JPRS-ELS-88-013
14 APRIL 1988

FOREIGN
BROADCAST
INFORMATION
SERVICE

JPRS Report

Science & Technology

Europe & Latin America

Science & Technology
Europe & Latin America

JPRS-ELS-88-013 — 14 APRIL 1988

CONTENTS

ADVANCED MATERIALS

FRG Achievements in Advanced Materials Research Reported

Description of Latest Achievements

3698m149 Bonn TECHNOLOGIE NACHRICHTEN-PROGRAMM INFORMATION in German No 413, 2 Dec 87 pp 2-10

[Document entitled "Materials Research, Superconductivity, and Thin Film Technology: Results and Development of the Research Sponsorship of the Federal Ministry for Research and Technology (BMFT)"]

[Excerpts]

1. Introduction

The concept of material is presently undergoing fundamental changes that will have far-reaching effects on economic development.

Technical advances and industrial development are often only possible if the necessary materials are available. There are numerous examples of the key role played by new materials, for example in aircraft construction, propulsion technology, mechanical engineering, and in electronics in particular. Therefore the application of new and improved materials in a competitive market has become an urgent necessity for both individual companies and national economies. Improved or new materials can help to reinforce existing markets or pave the way for new ones.

The development of new materials with outstanding qualities specially adapted to individual applications creates new opportunities and helps to solve urgent problems in our society, for example in the fields of environmental protection, energy technology, or in the substitution of scarce raw materials.

BMFT support of research in the field of materials development should improve the competitiveness of companies in the materials technology sector so that FRG research and trade can achieve a strong position internationally and make better use of its own capabilities.

The main objective of this support is to ensure that the results of basic research are rapidly transferred to industrial applications. This is achieved by mobilizing the scientific and technological potential of researchers in scientific institutes to cooperate with industry to realize selected R&D objectives.

This report provides some examples of the initial results of subsidies granted to date and draws attention to recent developments and projects supported by the BMFT.

BMFT subsidy of materials research is concentrated mainly in the materials research program, with an emphasis on superconductivity research and thin-film technology. In other special BMFT programs, aspects of materials research are also being supported insofar as this is necessary to solve problems arising in the various disciplines. These include:

—corrosion research;
—physics and chemistry;
—environmental technology;
—information technology;
—humanization of the workplace;
—medical research and technology;
—aviation research and technology;
—aerospace research.

The following deals more closely with the development of the materials research program and with the fields of superconductivity and thin-film technology.

2.1 Plastics as Conductive as Metals

For a long time now there have been attempts to combine the advantages of plastics—particularly their light weight, corrosion resistance, and cost efficient working properties—with the electrical conductivity of metals.

Conductive polymers, for example, are required by the rapidly growing microelectronics industry to prevent the build-up of electrostatic charges and above all, for the screening of electromagnetic waves. An initial step in this direction was the integration of carbon or metal particles in a polymeric matrix. However such measures can have negative effects, for example on the working properties of the plastic or on the mechanical strength of the finished component.

Intrinsically conductive polymers represent a substantially better solution. These are plastics whose electrical conductivity is practically "inborn."

Typical examples of this new group of plastics are polyacetylene and polypyrrol. These polymers are characterized by having conjugated double bonds. The addition of electron donors or acceptors increases the number of mobile charges, thereby achieving a certain degree of electrical conductivity.

The BMFT has been subsidizing joint projects by institutes and industry in this sector since 1979. Around DM15 million in subsidies have been disbursed.

In the meantime institutes and industry have succeeded in producing polypyrrol in the form of flexible, self-supporting films with long-term stability. The self-contained films are as little as 300 micrometers thick and have electrical conductivity of up to 250 Siemens per centimeter (S/cm). They are extremely resistant. One important advantage of polypyrrols is that they can be left outdoors (22 degrees C, 55 percent humidity) for long periods of time with only a negligible reduction in conductivity.

These films are intended for use in batteries since polypyrrol is suitable for use as an electrode material (instead of metals) for rechargeable electrochemical cells. The polymeric electrodes have the advantage that they can be molded easily, which could lead to the development of new types of batteries—to be used in the electronics sector, for example—and provide the impetus for new, cost-saving production methods.

Cells with polypyrrol and lithium electrodes were developed in cooperation with a battery manufacturer. Energy per unit mass and self-discharge correspond to conventional nickel-cadmium accumulators. The cells can be recharged up to 500 times and can be manufactured in the conventional manner. However, the main characteristic lies in the possibility of flexible cell design to allow production of space-saving, flat batteries. This would allow a greater degree of freedom in the design of electrical appliances. To date two types of cell have been built using polypyrrol. The flat cell is a sandwich-type structure of polypyrrol and lithium films. In the cylindrical cell the films are wound concentrically.

These batteries, which should be ready to be launched into the market within a few years, will be used in protable electrical appliances such as radios, CD players, Walkman, flash cubes, or dictaphones.

Polyacetylene is another polymer being investigated in the BMFT joint projects. These polymers, produced according to the Ziegler-Natta method, are made conductive by "doping" that is, by oxidation or reduction. Significant progress has been made in this field recently. By modifying the catalyst, institutes and industry have succeeded in improving the structure of the polyacetylene, making it increasingly free of defects. In addition to this, the films can be expanded by up to 600 percent. The polyacetylene films produced by the new method achieve conductivity of around 100,000 S/cm, proving that it is possible in principle to produce organic polymers with metallic characteristics which in terms of density are more conductive than copper.

As opposed to polypyrrol, which is designed for application in batteries, polyacetylene is still the subject of basic research which may eventually lead to practical applications.

Polypyrrol films can be produced electrochemically. Polypyrrol is deposited on a positively charged, rotating drum and is drawn off continuously as a film. Polyacetylene, which is more sensitive to air, is, therefore produced in a "glove box." This is an airtight glass box filled with oxygen, in which all operations are carried out by means of installed rubber gloves. A special catalyst mixture of aluminium-alkylene and derivatives of transition metals is applied to an even surface and then treated with a defined maount of gaseous acetylene. This causes polymerization. The gaseous acetylene produces a thin polyacetylene film containing conjugated double bonds. By stretching the film, parallel fibers are formed which are made conductive by doping with, for example, iodine.

Although the development of electrically conductive polymers gives rise to justified optimism, scientists point out that research is by no means complete. Speculation that conductive polymers will soon replace copper in large scale technical areas, such as overland power supply networks, are unfounded.

Nevertheless, some ideas are quite realistic. In addition to the battery sector, this is certainly true for aviation and aerospace applications. The market certainly holds promise since in these sectors every gram of weight reduced means significant savings. Work is continuing systematically to improve electrically conductive polymers. For the moment, however, it is a relatively young research field. Therefore, higher levels of conductivity and other improvements—particularly with regard to the working properties—can be expected.

2.2 Axial Face Seals Made of a New Ceramic Material Help Secure Jobs

A medium-sized company (250 employees) in Dortmund has developed new ceramic axial face seals in cooperation with a college institute and two other companies from the mechanical engineering and ceramics sectors.

Axial face seals are used when rotating shafts pass through walls separating chambers with different pressures. They are used in the chemical industry, in refineries, in power stations, and in many other mechanical engineering sectors. Through the support of the BMFT in the form of a research plan, a new shaft seal technology was developed in cooperation with the research partners.

This combined knowledge made it possible to produce axial face seals for extreme loads, for example for very high speeds and pressures. These seals, called EHC-GLRD [as published], operate without contact. The rotating surface of the shaft and the stationary surface of the casing are separated by a thin film of liquid. As a result, they operate without wear and with a minimum of friction. The experience gained from this development led to the initiation of an additional research project which is still underway. This is concerned with the development of modified ceramic silicon-carbide materials with special tribological properties important for applications as a sealant.

Based on the technical know-how gained from these BMFT-promoted research projects it was possible to bring the development of the so-called "dry" shaft seal to the production stage.

This is a high-precision technology in which a film of gas, thinner than one thousandth of a millimeter, separates the rotating and the stationary surfaces. Until now a company in the United States was the only one in the world offering a similar product.

Due in particular to the intensive development work of the research project on ceramic silicon-carbide materials was it possible to produce a seal which not only equals the American product, but which represents a clear improvement on it. A market analysis study predicts that this new development will secure present employment levels in the company for at least 10 years and will probably allow the company to expand.

2.3 Inorganic-organic Polymers—a New Class of Materials

They can be hard and yet elastic, they can weld aluminium to glass or detect poisonous gases, they can be molded into spheres which are so small that three thousand of them will fit in the space of a millimeter: the new class of materials developed by the Fraunhofer Institute for Silicate Research and subsidized by the BMFT. The mechanical, optical, thermal, electrical, and other properties of the new materials can be varied as required so that they can be developed on the drawing board to suit specific applications.

The secret of their versatility lies in the combination of one of the world's oldest materials—ceramics, with a more recent arrival on the technological scene—organic plastics. However, this combination is not based on the integration of fibers as is the case with the fiber reinforced plastics used in aircraft construction. Researchers at the Frauenhofer Institute for Silicate Research in Wuerzburg have developed a process to produce atomic networks of ceramics and plastics which then join together and interlock.

The two large material groups of non-metallic, inorganic materials (NAW), such as glass and ceramics, have a number of important characteristics in common with plastics. They can both be regarded as polymers and can be produced chemically by similar processes. In the case of non-metallic organic materials, chemical synthesis is not the classical method (this is still melting or sintering). However they can be produced by a recently developed chemical method known as the sol-gel process. In this process the inorganic polymer or at least its basic material can be synthesized by a type of chemical polycondensation which allows the incorporation of organic components. This molecular composition allows completely new materials to be produced that combine the properties of glass or ceramics with those of plastics.

At present intensive research work in this area is underway in the United States and Japan. With the financial support of industry, the BMFT, and the Bavarian Government, work began in Wuerzburg on the development of these materials as long as 10 years ago.

The versatility of these materials is demonstrated by the potential applications that are offered, which range from electronic products, cheap but durable caps for reusable foodstuff containers, pharmaceuticals to a gas sensor no bigger than a microchip.

At present the BMFT is subsidizing research work to continue developing new materials for use in the manufacture of optical products such as lenses and eye glasses. The disadvantages of conventional types of glass (heavy weight, brittleness) or plastics (inadequate optical properties, smudge-proofing only possible with expensive coating processes) can potentially be overcome by these new materials.

2.3.2 Microspheres—Over 1000 Spheres per Millimeter

There are numerous applications for which it is desirable to use submicroscopic particles of defined geometry (spheres) and size. For example, the manufacture of highly resistant ceramic materials requires defined submicroscopic powder of homogenous composition.

Other applications include the production of carrier materials for use in chromatography, which could be produced with predefined pore sizes and functions to increase separation efficiency. There is a strong demand for a process which can be applied to many different material systems and which offers sufficient opportunities to control the size of the particles, for example.

The researcher's solution: The sol-gel process for the manufacture of organically modified silicates offers various opportunities for controlling the reaction and therefore for the manufacture of submicroscopic particles of predefined size and structure. By adjusting the reaction conditions it is possible to produce spherical particles of homogenous composition (important in the case of multi-component systems) and to integrate functional groups into inorganic-organic polymers which are capable of selective interaction with particular substances.

2.3.3 Electronic Gas Sensor

Gas sensors are required not only in industry and technology but also in everyday life. They can be applied everywhere that monitoring of gaseous atmospheres is required, for example in air pollution control, monitoring of furnace plants, or as gas detectors for SO_2, CO, NO_x, and other gases.

