed by the Director General following suggestions from the Director of the Science Program. This one is supposed to base his proposals on consultations with the science committee. The choice of scientists depends more on their general competency within their field of specialization than on their contribution to special space projects. The opportunity for Norwegian scientists to become members depends mainly on their competence and international reputation but is also to some extent dependent on manipulations made from the Norwegian side.

A project proposal for the ESA Science Program shall contain a description of the objectives of the project, the methods to be used and the plausibility of its completion. ESA adheres to the policy that scientific instrumentation shall as a rule be financed by national funds, while the expenses for the satellite, the remote sensing, etc., shall be budgetted by ESA. The plausibility of completing a project is directly dependent on the access to national research funds. Frequently, several research teams unite aound some experiments. When evaluating the project proposals, the working groups and the advisory committee will consider both the scientific merit and the probability that the research team(s) shall be able to complete the project.

During the ministerial conference in Rome, Italy, in January 1985, the long-term plan (for 1986 - 2004) for the Science Program was accepted. This means that the budget for this program will be increase by 5% annually during the next couple of years. The completion of this plan means that four main areas of effort have already been selected (cf. 2.3.1). Thus, it will, for instance, be decided in 1986 whether the projects called SOHO and CLUSTER shall together become the main area devoted to solar- and geophysics.

This description of the decisive process within the ESA Science Program can serve as an example of how the decisive process operates also within the other program areas (e.g., telecommunication, etc.).

2. DEVELOPMENT OF TECHNOLOGY AND THE INDUSTRIAL POLICY OF ESA

2.1 The Idea and Prospective Stage

The prospectives which form the basis for the strategy and objectives of ESA concerning the programs for technological development are worked out and updated, among others, in joint collaboration with a number of advisory committees. These express their views about what kind of program objectives ESA should have on the basis of the development expected within the various fields of technology and application. Of importance here are the advisory committees of telecommunication (the "Telecommunications Advisory Committee", TAC) and of remote sensing (the "Remote Sensing Advisory Committee", RSAC). The members of the advisory committees are individually selected and represent different fields of technology and application. /67

2.2 Technological Development

The basic and long-term development of a technology occurs within ESA via the so-called Technology Programs.

The main objective of the technology programs is to assure an effective long-term and systematic technological preparation for future space projects and, in addition, that this shall be done on the basis of a joint European industrial policy oriented toward making Europe able to compete on the global market. The activities of ESA shall harmonize also with national, technological developmental programs in order to achieve a more effective utilization of the resources.

Specifically, the objectives of the technical programs can be said to be:

- to assure that the technology necessary for completing the scientific and practical programs shall be available at the correct point in time;
- to look for cost-effective solutions in combination with an effort toward standardization of products and lines of products (this is particularly necessary for qualifying products and lines of products for the space segment);

- to maintain a high standard of competency within the European space industry as a basis for its ability to compete on the global market; this means that this strategy shall also take important projects outside ESA into consideration (such as, e.g., the plans for INMARSAT); and
- to reduce the dependency of Europe on the U.S.A. as far as components and processes necessary for completing the ESA programs are concerned.

In order to be able to satisfy the demands on the technical development within ESA such as listed, the following programs have been initiated:

- The Basic Technology Research Program (Basic TRP): This aims toward development of the technical standard within areas common to many or all of the program activities during the near future (typically spanning 8 - 10 years). The areas are selected against a background of predicted future needs for the space program activities both inside and outside ESA. The development shall be pursued up to a point where the feasibility of the technology can be demonstrated by investigating studies, drafts for construction, development of critical components and the construction of laboratory models. /68

  This program is financed by the obligatory budget. All member nations must therefore contribute to it.