However, expensive devices and equipment must often be used for this purpose. It appears that it is possible to apply microelectronic principles in this field, since modern production processes enable low-cost mass production. Such sensors require a gas-sensitive material which will produce an electric signal to trigger the microelectronic component when gas molecules are present.

In a BMFT subsidized project within the priority area "microperiphals," researchers have produced inorganic-organic materials (for example organically modified silicates) which can absorb a particular gas (for example sulphur dioxide) and depending on the amount absorbed, alter an electrical characteristic (for example the dielectric constant). If an interdigital capacitor is coated with this material, its capacity can serve as a measure for the concentration of gas (for example SO_2.

Due to the versatility of the organically modified silicates, gas sensors can be produced to detect various gases. Other systems, such as field effect transistors are available for microelectronic applications. This offers new possibilities for the development of sensors to cope with a wide range of gas measurement problems.

2.5 Development of High-transparency Optical Fibers in Plastic

It has been predicted that plastic optical fibers will play an important role in the short-range information technology sector—transmission distance less than 2 km—since they are more flexible even with large fiber diameters, allow greater variation in cost calculations, and are cheaper than glass fibers due to favorable working properties and lower production costs. Potential applications exist in the field of measurement value transmission, sensor technology in the automotive and mechanical engineering sectors, automatic control technology, and lighting.

A remarkable success was achieved in a BMFT-subsidized research project in which an industrial company and two institutes cooperated. It was possible to synthesize basic materials for a polymeric optical conductor with improved thermal resistance (T_G less than 130 degrees C) and better light transmission characteristics than conventional polymeric optical conductors of polymethylmethacrylate (PMMA). Current attenuation values of 20 dB/km were measured. (PMMA: 200 dB/km). This was achieved by a hydrogen-flourine and hydrogen-deuterium exchange in esters based on acrylic and methacrylic acids. Signal transmissions of up to 1500 meters were possible without intermediate repeaters. Conventional plastic optical conductors require an intermediate repeater every 100 meters.

When BMFT financial support comes to end, the company plans to invest a further DM50 million in developing the materials and construction of a pilot plant.

2.6 Spray Process To Produce Sheet Metal

Today, semi-finished products like sheet metals or profiles are manufactured in the steel industry by extruding and subsequent rolling or tossing. Due to high investment costs, it is necessary to produce large quantities of the same product. In a changing market there is an ever increasing demand for small quantities of different products and "specialities."

Powder metallurgy can offer the desired level of flexibility. A new process is being developed in a BMFT-subsidized project to produce semi-finished products by "spraying" atomized drops of molten metal.

The main difference between this process and conventional steel technology is the substitution of the production stages of casting and rolling of atomized molten metal, with direct adhesion to the external contours under the influence of heat. This allows more flexibility in the molding process as well as offering opportunities for building small production plants that can operate economically.

Initial results from this project, in which two industrial companies and two institutes are cooperating, are already available and indicate a high product quality. The material properties were compared with conventionally cast and rolled materials and the values are approximately equal with regard to strength. However, the new materials have isotropic properties in all directions of strain which are very difficult to achieve by conventional methods. The sprayed material has good cold working properties even without heat treatment between spraying and working. Otherwise the properties correspond for the most part with those of conventionally produced, normalized steel of the same composition (cold-flow graph).

2.7 CARMAT 2000—"The Plastic Car" of the Future

There has been talk about the plastic car of the future for a long time. However, the properties of currently available plastics are not suitable for use in automobile parts. Fiber-reinforced plastics offer a solution—even in large-scale production. The BMFT is subsidizing a EUREKA research project in which numerous European partners are cooperating, with the objective of developing an automboile prototype using mainly plastic and composite materials.

The particular importance of this project lies in the international cooperation between automobile manufacturers, processing industries, and raw material producers in the development of a new concept for the design and manufacture of a vehicle that is based on the application of new materials from its conception. The most important objectives are as follows:

—increasing the life-span of the automobile, high corrosion resistance;

—increasing product quality, in particular lowering noise emission and fuel consumption;

—easy modification of appearance by easy replacement of components based on the same design;

—lowering of production costs by extensive, material oriented automation of assembly.

The German project participants are developing an integrated floor group, a side door, front car body, and front bumper. Computer aided design plays a particularly important role here. The use of computers offers many advantages, since initial tests can be carried out in this way and time-consuming experiments can be avoided in the initial phase, thereby contributing considerably to the optimization of the design.

2.8 Porous Ceramic Soot-Filters for Diesel Motors

Solving the problem of air pollution caused by exhaust gas from cars and trucks has become a priority in recent years. Although numerous gasoline motors have been fitted with catalytic converters to reduce the emission of polluting substances, it is still not possible to reduce exhaust gas emissions in the case of diesel motors. For this reason, the BMFT is supporting the efforts of a German engine manufacturer to develop suitable materials for this type of soot-filter. The company is trying to develop deep-bed filters of ceramic materials which can adsorb most of the soot emission due to their extremely high porosity of up to 90 percent. However, a stable structure with such high porosity can only be achieved by using fiber-reinforced ceramic materials. In addition to increasing the mechanical strength, the fibers produce an increase in the specific surface area necessary to accommodate the deposits of soot particles.

To achieve the desired properties and to ensure their economic feasibility, a number of different manufacturing methods were investigated in the course of the research project. Initial results indicate that it will be possible to develop a suitable material, as adsorption levels of up to 90 percent were achieved in the first tests. One important problem which remains to be solved concerns the regeneration of the filters when they are full, since incinerating the soots requires temperatures that damage the material, for example by cracking due to stress.

3. Superconductivity and Thin-film Technologies—Materials and Processes for the Technology of the Future

Two areas whose importance as key technologies of the future is becoming increasingly clear and which shall be receiving intensive finanical support in coming years are superconductivity and thin-film technologies.

Superconductivity, in particular, has gained the attention of the public since the surprising discovery of the Swiss professor Dr Mueller and the German Dr Bednorz on superconductivity at high temperatures for which both scientists received the Nobel Prize for Physics in 1987. This fundamental discovery could go beyond previous utilizations and result in the application of superconductivity to energy saving, process improvement, and in the manufacture of new, superior products.

Superconductivity at low temperatures (near absolute zero = 0 Kelvin = -273 degrees C) has been applied to date mainly in basic research in physics, in generating strong magnetic fields, for medical diagnosis by means of magnetic resonance imaging (NMR), or with the aid of superconducting quantum interference devices (SQUIDs) which can measure the most minute magnetic fields and are used in the analysis of brain and liver functions. Superconductive magnets are also used in testing of ore processing. In all these applications the devices must be cooled with liquid helium. This method of cooling is both complicated and costly.

Mueller and Bednorz's discovery means that it may now be possible to run superconductive devices at 77 Kelvin (= -196 degrees C), so that they could be cooled with liquid nitrogen. This would make the cooling units less complicated, thereby reducing costs considerably. It would also mean that the application of superconductivity could be extended in traditional fields, and new areas of application could be opened. These would most likely be primarily for conductive junctions of hybrid systems in the microelectronics sector, for example in mainframe computers. However, the development of switching functions (Josephson Junctions) also seems possible.

The main technical requirement for the application of superconductors at high temperatures is the production of flexible conductive elements with a current carrying capacity that is greater than 10^5 A/cm^2. As soon as this condition can be fulfilled—at present the subject of intensive research on the part of numerous institutes and industrial researchers—extremely important application opportunities for superconductors will be opened. This is particularly true if materials can be discovered that have superconductive properties at temperatures even higher than the nitrogen boiling point (= -196 degrees C), or even at room temperature. The most important application fields are the following:

—data processing and transmission;

—R&D (accelerators, storage rings, measurement technology);

—health (NMR-magnets, SQUIDs);

—energy (cables, transformers, generators, energy storage);

—public transport (magnetic rails);

—aerospace, marine technology, military applications (sensors, measurement devices).

In the FRG at present there are around 90 research groups in institutes and industry working on these subjects. In particular, the Nuclear Research Center in Karlsruhe has been carrying out successful research for many years in the field of low temperature superconductivity, and is intensifying its activities in the direction of high temperature superconductivity. The BMFT has increased its subsidies for projects in the field of superconductivity, assisted by the establishment of rapid information system to encourage cooperation among the groups. It also provided initial assistance for 30 college institutes as early as April 1987 and is directly promoting cooperative research between institutes and industry, particularly in the field of basic research and in the development of high temperature superconductors. It intends to increase the level of subsidies in the coming years.

Modern processes of thin-film technology also play an important role in the development of superconductive structures. In many cases, technical application of superconductivity is only possible if the materials can be produced in the form of thin films.

The following processes are available, arranged in order of the films' microstructural homogeneity:

—processes in which material is deposited in powder form;

—processes in which molten material is deposited;

—processes in which the materials are deposited from a gaseous phase.

In the case of powder processes, the material retains its powder characteristic as long as it is not subjected to any further treatment. Since superconductivity in these materials is strongly dependent on the direction of particle flow charge, films in which the particles are irregularly deposited or embedded are probably suitable for only a limited range of applications. The objective of powder process research is therefore manufacturing films in which the individual particles are as densely packed as possible and correctly aligned.

In those processes where molten material is deposited (for example plasma spraying or pouring of molten material onto a substrate), a solid film is generally formed whose structure can be determined by varying the process parameters. Optimum alignment of the particles must also be achieved here.

In both cases many interfaces are formed that can strongly influence the superconductive properties of the films. It is therefore necessary to carry out an intensive investigation of the physical processes at the interfaces.

The deposition of material from the gaseous phase—in accordance with physical (PVD process) [Powder Vapor Deposition] or chemical (CVD process) [Chemical Vapor Deposition] principles—offers a wide range of preparation methods with potential for generating monocrystalline films with correctly aligned crystal axes. The most important variables here are the crystallographic and chemical properties of the substrate and the process temperature.

Since chemical reactions between the substrate and the superconductive film must generally be avoided during the deposition process, the process temperature must be kept as low as possible. This is achieved, for example, by applying vacuum, plasma, or ion beam processes (for example evaporation, sputtering, molecular radiation epitaxy, or plasma CVD from metallo-organic composites).

In some cases the films are not immediately superconductive but must be further treated with oxygen. Plasma oxidation seems to be a suitable process here, as the temperature of the films remains below 370 K (= 97 degrees C) during this treatment.

However, the importance of modern thin-film technologies goes far beyond their application in the manufacture of superconductive films. Above all, this lies in the possibility of applying coatings of only a few nanometers thickness to a broad range of technical products to fulfill decisive functions in various fields of application. These include for example, corrosion protection, reduction of friction and wear, catalysis (environmental protection, petrochemistry, chemical engineering), biological compatibility (in the case of implants, for example) or barrier applications. Physically active films such as high density optic or magnetic storage films can also be produced using modern surface technology.

The thin-film technology sector is characterized by the rapid development of a series of new techniques. These are based mainly on vacuum, plasma, and ion beam processes which can be used to produce non-polluting films from various types of material to comply with highly specific requirements. To a great extent, the new techniques serve to replace chemical, electrochemical, mechanical, and thermal techniques used to date.

It is vital for the industry dealing with surface technologies, which consists mainly of medium-sized companies, to have access to the new thin-film technology. The economic significance is demonstrated by the following market statistics (microelectronics and sensor technology not included):

—world market volume for plants and equipment (1985): approximately DM6.5 billion;

—world market volume of products manufactured by these plants: approximately DM60 billion;

—world market volume of finished products, in which products coated by means of modern thin-film technologies play a key role: approximately DM600 billion.

Technologies of the future are not discovered by accident, but rather are based on successful basic research. For this reason, the Federal Ministry for Research and Development is subsidizing thin-film technologies in a priority program falling under the subsidy category of physical technologies. Areas which experts believe to have a high potential for innovation are being subsidized. These include:

—coating technology;

—development of radiation and plasma processes for the manufacture and modification of thin films;

—chemical vapor deposition processes (CVD);

—combination of the various thin-film techniques;

—surfacing and thin-film analysis and measurement technology;

—production diagnostics.

Increased activity in the thin-film technology sector should form a basis for highly developed know-how and modern technology. The objective of such activity would be to strengthen and secure the long-term competitiveness of German industry, with particular regard for process users and plant manufacturers in the thin-film technology sector. This does not in any way affect the industry's responsibility to carry out its own research in order to secure its existence.

Cooperative research in which institutes and industry work together is to be strived for. This allows the available R&D potential to be effectively exploited, as well as facilitating and accelerating the exchange of technology.

Support for individual projects should encourage the early recognition of emerging technologies. Such projects, as precursors to cooperative research projects, should challenge scientific creativity to develop new, as yet unknown, thin-film technologies.

Advanced Ceramics Research Detailed

3698m149 Bonn MATERIALFORSCHUNG in German 1987 pp 57-60, 800-802

[Descriptions of two projects on fiber reinforced ceramic composites taken from the annual report on the BMFT's Materials Research Program for 1986; the first is sponsored by the DFVLR's Institute for Materials Research, Prof Dr G. Ziegler, Project Director; the second is sponsored by the University of Karlsruhe's Institute for Chemical Technology, Prof Dr E. Fitzes, Project Director]

[Excerpts] Ceramics

From both a technical and economical point of view, high-performance ceramics, that is, special ceramic materials based on metallic oxides, nitrides, carbides, and borides, are particularly attractive. They are highly resistant to heat, corrosion, and wear, they have a low specific weight, and the raw materials for their production are cheap and generally available. On the other hand, they do have disadvantages which must be overcome, such as low impact and thermal shock resistance.

Despite years of international R&D work, extensive application of structural ceramic materials has not yet been achieved, while ceramics for electric, magnetic, and biological applications have managed to acquire a large share of the market.

Only in the labroatory, and then only in small quantities, has it been possible to achieve outstanding property values for structural ceramics. It was possible, for example, to manufacture recrystallized Si_3N_4 materials with crystalline grain boundary phases, short term strength of 800 MPa up to 1,400 degrees C, and excellent thermal shock resistance. Peak values have also been achieved in the case of oxidic structural ceramics. It was possible, for example, to manufacture Y-stabilized TZP (tetragonal zirconia polycrystal) with tensile strength of more than 12 MPa $m^{1/2}$ and strengths at room temperature of more than 2,500 MPa.

Recent advances in processing technology have not been sufficient for mass production of components. The objective is to be able to reproduce the criteria established by the designer with a low level of deviation. This is why increased R&D efforts are being subsidized in projects ranging from basic research to application-specific material and processing developments.

Other material and processing developments being subsidized in the ceramics sector are outlined in Section 2.3 (Mechanically Resistant Materials) of the priority program 2 (Powder Metallurgy) in Sections 3.1 (Intermetallic Phases) and 3.4 (Protective Coatings) of priority program 3; in section 5.3 (composite materials with ceramic matrix) of priority program 5 (composite materiasl) and in sections 6.1 (Basic Tribology) and 6.2 (Materials) of priority program 6 (Tribology).

Financial Status of the Projects Supported by PLR [Project Management on Materials & Raw Material Research] Under the Priority Program 1 on Ceramic Materials:

Total Costs (TDM) [thousands of DM]	Amount of Subsidies (TDM)	1986 Allocations (TDM)	Average Subsidy Rate
148,166	73,523	13,996	49.6 percent

1.1 Basic Material and Process Development

There are many reasons to assume that the failure to achieve a wide market is based on the lack of technical experience in the high-performance ceramics sector. One comes to this conclusion when one observes the history of metal-based materials, materials which may someday be replaced by ceramics. For example, the application of nickel-based superalloys, which are generally regarded as tailor-made materials par excellence, was the result of decades of research and development in materials technology.

However systematic materials development in the high-performance ceramics sector has only existed for a few years. This research must be intensified with the objective of increasing our understanding of existing materials so we can invent the materials of the future, tailor-made to meet increasing demands in the mechanical and equipment engineering sectors and if possible to achieve new technical processes. These "second generation" materials must be ready in about 5 years to go into mass production. Substantial increases in R&D expenditure will be necessary once again to practically apply "second generation" high-performance ceramic components in about 10 years.

Priority areas for these basic materials and process developments are as follows:

—computer aided structural research;

—basic research and development on powder synthesis, molding (for example sol-gel process), and finishing;

—high-purity processing, avoidance of irregularities;

—measures for structure reinforcement, such as crystallization of the secondary phase, and particle, fiber, and wisker reinforcements;

—analysis of material failures at high temperature for insight into wear and fracture characteristics;

—correlation of micro-structures and macroscopic features;

—development of non-destructive testing methods for both process control and detection of structural irregularities, faults, and internal stress.

Financial Status of PLR-projects in the Basic Materials and Process Development

Total Costs (TDM)[thousands of DM]	Amount of Subsidies (TDM)	1986 Allocations (TDM)	Average Rate of Subsidies
34,429	19,602	3,522	53.8 percent

1.2 New Powder Manufacturing Methods

Powder synthesis is the first link in a chain of manufacturing and processing steps and has a decisive effect on the mechanical, thermal, and chemical properties of the finished components as well as on the economies of production. For this reason, every advance from one phase to the next (lab, pilot, demonstration phases) must be based on positive results in each successive phase, from both a technical and an economic point of view.

The subjects dealt with in the 1986 materials research program for the development of new powder manufacturing processes include:

—hydrothermal synthesis of oxide-ceramic powders with special consideration of agglomeration problems;

—flame-hydrolysis and flame-ammonolysis for the manufacture of oxides and Si_3N_4;

—plasma synthesis of Si_3N_4-powder;

—ammonolytic precipitation of silicon-diimide in organic solutions for the manufacture of Si_3N_4;

—characterization of ceramic sintered powders and assessment of their suitability for various processes (see 1.3).

Financial Status of Projects Supported by PLR in the Field of New Powder Manufacturing Processes

Total Costs (TDM)[thousands of DM]	Amount of Subsidies (TDM)	1986 Allocations (TDM)	Average Subsidy Rate
11,770	6,708	1,458	57 percent

1.3 Process Development of Prototype Components

The majority of projects within the materials research program in the high-performance ceramics sector are concentrated on process development of prototype components. The projects are divided under the headings of materials (including powder synthesis), molding processes, and/or components, depending on the requirements of the respective component. As there is as yet no set procedure for large-scale components, it is often necessary to pursue a number of different solutions simultaneously, until decisive stages are reached. Powder manufacturers, component manufacturers, and consumers are cooperating with research institutes in these projects.

The new approved projects are usually based on experience gained from the BMFT program "Ceramic Components for Vehicle Gas Turbines." This program began in 1974 but failed however to reach its highly publicized aim of developing a gas turbine (for mass production). The following objectives have been set for the new program:

—an expansion in the range of materials;

—development of procedures for molding, (including quasi-isostatic pressing, pressure slip casting, injection molding), sintering and, if necessary, redensification, adapted to powder synthesis;

—careful selection of components with increasing complexity and growing requirements—also adapted to powder synthesis and subsequent processing steps—to demonstrate materials and process development;

—design of components corresponding to materials and testing methods as well as durability assessments based on theoretical considerations and component tests.

Financial Situation of the Projects Supported by PLR for the Development of Processing Techniques for Prototype Components

Total Costs (TDM)[thousands of DM]	Amount of Subsidies (TDM)	1986 Allocations (TDM)	Average Subsidy Rate
94,770	44,616	8,601	47.1 percent

1.4 Ceramic Composites

Ceramic composites are particularly valuable, because they represent the preliminary requirement for a wide range of applications of ceramics as structural materials.

Various features, such as different material structures, fracture resistance, expansion behavior, conductivity as well as the incapability of ceramics to react to external tensions with a plastic deformation, require new solutions to enable the blending of metals and ceramics, in particular. Special soldering methods (active soldering) are suggested for applications at temperatures below 800 degrees C. Systematic tests are being conducted to combine the major structural ceramic materials ZrO_2, Al_2O_3, Si_3N_4 and SiC with steel, in iron casting and Ni-based alloys. The various methods are tested on prototype components; their application limits, particularly their life-span, are described so precisely that they can offer an indisputable basis for the planning of composite components.

Financial Status of the Projects Supported by PLR in the Area of Ceramic Composites

Total Costs (TDM)	Amount of Subsidies (TDM)	1986 Allocations (TDM)	Average Subsidy Rate
5,197	2,599	416	50.0 percent

Theme: High-strength, fiber-reinforced ceramic composite materials on a non-oxidic and oxidic basis; and powder-metallurgic manufacture, optimization of grain boundaries, material characterization.

Duration: 11/01/1985—10/31/1988
Total Cost of Project: DM1,841,125
Project No: 03 M 1005 A6
Government Subsidies = 100 percent

Project Description:

1. Objectives

The objective of the research project is to develop, characterize and optimize materials with improved crack propagation properties on the basis of nitride, carbide, and oxide matrix materials. This will primarily be achieved by means of powder technology, within the framework of the cooperative project "high-strength fiber-reinforced composite materials with ceramic matrix." Initial investigations will concentrate on the matrix materials Al_2O_3, Si_3N_4, and SiC.

2. Program

The project will deal with the following priorities:

—structural and analytical characterization and investigation of the thermal stability of the fibers;

—microanalytical and microstructural investigation of the interface and the fiber matrix, including the thermal stability of the composite combinations and optimization of interfacial properties;

—development of fiber-reinforced Al_2O_3, Si_3N_4, and SiC by means of powder technology;

—characterization of thermo-mechanical and thermophysical properties, in particular the elasticity module, thermic expansion, thermal conductivity, thermal shock, and thermal stress.

Continuous and discontinuous fibers as well as whiskers are used for reinforcement. This is achieved in the composite materials by reaction sintering (in the case of Si_3N_4), or by hot pressing and sintering with subsequent inforcement by means of hot isostatic pressing (HIP). In the case of Si_3N_4, the process steps are carried out using reaction sintered Si_3N_4 and Si_3N_4 powder preforms.

3. Progress

Due to problems in recruiting personnel, the project was only fully staffed by the middle of 1986.

In the period covered by the report the following work was begun:

—SiC fiber and whisker reinforced Al_2O_3;

—SiC fiber and whisker-reinforced, reaction sintered Si_3N_4;

—SiC whisker-reinforced dense Si_3N_4.

In the case of Al_2O_3, priority was given to questions of processing, with particular regard to the homogenous distribution of whiskers, molding of whisker and long fiber reinforced composite materials as well as the optimization of compaction parameters. In addition to pressing, slip casting was largely used for molding. In the case of slip casting, dispersion agents, stabilizing agents, emulsifiers, and binder were optimized in terms of viscosity and solids content. Preliminary tests on the wetting of long fibers in ceramic slips were carried out. Various raw materials were tested furing slip casting and pressing.