- The Preparatory and Supporting Technology Program (STP): This one aims at further developing the technology, frequently on the basis of the "Basic TRP" where the feasibility of the technology was tested and up to a point where it can be demonstrated that the technology, adapted to the needs of the scientific and practical program concerned, can be applied (i.e., "flight worthiness" in the case of the construction of a primary prototype). There is one such technical program for each of the major ESA programs. As example we can mention: the"Earth Observation Preparatory Program" (EOPP), the "Telecommunications Preparatory Programs" (TPP and ASTP) and the program supporting the space station program (the "COLUMBUS Supporting Technology Program"). The EOPP is under preparation.

  These are all voluntary programs.

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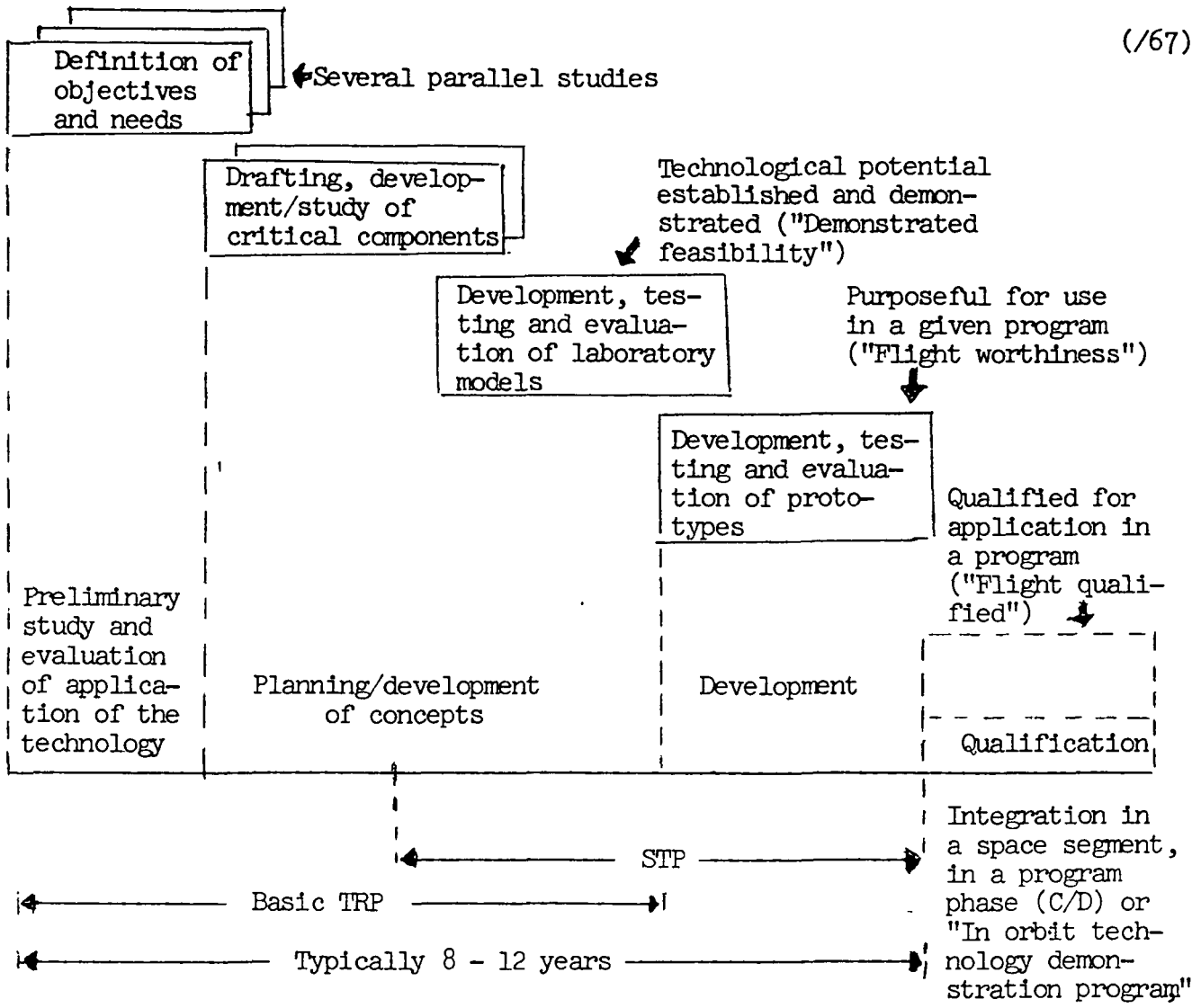

Fig. 1. The methodology for the ESA technological - developmental work.