The whisker-reinforced materials were compacted by hot pressing, then experiments with sintering and HIP were carried out. In the case of SiC whisker-reinforced Al_2O_3 (variation of whisker proportion between 10 and 50 percent volume), strengths of 730 MPa (at 20 percent volume of SiC whiskers) and 800 MPa (at 50 percent volume of SiC whiskers) were measured. Material fatigue values were 5.5 $MNm^{-3/2}$ (at 20 percent volume of SiC whiskers) and 7.2 $MNm^{-3/2}$ (at 50 percent volume of SiC whiskers).

An investigation of the thermic and chemical stability of various SiC fibers and whiskers in the nitriding atmosphere and in the SiC-Si composite under nitriding conditions was begun during the course of work to develop fiber and whisker-reinforced reaction-bonded Si_3N_4. Investigations to date show that the thermic and chemical stability of the reinforcement components depend on the composition of the nitriding atmosphere, and that secondary components also have a strong influence.

Initial experiments on whisker reinforcement of Si_3N_4 green solids led to almost complete compaction by means of hot pressing.

4. Reference to Other Projects

The project priority on "characterization" includes the investigation of various thermo-mechanical and thermophysical properties of all composite materials developed in the course of the cooperative project.

Theme: "FASKER:" Fiber-reinforced silicon ceramics; reimpregnation technology, prepreg development, and fiber coating

Duration: 11/01/1985—10/31/1988
Total Project Cost: DM1,145,000
Project No: 03M 1005 B9
Government Participation: 91.27 percent

Project description:

1. Objectives
Subproject 1: Development of fiber-reinforced SiC
Subproject 2: Reimpregnation of porous SiC ceramics
Subproject 3: Development of prepregs
Subproject 4: CVD coating of C-fibers

2. Program

Subproject 1:

The following activities are involved:

Investigation of possible reinforcement components with regard to high temperature resistance in inert gas atmosphere and damages caused by annealing in air.

Synthesis of fiber-reinforced porous carbon matrixes from suitable thermoduric materials and reaction of these materials with liquid silicon. Optimization of both of these steps to achieve low porosity and favorable characteristics against mechanical fracture.

Subproject 2:

Development of impregnating agents to be applied by means of the sol-gel process, for example silicic acid and zirconium silicate on the one hand, and on the other, in the form of silicon-organic composites for the investigation of thermic decomposition.

Optimization of the impregnation process with these agents to minimize porosity and improve the thermal and mechanical properties of the impregnated materials.

Subproject 3:

Development of high-strength reinforced glass fibers by means of the sol-gel process, and subsequent hot pressing using alkoxide composites of oxide-forming elements and ceramic components, such as $MoSi_2$ powder, Al_2O_3 wool, and SiC whiskers.

Subproject 4:

Optimization of the process for applying protective and primer coatings, such as SiC, TiC, TiN, and WC to carbon fibers, and small scale production of an SiC coating for delivery from research partners.

3. Status

Subproject 1:

The investigation of the reinforcement components was carried out. The mechanical properties of these components were measured before and after annealing up to 1500 degrees C in inert gas. Their resistance to oxidation up to 1400 degrees C was also measured.

Subproject 2:

Porous SiC ceramic material was impregnated by means of the sol-gel process, and the improvement in the mechanical properties and the reduction in porosity were measured. Silicon organic materials were produced and their thermic decomposition investigated.

Subproject 3:

Various fiber types and compatible gels were investigated for their suitability for use in glass reinforcement with continuous fibers. It was possible to produce crack-free, SiC whisker reinforced SiO_2 gel material.

Subproject 4:

After the production of samples for kinetic studies and strength tests, the production of SIC-coated carbon fibers was begun. Coated fibers have already been sent to joint research partners.

08617

COMPUTERS

Esprit PCTE Initiative, PACT Project Updated

3698A149 Louveciennes THE PCTE INITIATIVE AND THE PACT PROJECT in English undated pp 1-23

[Paper by Ian Thomas of GIE Emeraude, c/o Bull, 68 Route de Versailles, 78430 Louveciennes, France; publication date and place not given; distributed by the EC Commission in Jan 88]

[Text]

Abstract

The PCTE initiative has long ago passed beyond the confines of the PCTE Esprit project. It now encompasses a large number of projects, organisations and programmes. This paper described the PCTE initiative by discussing the work being done on implementations of the PCTE interfaces, their formalisation and evolution. It goes on to describe current efforts to build integrated environments on the interfaces and describes the Pact project in particular. Finally, there is an attempt to place PCTE in a world context.

Ada is a trademark of the Ada Joint Program Office.

DEC, Ultrix, VAX and VMS are trademarks of the Digital Equipment Corporation.

DRS300 is the trademark of International Computers Ltd.

HP9300 is a trademark of Hewlett-Packard Inc.

IBM is a trademark of International Business Machines.

Sun is a trademark of Sun Microsystems Incorporated.

Unix, System V are trademarks of AT&T Bell Laboratories.

Verdix is a trademark of Verdix Corporation.

1. Introduction

Until very recently software has been developed predominantly on large centralised computer systems using a collection of tools bearing little or no relationship to one another. There has consequently been little general support given to the software engineer during the software development process.

It is against this background that the concept of an Integrated Project Support Environment (IPSE) has emerged. An IPSE is a development environment into which tools supporting all the various phases of software development (sometimes called the life cycle) are integrated.

It is recognised that the availability of such integrated environments is crucial for improving the productivity of the software industry. It is also recognised that the environments should not be tied to particular hardware. Indeed, one important aspect is to enlarge the choice for software developers of which tool sets (supporting methods, languages, etc.) to use, whether in a given organisation or for a given development. Another aspect is the need to enlarge the tool market for the tool suppliers, so as to increase potential sales, which in turn should lead to a large catalogue of tools and toolsets and thus a better cost/quality ratio for environment builders and end-users.

One approach to the efficient integrated environments is crucial for improving the productivity of the software industry. It is also recognised that the environments should not be tied to particular hardware. Indeed, one important aspect is to enlarge the choice for software developers of which tools sets (supporting methods, languages, etc.) to use, whether in a given organisation or for a given development. Another aspect is the need to enlarge the tool market for the tool suppliers, so as to increase potential sales, which in turn should lead to a large catalogue of tools and toolsets and thus a better cost/quality ratio for environment builders and end-users.

One approach to the efficient integration of software engineering tools sets is to factor out those common features required by most tools for information management and interaction with the tools users. It is therefore an efficient way forward to define a domain in which these common needs are satisfied, whilst leaving the tools themselves to carry on their specific tasks and offer their specific facilities. Out of this realisation has arisen the concept of the Public Tool Interface (PTI).

The PCTE project (actually entitled "A Basis for A Portable Common Tool Environment") was launched with six partners—Bull, GEC, ICL, Nixdorf, Olivetti and Siemens—in October 1983 with the aim of providing a common environment for the Esprit programme. The project was intended to produce a definition of a Public Tool Interface and to prototype implementations of different aspects of this interface. Version 1.4 of the Functional Specifications of the PCTE interfaces was published in August 1986 and is in the public domain [Bull86].

From this approach it is clear that PCTE itself is not an IPSE, but provides a basis on which an IPSE architect can construct environments by the integration of the appropriate tools supporting all aspects of the software development process.

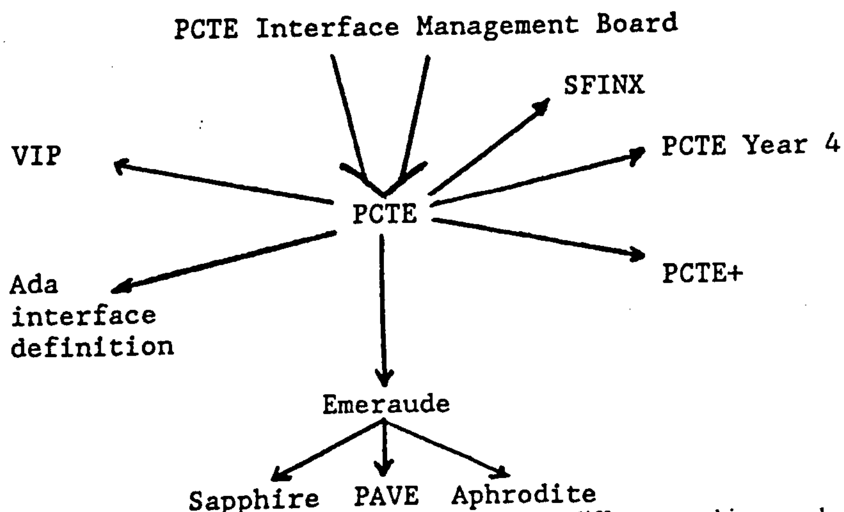
The development and implementation of a Public Tool Interface is a costly endeavour, though even this is modest compared to the development of an IPSE. Few single organisations can afford the effort or have the required range of technical expertise to perform such a large task. In addition, it is important to develop a consensus for the PTI amongst potential user organisations in order to establish the presence of the "tool market place".

These factors indicate the usefulness of Esprit funding support for the initial PCTE activity though the long-term objective is to develop a strong, financially self-sufficient tool market based on the PTI.

It was already evident at the Esprit Technical Week in 1986 that the PCTE interface definition and associated activities, with the energetic backing of the industrial partners and the Commission of the European Community itself, were taking on an importance that surpassed the project itself. This paper is an attempt to draw together some of the principal strands of activity taking place around the PCTE interface definitions. These diverse activities have now become important enough for us to be able to speak of a PCTE initiative, hence the title of this paper. Note that this initiative now includes many non-Esprit activities.

The paper assumes some knowledge of the interfaces and underlying philosophy of PCTE. It does not seek to present the technical features, rather to show the context of the current work in the area.

In order to structure the discussion, the paper begins with a description of activities that are concerned with the definition and implementation of the interfaces, including their formalisation and proposals for language bindings for the interfaces. This is followed by a brief review of some projects that are building integrated software environments on the PCTE interfaces. Finally, there is an attempt to place PCTE in a world context.



2. The PCTE Interfaces—Implementation, Consolidation and Evolution

This chapter reviews the complex of projects that are principally concerned with the interfaces themselves. It also introduces the PCTE Interface Management Board and the SFINX project.

There are three principal areas under this heading: the first concerns implementations of the interfaces; the second concerns formalisation of the interface specification and the development of bindings for other programming languages; the third area deals with evolution of the interface specifications. Each of these areas is dealt with in one of the following sections.

The following diagram shows the various activities and the relationships between them. Note that only activities concerned with the implementation, consolidation and evolution of the interfaces are shown; use of the interfaces for the construction of environments is discussed in the next chapter. The PCTE project, and the interface definitions that it produced, are shown at the centre of the diagram. The diagram is followed by a description of the activities.

2.1. Implementation of the Interfaces.

The PCTE project was intended to produce a set of interface definitions for a public common tool interface and to prototype implementations of these interfaces.

One of the prototype implementations, carried out by Olivetti, aims to provide the interfaces as a layer of software outside the operating system kernel. This is known as the black box implementation. It is intended to run on non-Unix operating systems as well as Unix and Unix-like operating systems. This prototype implementation has been successfully installed on a number of different machines, such as: Olivetti 3B2 300/400 under Unix System V, VAX under BSD 4.1, BSD 4.2, Ultrix and VMS, Sun 2 and 3, HP9000 and Apollo.

2.1.1. The Emeraude Project.

In parallel with the PCTE interface definition and prototyping effort, a French consortium of three companies—Bull, Eurosoft and Syseca—responded to a call for proposals from the French national software engineering programme concerning the definition and implementation of a "hosting structure" for Software Engineering Environments (SEEs). They decided to produce an industrial quality implementation of the PCTE interfaces in the Emeraude project [Camp87].