- The "In Orbit Technological Research Program ("In Orbit TRP): Its purpose is to systematically present opportunities for demonstrating and veryfying new technology on board a satellite in orbit (or before that) in order to be able to apply the new technology for the developmental and constructive phases (i.e., the C and D phases) of a main program.

Technology programs of this type have not yet been started by ESA but proposals from the administration of ESA for such programs exist.

Figure 1 summarizes what has been stated above.

This strategy means that ESA is responsible for promoting the development of a technology which at present is relatively far removed from commercial application up to a point where its use could become of interest mainly for the industries which have participated in the process and, thus, have built up competency and an ability to compete.

The ESA strategy for development of technology has a prospective typically spanning over a time period of 10 years in respect to the application of the new technology within the actual space projects inside and outside the regimen of ESA. From the financial point of view the activities within the technological programs are modest, especially during the earliest stages. The contracts can in this case amount to some 300,000 to 2 mill. N. Crowns. It should be emphasized that these activities are quite central concerning the development of competency in respect to the European technology and its ability to compete.

ESA conducts by itself relatively small-scale research and development activity. The technical development is administered and supervised by ESA but is produced by the industries and the resarch and development institutes according to the ESA contracts. In respect to the prospects of the technological programs it is evident from this additional premise that the technical development shall to a major extent take place within a commercial environment and that the build-up of competency shall occur within the industries. The industries should, consequently, be oriented toward the special technology programs if they desire to take part in the technical research and developmental activities, initiated and financed by ESA. The most intense developmental activity concerning the technology needed for the technological programs occurs, thus, within the industrial and research and developmental areas. The national program activities within the individual member nations must also be worked out so that they become aligned with the ESA strategy concerning technical development.

In respect to the formation of a policy for the Norwegian space industry it is necessary to plan for national areas of effort and the use of effective means against the background of the systematic and long-term strategy of ESA concerning the development of technology. It is quite possible to find

niches for new members in ESA, especially where this organization wishes to build up competition within areas where, at present, the U.S.A. dominates.

The technical development of ESA is administered and supervised by the ESTEC. Cf. also Fig. 2.1.

ESTEC published annually a so-called "Blue Book" which is the central reference document concerning the strategy of the technological development within ESA. Norwegian industries, wishing to become engaged in ESA activities, should first and foremost acquaint themselves with ESTEC and its "Blue Book".

2.3 THE ESA INDUSTRIAL POLICY AND THE EUROPEAN SPACE INDUSTRY

ESA adheres to and practices the principle of "fair return": the industrial and research environments of a member nation can demand contracts with ESA at a volume relative to the financial contribution which it has made to this organization. Within this framework the distribution of contracts shall as far as possible be made on the basis of the conventional criteria for competition.

Together with the European space-related research and industries ESA has built up an advanced but effective infrastructure in order to be able to practice the principle of "fair return" at the same time as the ability to compete on a global scale is taken into consideration. In this section the attention shall be directed toward the manner in which ESA conducts its business with European research and development interests.

Appraisal, Return Coefficient and Compensation

Since the products purchased by ESA vary in respect to whether they are shelf goods, ordinary technological products or very advanced ones, the /69
various categories are quite differently appraised. Advanced products have a much higher appraisal value than those not advanced. The appraisal value and the value of the contracts furnish together the basis for the quantification of the value of a contract with a member nation and for how much it shall amount to in respect to the return statistics.