The result of this project, the Emeraude product, is now available on Bull SPS7 workstations.

Emeraude has contributed significantly to the total PCTE effort as the definition of the interfaces was able to benefit from the parallel industrial initiative. This synergy ensured that the interface definitions did not only reflect what could be prototyped, often in a research laboratory setting, but also what could be implemented with industrial-quality reliability and performance.

Another contribution from the Emeraude project relates to the credibility of the interfaces. Elegant paper definitions are too easy to criticise and dismiss if there are no good, complete implementations available to demonstrate their industrial feasibility.

2.1.2. The Sapphire Project.

The Sapphire project is an Esprit project whose aims are to port the Emeraude implementation of the PCTE interfaces onto a number of different machines, validate

Sun 3 DEC VAX 750 DEC VAX workstation IBM PC/AT HP9300	These ports are onto the Unix systems on these machines.

the adequacy and completeness of the interfaces by porting a number of complex, demanding tools onto the implementations and, finally, to assess the resulting performance.

The machines that are the targets of the ports are:

The tools to be ported for the validation work include an Integrated Project Support Environment (IPSE) developed during an Alvey project (the Eclipse project is described briefly later), a technical writers' workbench developed in the Fortune project [Mull87] and an Ada compiler. The project is also prototyping the Common APSE Interface Set (CAIS). CAIS is discussed further in Chapter 4 of this document.

Some of the results of this project are being demonstrated during the 1987 Esprit Technical Week. All of the ports are expected to be completed within the first two years of the project which began in October 1986.

2.1.3. The PAVE Project.

The PAVE project is an Esprit project, (officially entitled Combined PCTE and VMS Environment), which aims to develop a number of software components that will enable use of the PCTE interfaces, and tools constructed using them, within existing VAX/VMS environments. The widespread use of VAX/VMS environments means that a migration path to PCTE needs to be defined for these users.

A major concern of this work is the generalisability of the results. The project will consider the independence of PCTE with respect to Unix to establish those aspects that are difficult to implement efficiently on non-Unix like operating systems. These general concerns will then be applied to the problem of providing the PCTE interfaces on VAX/VMS.

2.1.4. The Aphrodite Project.

The Aphrodite project is an Esprit project that aims to define a distributed environment that encompasses both host and target machines. The project's primary focus is to define an architecture and software development method that will allow debugging and testing of distributed applications. The distributed application may be running partly on the host system (or systems) and partly on the target system (or systems). The approach is to allow gradual migration of processes of an application from the host machine to the target machines as the application is debugged and tested.

The project will also implement software to support this architecture and method. This software will be based on the Chorus fully distributed operating system [Bani85, Zimm84].

Since the objective is to have the host system running under PCTE, the project will also implement the PCTE interfaces starting from Emeraude and the Chorus system. This represents a radical departure from existing Unix kernel-based implementations such as Emeraude as the kernel itself is distributed in Chorus. The host machine for which this work will be done is the PC/AT.

The project began in early 1987 and is scheduled to last for two years.

2.2. Formalisation and New Language Bindings.

The current interface definition is expressed in the C language accompanied by a textual explanation. The shortcomings of such definitions have been highlighted many times and have led to the creation of an Esprit project, the VIP project (VDM Interfaces for PCTE).

Much work on project support environments in Europe and the United States is focused on supporting the development of programs written in Ada. In fact, there is relatively little in public tool interfaces following the Stoneman model, such as PCTE, that is programming language specific. The independence of the PCTE interface from the application programming language makes it a suitable candidate for the definition of a KAPSE (Kernel Ada Programming Support Environment) interface. This observation led to the CEC funding of a project to propose an Ada language binding for the PCTE interfaces.

2.2.1. The VIP Project.

The VIP project is an Esprit project that aims to produce a formal specification of the PCTE interfaces. This work is expected to uncover the ambiguities and omissions that exist in the current natural language specifications as well as providing the definite standard against which bindings for different languages and implementations of these bindings can be validated.

The approach to the activity of formalisation is to define the interfaces in a formalism that is independent of programming language bindings. The behaviour of these interface primitives is then expressed formally.

2.2.2. The Ada Interfaces to PCTE.

Much work on project support environments in Europe and the United States is focused on supporting the development of Ada programs. In order to promote PCTE in this community, the CEC has funded a project to propose an Ada language binding for the PCTE interfaces. The binding is currently partial in that it covers only the first volume of the two volumes of the PCTE specifications. A project to propose a binding for the second volume will shortly begin.

The first project was completed earlier this year and the Ada language binding has been published by the CEC and submitted to the PCTE Interface Management Board.

The proposal makes the PCTE facilities available to tool writers working in Ada. They are expressed in good Ada style conforming to a presentation of the facilities that is natural for Ada programmers.

The designers of the binding have also identified those features of PCTE that are subsumed by the Ada language definition (such as storage allocation). These are not part of the binding. Other omissions concern primitives that are specific to Unix.

2.3. Evolution of the PCTE Interfaces.

The PCTE interfaces are clearly of interest to organisations that develop significant amounts of software. As the defence industries and establishments fall into this class, they have been following the PCTE effort keenly. This has resulted in a project, called PCTE+, to examine the evolutions necessary in the PCTE interface definitions to render them appropriate for the development of military applications. One such area relates to security aspects, though this may apply equally well to sensitive commercial applications.

At the end of September 1986, the partners of the original PCTE project decided to revise the plan of work for the remaining period of time in the project to take account of the growing interest and success of the PCTE interfaces. This revised work plan, known to the partners as PCTE Year 4 though the year is a virtual one lasting longer than twelve months, includes work packages that examine how the interfaces can evolve to meet some of the criticisms and comments that have been made of them.

2.3.1. The PCTE+ Definition Phase Project.

This project is being funded by the IEPG (Independent European Procurement Group) group of European NATO countries. The objective of the project is to define an interface set that satisfies specific defence-related requirements on an interface set as well as civil requirements. The project is part of a programme that will also evaluate the proposed interface sets.

A requirements document, the EURAC (European Requirements and Criteria for a public tool interface) [EURA87] has already been produced and work is in progress to propose modifications to the PCTE interfaces that would satisfy these requirements.

The main areas in which evolutions are being suggested are:

—security, essentially the protection of the environment against unauthorised intrusion or parts of the environment from unauthorised use by persons who are authorised to use other parts only.

—integrity, essentially supporting the development of secure software. this aspect concerns support for enforcement of configuration management policies amongst other aspects.

—Unix independence, to make the interface independent of Unix in the sense described in section 2.1.3 above.

—formal definition, in cooperation with the VIP project (see section 2.2.1), there will be a study to see how to extend their results on PCTE to the PCTE+ proposals.

The current project, which represents the Definition Phase, will end at the end of 1989, with a first definition available for public review and comment early in 1988.

2.3.2. The PCTE Year 4 Programme.

A number of themes run through the programme. The first concerns the consolidation of the existing PCTE interfaces. This activity is principally revision and error or omission correction except for some additional work on distribution over a heterogeneous network.

The second theme concerns enhancements and evolution of the PCTE interfaces. Two areas will be considered here: the OMS and the user interface. A number of comments and suggestions have already been made on the OMS specifications. This area involves the preparation of a unified and coherent set of proposals for evolution of the interface.

The third theme involves demonstrating the suitability of PCTE as the basis for an APSE. The importance of this work in advancing the acceptance of the PCTE interfaces in the Ada community is clear. The work involves developing an implementation of the proposed Ada binding of the interfaces mentioned in section 2.2.2 above, adapting an Ada compiler's library management system to PCTE's OMS and validating the compiler on PCTE. The implementation will use the Verdix Ada compiler and the Emeraude implementation of PCTE. This work is scheduled to be complete in mid 1988.

The work programme also contains some effort for PCTE implementations. Olivetti are completing the black-box implementation and ICL are porting the Emeraude implementation onto their DRS300 machine.

2.3.3. Control and Coordination.

In 1986 it was already clear that the PCTE interface specifications should no longer be controlled by the consortium of PCTE project partners if the interfaces were to become a recognised standard to which non-members of the original consortium could adhere. Accordingly, the PCTE Interface Management Board (PIMB) was set up, with the aid of the CEC, to control the evolution of the interfaces and to prepare their submission as an international standard. In addition to representatives of the initial designers of the interfaces, this body contains representatives of other organisations, both commercial, military, national and supranational, with a strong interest in, and commitment to, PCTE Public Tool Interface standardisation.

The PIMB has created a technical working group, the PCTE Interface Control Group, whose brief is to support the work of the PIMB in the areas of:

—Controlling the release of the interface specifications into the public domain;

—Controlling the evolution of the interface specifications, particularly the receipt, recording, and response to comments and proposed modifications to the interface specifications.

This body has already begun to function.

As the controlling body for the PCTE interface specifications, the PIMB is the ultimate arbiter of changes and evolutions to the interface definition. The PCTE+ project and also the PCTE Year 4 project will therefore submit their proposed evolutions to the PIMB for acceptance if the proposals are to become part of the standard. It is also the PIMB that accepts and manages the language bindings that are published for PCTE, such as the proposal for the Ada language interface mentioned above. Other language bindings for CommonLisp and Prolog are being prepared in the Pact project discussed later.

The SFINX project (Software Factory INtegration and eXperimentation) project has the principal objective of integrating the results of Esprit projects into a PCTE-based environment. It also has an objective of collection of comments, criticisms and change requests on the interfaces from partners in Esprit projects.

3. Integrated Environments on the PCTE Interfaces.

The PCTE project is one of a number that have addressed the definition of a Public Tool Interface (PTI). Other European efforts have included M-CHAPSE and PAPS [Oliv82]. In the United States, there is the CAIS military standard ("CAIS 1") [CAIS85] and an on-going project to define a successor to this standard.

One objective of a Public Tool Interface is to enable the construction of integrated environments and tool sets on the interface. The fact that it is public means that any interested organisation can develop tools to run on it.

The effort that has been devoted to definition of the PTI logically precedes and has not, up to now, been matched by an equivalent effort in the area of building integrated environments on PTIs. It is almost an article of faith that we have a sufficiently clear understanding of the requirements on a PTI to design one. As yet, we have little validation of our PTI design efforts in the form of integrated environments running on a PTI.

This chapter looks at some of the work that has been done, or is in progress, in the design and implementation of environments on the PCTE interfaces.

3.1. The Eclipse Project.

The Eclipse project is a British project, partially funded by the Alvey programme [Alde86, Cart87]. The project had four main themes: the development of an Eclipse "kernel" as a set of general mechanisms available to tool writers; a tool set built using these facilities; general tool builder support facilities and, finally, a research programme.

The general purpose mechanisms are described in a publicly available interface and deal with the recording, editing and analysing of text and diagrams such as are frequently manipulated in a present-day software development methods. The tool set includes a number of specific software development tools using these general mechanisms. The project chose the PCTE interfaces as the PTI on which to implement its general mechanisms. In fact, the Emeraude implementation of PCTE was chosen as the platform for its implementation.

Three general mechanisms were defined and implemented. The first provides a two-tier database implemented on PCTE's OMS. The two-tier database presents a unified interface, based on IDL (Interface Definition Language), that allows the tool writer to define the "fine structure" of the objects that the tool manipulates. Each fine structure database (FSD) is stored as an OMS object's contents.

The second general mechanism defines version and configuration control facilities for objects in the two-tier database.

The third general mechanism defines user interface facilities for the tool writer that support a specific dialogue model for the man-machine communication.

The tool set designed and implemented in Eclipse includes support for the Mascot design method and an Ada compilation system.