The return coefficient is calculated on the basis of the program as one unit. The return coefficient is an expression for the value of those contracts which a member nation has been awarded in a program in relation to what the country should ideally receive. At a return coefficient of 1.0 the principle of "fair return" has been fulfilled. In respect to voluntary programs the contribution of the countries and the total value of the contracts are adjusted so that the return coefficient will be approximately 1.0. In addition, ESA keeps track of the total value of all programs in which the nations participate and calculates a return coefficient for the entire program activity of each country. In the case that the total return coefficient falls below a certain value (e.g., 0.90), special measures are taken (e.g., an opportunity for contracts in programs in which the nation in question does not participate) in order to bring the return coefficient up above a certain level (e.g., 0.95) within a certain period of time (e.g., 3 years).

Types of Contracts

Generally ESA offers four types of contracts:

1. Developmental contracts subordinate to or in connection with an applied or a scientific program. As a rule, these have a contract period of four to six years. The monetary value amounts typically to 600 to 2000 mill. N. Crowns for each contract (i.e., for the entire space project in question). Such contracts are awarded to industrial syndicates within the ESA nations (i.e., to a "prime contractor/ contractors or subcontractors"). The classification reflects the contribution of the participating nations to the program.

From the point of view of the industries, the most important factors are here that they must belong to an industrial syndicate in order to become partner in the contract awarding process as well as that they must have built up proper technical competence and be able to compete.

2. Research and development contracts associated with technology programs. These are typically 1 - 2 year contracts with a contract value of 300,000 to 2 mill. N. Crowns. An important factor in this connection is that the

industry should try to obtain such contracts within special fields and that this often forms the basis for later contracts belonging to major contracts of type 1.

3. Contracts for building up infrastructures and local contracts. These vary considerably in respect to time period and volume.

4. Service contracts. These are multi-annual (as a rule 3 years) contracts amounting to relatively large totals. They are awarded on a competitive basis and therefore it is often difficult to get a foothold within areas where other industries have already become established.

The NTNF, the NAVF and the Export Council have together decided to employ a person whose purpose it shall be to work toward more contracts with ESA and the nuclear physics institute CERN on behalf of the Norwegian industry. As far as ESA is concerned, this work shall be oriented especially toward contracts of types 3 and 4.

Below, especially the contracts belonging to categories 1 and 2 will be discussed.

The Process of Awarding Contracts

Preparations for sending out invitations to tenders among the industries run in parallel with the establishment of the contributions to the voluntary programs.

Several elements are included in the preparation for the invitation to tenders. Technical specifications and the financial framework for the contracts in question must be established. The board or the committee which shall evaluate the offers must be nominated and the criteria for the evaluation must be established.

The purchasing policy used shall be based on the preference for purchases within the member nations participating in the program in question.

In respect to the competitive conditions ESA operates at several levels, from free competition to direct negotiations, - e.g., by offering:

- opportunities for free competition; or
- opportunities for preferred purchases from a member nation, for

instance on the basis of technological specialities available in the country in question or as a consequence of a low total return coefficient.

- opportunities for recommending distribution of the work among industries belonging to several member nations; these can be used, e.g., for encouraging transfer of technology to countries wishing to develop space-related industry and research; and

- opportunities for direct negotiations without inviting to tenders; this is practized only in well defined cases.

At the initial stage and in conventional cases it is standard that the tenders shall be evaluated according to the ordinary criteria for competition (i.e., the most satisfactory price in relation to the technical and administrative solution). It is selfevident that if this shall be feasible, the industrial syndicates, which have established themselves among the ESA countries, must have a membership reflecting the average level of activities within ESA and have a balanced composition of technical competency. As a rule it is in the interest of the syndicates to include new members in order to achieve such a balanced composition. /70

ESA keeps a file concerning companies which are competent and are interested in obtaining information about opportunities for contracts of a detailed and specific nature. Because such information is voluminous and frequently distributed and because the industries are already subjected to a heavy pressure in respect to information, it is important that the information sent to an industry shall be aligned with the competency, interest and capacity of the industry in question. It is a very important task for a national space organization to direct the flow of information between ESA and the industries.