3.2. The Entreprise Project.

Entreprise is an French environment development designed to support software development for Ada, modular Pascal, modular C and LTR3 which is a programming language for embedded applications largely used for military software.

Earlier versions of Entreprise were developed for Unix and extensively used, particularly in the defence industry. Work is currently in progress to adapt the environment to the PCTE interfaces and to extend it to take advantage of the additional power of PCTE.

3.3. The Pact Project.

The Pact project is an Esprit project that is building an environment containing an implemented tool set. This section presents an overview of the Pact environment.

The diagram on the next page is adapted from the Pact general description and shows many of the components of the Pact environment.

The innermost circle in the diagram, labelled PCTE, represents an implementation of the PCTE interfaces.

The next circle represents the Pact Common Services. The role of these is to provide services that will be useful to a number of tools. This "factoring out" of commonly used functionalities eases the tool writer's task by reducing the amount of code to be written for a tool. The use of the Common Services also results in a higher degree of consistency amongst tools.

Five Common Services are listed in the diagram.

Dialogue Management: This service supports the dialogue style of the Pact environment.

Tool Composition: This service provides software support for the construction of independent tool components and their composition into composite tools.

Internal Document Management: Many tools create or manipulate documents. This common service provides facilities to manage a common structure for Pact documents.

Data Query and Manipulation (DQM-AM): This service provides query facilities on the object base of PCTE. The service is available to all tools and the Pact project is developing a graphical query tool and a textual interface for queries.

Version Management: This service provides management of versions of objects and versions of groups of linked objects.

The outermost circle of the diagram represents the tools that will be constructed during the project.

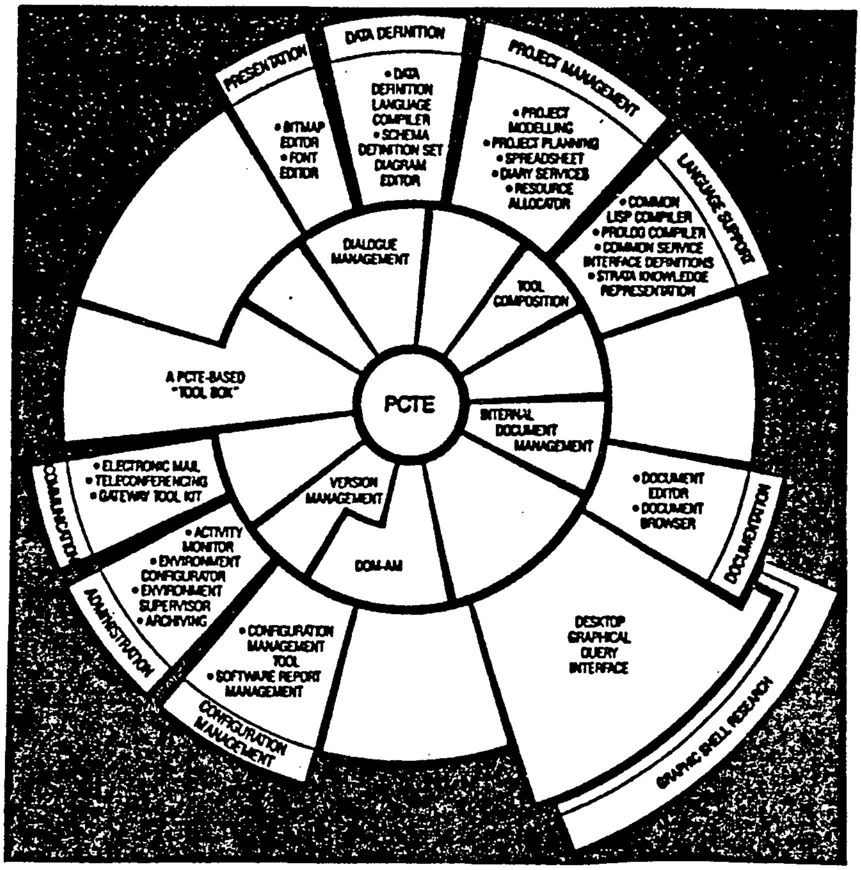
The "tail" of the rosette in the diagram, labelled Desktop but more accurately entitled the Desktop Manager, represents a particular tool that provides a user interface to the system. The Desktop's functionalities include a graphical interface for Data Query and Manipulation. Eventually, this tool could be superseded or subsumed by the Visual Shell.

Pact will provide an integrated toolset. In order to achieve this goal, each individual tool or tool component must be written to conform to a set of tool integration rules. These rules must deal with a certain number of facets of the integration problem. We have identified five main areas that must be addressed: the use of the object base, access to an object, tool composition mechanisms, the tools' user interface and the use of Common Services.

The Pact project began in February 1986 and will last for three years. Its total effort amounts to approximately 150 man-years. One of the early tasks of the project has been to provide a limited initial tool set to allow use of the PCTE interfaces. This tool set is currently available. The first tools integrated with each other and with the Common Services will be available in the first quarter of 1988.

3.4. The EAST Project.

The EAST (Eureka Advanced Software Technology) project aims to produce integrated software factories for a number of application domains. Its first truly integrated environment is scheduled to be available at the end of 1988 and includes a number of integrated tools. The environment will support development of system software and software for embedded systems. The tools of this environment will support well-accepted methods and functions, the added value of EAST being their integration. They include:



—structured editors for a variety of languages used in the software development process;

—text and graphic processing facilities, to support the large amount of effort devoted to document production by software engineers;

—low-level design tools, such as Program Design Languages (PDLs);

—programming language support tools, e.g., compilers etc.

—test and debugging support tools, including support for host-target use of these tools;

—language and method support tool kits will provide generic facilities on which tools to support particular methods can be built. Examples would include a generic graphic editor that could be customised for a particular graphic design language.

—version management tools will deal with simultaneous versions and history management;

—configuration management will deal with related groups of elements together with generation rules and procedures;

—host-target interface tools.

As one will observe from the above list, the tools will initially cover the later stages of the life-cycle more completely than the earlier stages. As the project continues more support will be offered for activities early in the life-cycle.

EAST has chosen to base its environments on PCTE and on the Pact results, particularly the Common Services that were mentioned above. They will therefore run on any PCTE implementation with sufficient hardware resources.

The EAST project began in April 1987 and will last for six years. The total effort is 900 man-years.

3.5. The ESF Project.

ESF (Eureka Software Factory) is a ten-year project under the Eureka programme. Its aim is to develop for an integrated software factory. The project involves fourteen major European manufacturers, software houses and research institutes.

A prime focus of the project is the exchange of information between tools in an integrated tool set and the storage of persistent data. In order for tools to share data, they must have a common understanding of the semantic of the data that they share.

The tendency is to represent more and more of the semantic of the data using the facilities provided by the basic SEE software. This software should therefore support a multitude of different standards corresponding to data with different semantics with the possibility of adding representations to the system.

It seems likely that the different standards may be organised in layers, each level conveying more and more semantic information about the data represented according to the standard defined at that level. The project has the declared intention of using, developing where necessary and promoting, data representation standards that will govern the exchange and sharing of data between ESF tools.

The ESF project does not yet have a declared position on the PCTE interfaces. Its emphasis on interoperability and the development of "deep" standards is complementary to the main thrust of other environment developments and compatible with the PCTE work.

As mentioned above, the ESF project is a ten-year project. It is divided into three phases. The first definition phase began in September 1986 and is due to end in September 1991. This phase has a projected effort of 980 man-years.

4. Conclusions: PCTE and the World.

The design and implementation of Public Tool Interfaces (PTIs) is an area in which there is much European work of high quality. This work has resulted in the PCTE interfaces.

Work in the United States in this area has, thus far, been dominated by the Ada community and the emphasis on support for the development of programs written in Ada. Our experience has shown that there is little that is language specific in a PTI.

The CAIS effort for Ada has already resulted in the definition of a military standard for Ada environment kernels. The standard has been greeted with some reticence by a number of important defence contractors and I am not aware of any industrial quality commercial implementations of the interface though several partial prototypes exist.

A United States Department of Defense project to revise the standard is currently in progress, the CAIS Revision A project. It is due to deliver its proposed revised specification at the end of 1987. After this, there is a period of review of the specifications. A prototype implementation is scheduled for mid-1988.

Amongst non-military and non-defence contractors in the United States there is a growing awareness of the importance of this area with the appearance of conferences and workshops on CASE (Computer Assisted Software Engineering), internal projects within computer manufacturers and even the establishment of specialist start-up companies with the goal of designing and implementing PITs.

In Europe, this parallel effort in the military and civil fields has been successfully avoided so far. Indeed, it is clear that many of the objectives of a PTI, for example, the enlarged market for software development support tools, are furthered if there is a common military and civil standard.

In Japan, the Sigma (Software Industrialised Generator and Maintenance Aids) project was begun in the mid 1980's. Its aim is to create a software development environment that is independent of hardware, and the development of a network system for retrieving and transmitting programs and technical information. The environment is designed to run on powerful single-user workstations connected on a local network. Its operating system will not be entirely new but rather an extension to Unix. It appears that the system will still be largely file-system based, without the richer data-modelling capabilities of PCTE's OMS for example. It appears that the design and development of this environment is still in progress with production quality implementations not available until 1989.

This brief review of the world scene shows that the public tool interface domain is one in which Europe has considerable expertise. We have transformed this expertise into a concrete specification for which there is now a standardisation initiative. Already, we are turning to the next challenge, developing our understanding of the nature of integrated environments built on PTIs and constructing the first examples.

Further information on PCTE or the Pact project may be obtained from:

Ian Thomas or Ian Campbell

GIE Emeraude

c/o Bull

68 Route de Versailles

78430 Louveciennes France.

More general information on PCTE and the PCTE initiative may be obtained form:

John Elmore

Software Technology and Advanced Information Processing Division, 25, rue Archimede,

B-1040 Bruxelles, Belgium.

5. References.

Alde86—Alderson, A., Bott, M.F., Falla, M.E., "An Overview of Eclipse", in "Integrated Project Support Environments", ed J. McDermid, Peter Peregrinus, 1986.

Bani85—Banino, J.S., Fabre, J.C., Guillemont, M., Morisset G., Rozier M., "Some Fault-tolerate Aspects of the CHORUS Distributed System", Proceedings of the 5th Intl. Conf. on Distributed Computing Systems, Denver, 1985.

Bull86—Bull, GEC, ICL, Nixdorf, Olivetti, Siemens, "PCTE: A Basis for a Portable Common Tool Environment, Functional Specifications, Fourth Edition", 1986.

CAIS85—Proposed Military Standard Common Apse Interface Set, U.S. Department of Defense, 1985.

Camp87—Campbell, I., "The PCTE Proposal for a Public Common Tool Interface", in "Software Engineering Environments", ed I. Sommerville, Peter Peregrinus, 1987.

Cart87—Cartmell, J., Alderson, A., "The Eclipse Two-tier Database Interface", Proceedings of the 1st ESEC, Strasbourg, 1987.

EURA87—Emeraude, Selenia, Software Sciences Ltd., "Requirements and Design Criteria for Tool Support Interface (EURAC)", 1987.

Mull87—Mullin, D., "Fortune: A Documentation Support System for Software Engineers", Proceedings of the 1st ESEC, Strasbourg, 1987.

Oliv82—Olivetti, "Portable Ada Programming System: Global Design Report", 1982.

Zimm84—Zimmerman, H. Guillemont, M., Morisset G., Banino, J.S., "CHORUS: A Communication and Processing Architecture for Distributed Systems", INRIA Research Report 328, 1984.

/06662

SCIENCE & TECHNOLOGY POLICY

Netherlands' New Science Policy Objectives Reviewed

New Orientation

3698A150 Zoetermeer SCIENCE POLICY IN THE NETHERLANDS in English Dec 87 p 2

[Text] A new orientation in Dutch science policy was announced in the first few lines of the 1988 Science Budget. There are various reasons for this. One is that changes are occurring in international competitiveness; others include the emergence of new issues and problems and changes in science and technology itself, both in Europe and outside.

The 1988 Science Budget, which was presented to parliament along with the national budget in September, exudes this air of change but the main features for the next fifteen years will be set out in a survey later this year. Over the past ten or fifteen years science policy has concentrated on developing policy instruments and changes in the infrastructure. This ties in with, for instance, the reorganisation of the Netherlands Organisation for Applied Scientific Research (TNO), the attempts to achieve an arm's length position for the research institutes, the arrangement of transfers of know-how and the institution of sector councils. A major change in public opinion over this period, the Science Budget states, is that there is now a more positive attitude towards science and technology.

The financial data relating to scientific research show that one sector, industrial productivity and technology, is becoming increasingly important. In 1988 it will account for some 31 percent of all government research spending.

This year, the Ministry of Education and Science has for the first time produced a higher education and research plan dealing with scientific research for which the ministry is responsible. A separate policy document, which also appeared on Budget Day, was issued by the Ministry or Education and Science and the Minister of Agriculture and Fisheries on the subject of the internationalisation of teaching and research.

Minister on Plans

3698A150 Zoetermeer SCIENCE POLICY IN THE NETHERLANDS in English Dec 87 pp 3-5

[Article by Jan Ormel and Liesbeth Jongkind: "Keep Checking To See if You Are on Course—Minister, We Have the Instruments, Now Let's Concentrate on the Substance"]

[Text] "We have now got our policy instruments sorted out, having spent a lot of time on this over the past ten years. You can talk for hours, days, weeks about responsibilities and interministerial coordination, but what matters at the end of the day is what you are going to do with them. It is time for the structure to prove itself. We must lay down the direction for the next ten or fifteen years of science policy."

Wim Deetman, who as education minister has also had the responsibility for coordination of the country's science policy since 1982, has talked more than he would have wished about structures and responsibilities in recent years. Not that nothing has happened in the world of research in that time, far from it. As an illustration, he had only to refer to the many promotion programmes that have been set up, for example in health research, information technology and soil research. These were areas selected for their importance to society and science and which may play a major role both at home and abroad in the near future. The programmes are evidently an instrument that works. Other examples are the investigation committees looking into various areas of science, reports, government statements, sector councils (in which groups from the world of science and within society have their part to play).

"These are things that we set up and are now under way," said the minister with evident satisfaction. "We are quite adapt at spotting gaps in technology and taking action, possibly involving other ministries. I don't usually have to give 'my officials' too many instructions. I start the ball rolling and after a few months a report lands on my desk, containing facts, analyses, pros and cons, suggestions for what to do and how much it will cost. 'Well, minister, what do you think'?"

"Some people think that I don't want to carry on with this sort of instrument, that I want to put a stop to them. Rubbish! Of course we must carry on. But if you can get things moving fairly rapidly, you must ask what new things you should get moving. What do you want science policy for? That is a question of contents, not of the instrument."

With these remarks the minister turned to the latest report from the Science Policy Advisory Council (RAWB). It dealt with just one subject this year—where to go next in science and technology policy. The Council's proposals were mainly about the structure of policy. "I would have liked to see the report deal with the subjects we should be looking at over the next few years, with the various aspects and developments. We need an analysis, an attempt to make predictions that can give direction to policy. These were the comments I made on the report and the RAWB has now started to look at the substantive question.

"A good structure is not the be all and end all. You can have a fantastic structure that just doesn't work and a ropy structure that sometimes does work if you have the right people and the right attitude."

Government encourages and directs. But how great is the government's influence? To what extent is a scientist free to come up with his own ideas?

"You can't really give a simple answer to that. On the one hand a scientist must come up with his own ideas. You can't impose them on him and he is there to develop them himself. But on the other hand, the public does ask questions. Scientists do not usually work in a vacuum. Since it is very difficult for the government to plan research, I have emphasised that universities and research institutes should set their own priorities. And, mark you, this is a matter for the universities as a whole, not just their research staff.

"At the same time the government does come across gaps in its policy, research that is not getting enough attention. Sometimes you need to take special action. But if you give additional funds you want to lay down some conditions.

"I am not saying that the government should not be involved. Give the money to the scientists and everything will be all right. On the other hand, the government cannot plan everything. You can't programme a research scientist. If you try, you are missing the point of research."

On the morning before this interview, the minister was at the celebration to mark the tenth anniversary of the science shops. On this occasion he called for the universities to be more open towards society—"more doors in the ivory towers"—and referred to the effect the science shops had had in this respect. The shops were brought into being by a previous science minister, but they were now run completely by the universities.

This is a typical example of how science policy works—getting out if it works well. Isn't that frustrating?

"It does necessitate a degree of detachment, but I don't find it frustrating. If things are going well it is time to move on to something else. If you take that attitude you can be independent and remain critical as to output. There were long discussions about the science shops—on how precisely they should be arranged. The nice things was that they produced results. That is what this ministry, and indeed all ministries, are there for. Not to hang on to things but to make sure that they get under way and succeed."

We asked the minister if he was satisfied at science policy's role in this.

"I don't go around worrying about it every day. Any more than I do about the education side of my ministry. But I once said that science policy is the relaxing part of the job. One factor is that I have been able to keep the science budget at about the same level in recent years. I am not sure whether I will succeed next year, but all in all you may conclude that the budget has not been cut. We've got sufficient elbowroom."

It seems that policy on science, technology and education is becoming integrated.

"I would resist any move to mix it all up together, but some overlap is unavoidable as we are pursuing a coordinated and integrated policy. It all ties in together. But science policy must influence the others. We have the sector councils, which are concerned with priorities, and the various ministries are more involved in this by definition. Another procedure for setting priorities before parliament is the science budget (which, strictly speaking isn't a budget at all but a number of observations). It states what we should be tackling. I will give you an example. Five years ago the budget contained something about soil technology, which was not an obvious area of research, not even for the Minister of Housing, Planning and the Environment.

"What is the next step? A discussion gets under way and parliament too feels that something should be set up. Twelve months later parliament asks why nothing has happened. So our answer is, listen, it all takes time. In any case the discussion has started because of the analysis or observation in the science budget.

"I am very much taken with the manner of working with promotion programmes. A relatively small budget can have quite a considerable effect. You involve others by means of matching grants. There have been some unfavourable comments about this, but it works quite well. For example, it guarantees involvement."

We asked the minister about future international policy. Should we go along with the rest or try to avoid doing so? To what extent is it still possible to go one's own way?

"I don't know whether you have to avoid it. You must indeed consider the questions which come up and try to arrive at a response. If you have taken up a position you are better placed in any discussion on the way to be followed. You may well have to give up the position, but at least you have considered it.

"You have to weigh up priorities. Nearly 190 million guilders for space research, for example, is a very large sum. This means there may be a time when you may want to call it a day unless there is obviously something in it. When you are putting such a large amount into an international organization as in the case of aerospace there must be some return for Dutch industry. I do worry about this as I wonder whether Dutch industry is sufficiently on the ball to use the knowledge gained from space research to improve its own production. If you feel there is not enough response, you have to ask yourself whether you shouldn't reduce such a large financial commitment. We haven't reached that stage yet, but I'm certainly not thinking of increasing it.

"It may be that people aren't interested—perhaps with good reason—but as a government you are then confronted with the question of whether you shouldn't cut back. For the time being I think we should stay at the same level, provided we get more response from the private sector."

Similar questions are now being asked, at Britain's instigation, about participation in CERN (the high-energy physics research institute) in Geneva. We asked the minister for his opinion.

"We have not yet made up our minds on possible cuts in the funds provided to CERN. The research there is so expensive that a small country cannot do it alone. That is really part and parcel of fundamental research into matter. It is a question not just of money but also of talent. The research is so wide-ranging that you can't have everything to hand that is needed. You have to work out well in advance the things that you do or do not want and act promptly to discuss the consequences of developments.

"CERN is successful, but it is time to have another look at it, perhaps precisely because it is successful. You have to keep checking that you are on course. This is why I fully approve of the British initiative. It came just when CERN had been awarded two Nobel Prizes, one to Simon van der Meer, a Dutch physicist. So it was quite a surprise to hear someone ask whether such an institute should be assessed. But it is actually just the right moment, so that ten years later you will not look back and say that was where it was at its peak."

Science Budget

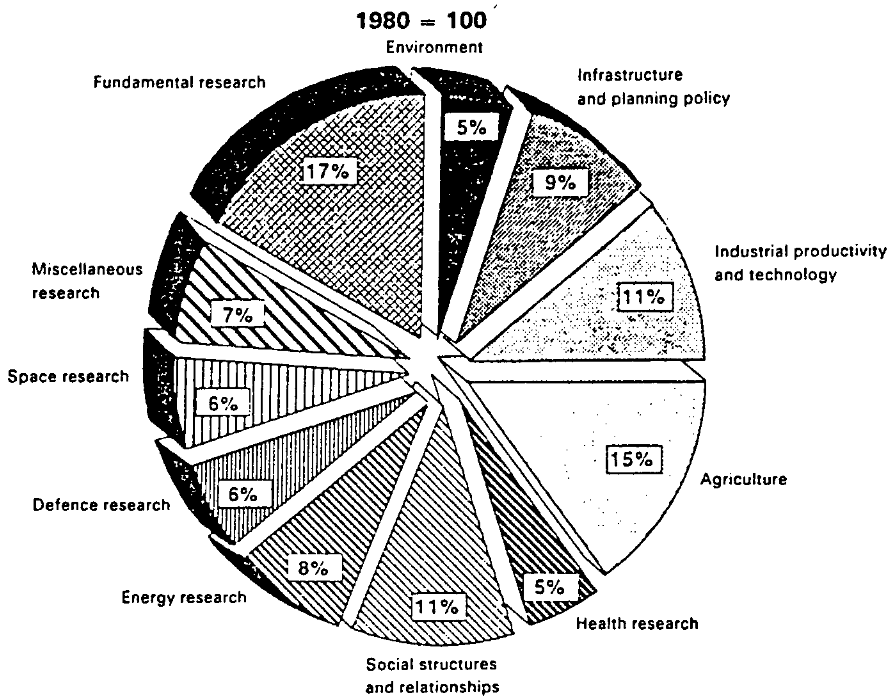
3698A150 Zoetermeer SCIENCE POLICY IN THE NETHERLANDS in English Dec 87 pp 6-8

[Article by Jacky Bax: "1988 Science Budget: More Attention for Culture and Medium-Term Trends"]

[Text] The Netherlands must be able to utilise and manage science and technology if it is to maintain its economic position in the 1990's. In so doing, economic, social and cultural developments must remain in balance. At present there are radical changes taking place in science and technology and in international competition. Next spring, therefore, the government intends to produce an outline of science policy for the next ten to fifteen years. In any case there must be greater international cooperation in teaching and research.