An Invitation to Tender (ITT) is as a rule kept open for 6 to 12 weeks. Thereafter a special board (the Tender Opening Board, TDB) opens and records the tenders and forwards them to the evaluating committee. The entire process, - from the time when the invitations to tender are sent out until the evaluating committee delivers its judgement to the Industrial Policy Commitee (IPC, cf. also Fig. 2.1), - requires 3 to 6 months. Thereafter a period of

contract negotiations and, - in the case of voluntary programs, - adjustment of the contributions follows. During this stage there may also be a certain reevaluation of the judgement of the evaluating committee in respect to the principle of "fair return". The latter is something which all parties must try to avoid; however, for better or worse, it represents a part of the ESA operation tactics.

The Structure of Syndicates Within the European Space Industry

The requirement for more or less firmly structured syndicates within the space-related activities depends, among others, on :

- the need for assuring a geographically balanced distribution of the contracts according to the principle of "fair return"; and
- the need for utilizing specialized competency within the space activities and for avoiding a build-up of costly competence in several countries. This is important because the entire market for space-related supplies is still relatively small.

The number of syndicates, their composition, their internal structure and form of cooperation vary in pace with the organization of European space activities.

In association with the "European Space Research Organization" (ESRO), the industrial syndicates were loosely structured but later on they developed into more formal assemblies with a permanent administration and well-defined procedures for distribution of the duties. At the beginning there were two such syndicates:

- MESH, composed of the MATRA; S.a., France, Entwicklung Ring Nordt (ERNO), West Germany; SAAB, Sweden and Hawker Siddeley (HSD), Great Britain; and

- ESTA, composed of ELLIOT, Great Britain; THOMSON, France; CGE-FIAR, Italy; FOKKER, the Netherlands; and ASEA, Sweden.

The driving force behind this development is, among others, the need for achieving a balanced composition of technical specialities both among the industries themselves and so that the technical specialities are built up in a balanced manner among the member nations as well.

The trend within the development aims at present toward dissolution of the rigid structure of syndicates. Thus, e.g., the contracts for ARIANE and SPACELAB were awarded rather to ad-hoc industrial groups in relation to the contributions to and the functions of the individual member nations within these programs.

As far as the EXOSAT contract is concerned an attempt was made to use a new concept where ESA selected the prime contractors on the basis of their ability to compete and where the subcontractors (also on the basis of ability to compete) were selected jointly by the prime contractors and ESA.

Lately ESA has operated according to a system where contracts at a systems level are awarded on a non-competitive basis but where there is sharp competition at the subsystems/equipment level.

When starting out on the basis of major industrial companies in Europe the situation is at present such that there is:

- one industrial group centered around MESH (MATRA, S.a., Entwicklung Ring Nordt (ESRO), SAAB, British Aerospace (BAe) and AIRITALIA), which specializes in minor telecommunication satellites, remote-sensing satellites and manned space activities (such as SPACELAB);
- another industrial group, moore loosely organized (where DORNIER and British Aerospace,BAe, predominate) which specializes in scientific satellites and cooperation with partners in the U.S.A.;and
- several national and bilateral groups which, for instance, participate in respect to ground stations for telecomminucation.

These groups, originally oriented toward the needs of ESA only, are gradually developing into commercially-oriented, flexible structures with long-term objectives on the global market. A differentiation can also be noticed where the "old" structures are kept together in order to safeguard the needs of ESA ("Fair return", international cooperation) and where the "new" structures are turning toward a global market. The new ones are flexible in order /71
to assure the development of competency and ability to compete as far as Europe is concerned but also to develop cooperation, e.g., with the U.S.A.

This description represents obviously a simplification of the picture and is only intended as a framework for understanding the form of cooperation existing within the European space industry.

In other respect we refer to reference [1] for a review of the development within the European space industry up until 1983.

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N O U

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