There are some of the points in the 1988 Science Budget, presented by Mr W.J. Deetman, the Minister for Science Policy. Together with Mr G.J.M. Braks, the Minister of Agriculture and Fisheries, he has produced a draft policy statement, "Internationalisation of Teaching and Research", with a view to promoting international cooperation. Besides financial data about research in the Netherlands the budget also refers to a number of trends

Total government-funded research (excl. university research) in 1980 and 1988 as a percentage of the total



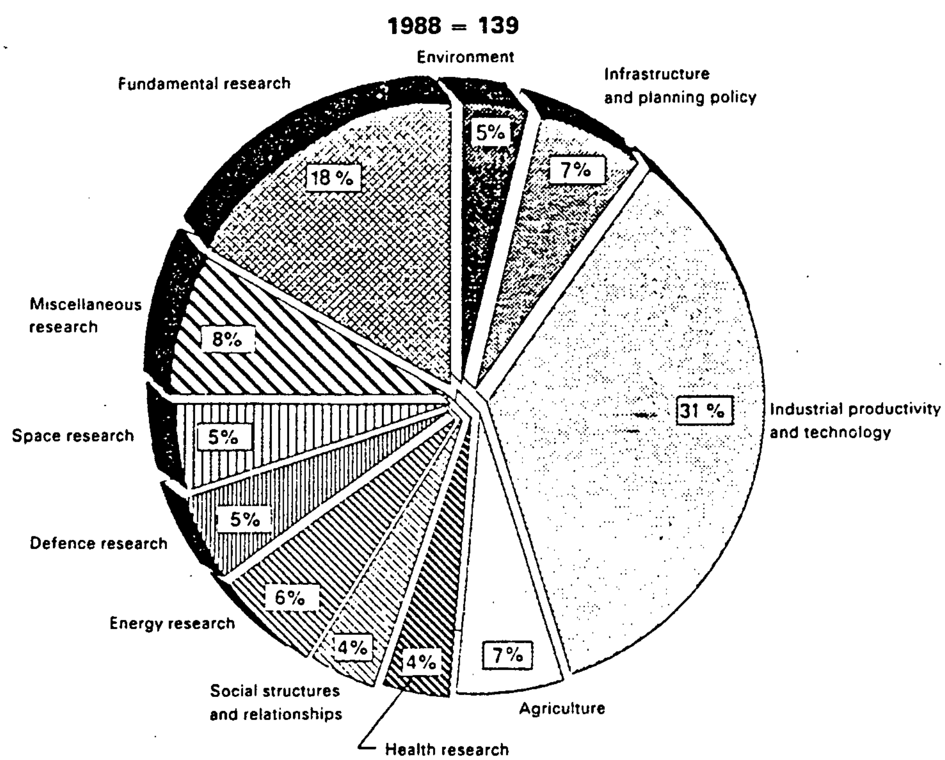


Table 1 Changes in total research spending, by sectors (in millions of guilders and as a percentage of GNP)

	Actual[1]										Estimates[2]									
	1980		1981		1982		1983		1984		1984		1985		1986		1987		1988	
	mln. gld.	% GNP	mln. gld.	% GNP	mln. gld.	% GNP	mln. gld.	% GNP	mln. gld.	% GNP	mln. gld.	% GNP	mln. gld.	% GNP	mln. gld.	% GNP	mln. gld.	% GNP	mln. gld.	% GNP
Central government, of which	3466	1.03	3569	1.01	3653	0.99	3763	0.99	3782	0.95	3794	0.95	3967	0.95	4093	0.95	4182	0.97	4183	0.95
- universities	1810	0.54	1794	0.51	1835	0.50	1841	0.48	1795	0.45	1700	0.43	1680	0.40	1690	0.39	1700	0.39	1630	0.37
- other institutes	1656	0.49	1775	0.50	1818	0.49	1922	0.51	1987	0.50	2094	0.52	2277	0.55	2413	0.56	2482	0.58	2553	0.58
Private sector	2978	0.89	3203	0.91	3393	0.92	3793	0.99	3940	0.99	3940	0.99	4250	1.02	4400	1.03	4550	1.05	4700	1.07
Other	485	0.14	473	0.13	535	0.15	553	0.15	464	0.11	460	0.12	460	0.11	460	0.11	460	0.11	460	0.11
Total	6929	2.03	7252	2.06	7581	2.06	8109	2.13	8186	2.05	8194	2.05	8677	2.08	8953	2.09	9192	2.13	9343	2.13
GNP (market prices, billions of guilders)	336.1		351.9		368.5		381.6		399.8		399.8		418.0		429.2		432.05		438.6	

[1] Source: Speur- en ontwikkelingswerk in Nederland (R&D in the Netherlands). Central Bureau of Statistics. For the purposes of comparison, the 1980 figures for university spending by the Ministry of Education and Science/Science Policy have been adjusted on the basis of the revised R&D percentages used after 1982. Unlike previous Science Budgets, use has been made of the data in the CBS input/output tables. This takes account of most of the funds for contract research to obtain a more statistically accurate picture of the flows of funds.

[2] Estimates for 'other institutes' are from ministerial figures. The same applies to estimates for universities but using the R&D percentages in the CBS time and motion study (1982/83). These estimates are to the nearest 10 million guilders. The estimates for 'private sector' and 'others' are estimates extrapolated from 1984 by the Ministry of Education and Science/Science Policy.

Table 2. 1987 and 1988 budget figures and 1989–1992 multiyear estimates for all research funding, classified according to areas of government responsibility (in millions of guilders)

	final budget 1987	draft budget 1988	1989	estimates 1990	1991	1992
1. Environment (exploration etc.)	23.1	25.2	24.4	23.9	23.9	23.9
2. Infrastructure and planning	190.1	187.7	190.2	188.1	185.0	184.9
3. Environmental pollution	127.6	130.4	130.0	132.9	139.0	131.6
4. Health research	105.2	104.7	103.1	103.0	103.0	103.0
5. Energy	168.4	145.9	144.0	142.6	166.4	168.0
6. Agriculture	177.7	179.0	176.8	174.0	173.9	172.6
7. Industrial productivity and technology	735.8	776.2	802.0	901.7	632.2	613.1
8. Social structures and relationships	101.0	101.4	100.9	99.4	100.0	100.0
9. Space research	116.0	137.6	143.5	152.2	156.0	151.0
10. University research	1700.0	1630.0	1640.0	1670.0	1680.0	1690.0
11. Non-application-oriented research	431.4	455.0	466.1	480.0	486.1	490.0
12. Miscellaneous research	188.7	181.3	182.0	177.5	177.8	178.0
13. Defence	117.2	126.0	127.1	127.8	128.8	129.7
Total	4182.2	4182.7	4229.8	4372.9	4152.0	4135.5

currently taking place in science and medium-term priorities for science policy. There is also a survey of current activities, including stimulation programmes, within science policy and a description of the use of investigations in various areas of science.

Financial Data

The Netherlands will spend 150 million guilders more on research in 1988 than in 1987. As a percentage of GDP this is a stabilisation as GDP rose more rapidly, but in comparison with the years up to 1987 the trend is still upwards.

The increase in research spending will be met by the private sector, which will spend 4.7 billion guilders in 1988, up from just over 4.5 billion in 1987. The government, on the other hand, will spend about the same. The multi-year estimates, however, indicate a slight rise in government spending on university research after 1988.

Priorities

The 1988 Science Budget sets out five main priorities for science policy: fundamental and strategic research; replacement of and investment in research equipment; international orientation and cooperation; promotion of and innovation in specific research fields; throughput of know-how within the research system and to society. Additional attention will also be given to courses to produce suitably qualified people ("human capital"). The 180-plus non-university research institutes in the Netherlands will also be looked at and their projects will be examined by the Science Policy Advisory Council.

Trends

The Science Budget notes a number of medium-term trends in scientific research as a whole. Major developments are occurring in biology—there are new applications in, for instance, energy, biotechnology, health care, environmental control and pattern recognition. Biology has to deal with problems on a worldwide scale, for example environmental problems, and is increasingly involved with other disciplines. The Sector Council for Environmental and Nature Research (RMNO) will be producing a report on environmental research later this year. Three disciplines are continuing to expand—mathematics, pattern recognition (important for cognitive psychology, photo-technologies like holography and possibly earth observation, neuro-informatics, medical diagnostics and data processing in the humanities and social sciences) and information technology as a research instrument.

In the field of fundamental and strategic research there are major developments in astronomy/high-energy physics, neuro-informatics, geophysics, microelectronics, IT in cooperation with other sciences (e.g. telematics), optical techniques and superconductors.

Technical sciences need to be developed in fields like IT, biotechnology and material technology and there should be renewed interest in traditional fields like chemical engineering, civil engineering, transport technology and agricultural technology.

Both medical sciences and behavioural sciences, as well as humanities, are seeing a growing gap between fundamental research on the one hand and professional practices and training on the other. The development of data infrastructures is increasingly crucial for these disciplines.

Research Management

The government is attempting to achieve indirect management, in which the research institutes themselves would be responsible for policy formulation and control. The government would simply indicate the desired directions for research and provide the required conditions (e.g., funds) for the organisations. Science policy includes the development and testing of financing and management models in order to promote such autonomy.

Promotion Programmes

The 1988 Science Budget contains a survey of current promotion programmes in information technology, microelectronics, employment issues, health research, soil research, earth observation, marine research, materials, programme evaluation, tropical rain forests, toxicology, cities, CO_2 problems, ageing, aids for the disabled and energy storage.

New Areas

As part of science policy, activities are being developed in telematics (the integration of IT and modern telecommunications technologies), IT and the law, culture, the humanities and infrastructure (transport, logistics, communications). Telematics is a promising area of research in both technological and economic terms. There is a growing feeling that more attention must be given to culture to counterbalance the increasingly technological and international nature of our society.

The humanities have not been left untouched by developments in other disciplines. There are, for example, areas of overlap between psychology and linguistics; logic, IT and linguistics; archaeology and the technical sciences.

The investigation project has been set up in order to identify anticipated developments in the various branches of research.

The Science Budget contains an analysis of the relationship between civilian and defence research as a contribution to the discussion on this issue.

Progress Report

3698A150 Zoetermeer SCIENCE POLICY IN THE NETHERLANDS in English Dec 87 p 12

[Article by Jan Ormel: "Progress Report—Greater Interest in Information Technology"]

[Text] As in previous years, Mr W.J. Deetman, the Minister of Education and Science, presented the progress report on the IT Promotion Plan at the official opening of Parliament in September. In so doing he was also speaking on behalf of the Minister of Economic Affairs and the Minister of Agriculture and Fisheries. The plan was initiated in 1984 and is due to run until 1988 but certain elements are to run a further year, such as the promotion of IT research, the implementation of the SURF[1] plan and government acquisitions for innovation.

The government felt that the various parts of the plan had made good progress and the public was now much more aware of IT. The next step will be to evaluate the progress of the plan, and a group of external consultants have been commissioned to do this. A more substantive evaluation will follow later. Some parts of the plan will be carried out by the Technology Agency proposed by the Dekker Committee.

Education

At present there is not enough educational software and the government intends to appoint a project manager to develop such software over a four-year period, as set out in its policy document on the matter. A project will be set up to provide training courses for teachers in vocational schools, while the NIVO project, to enable secondary schools to use computers, is going according to plan. Last year a second group of schools received the necessary hardware and software.

A school leavers project, set up by the Ministry of Education and Science, the Ministry of Economic Affairs and the Ministry of Employment and Social Security, is producing results—over 85 percent of its graduates have found jobs.

A number of spearhead projects have been set up for higher vocational schools and a start has been made on projects on office automation and artificial intelligence. Definition studies are being carried out in telematics, computer integrated manufacturing, systems development and other fields. As from 1989 promotion of information technology in schools must be performed through normal channels, which means that next year the plans' achievements must be incorporated into everyday schooling.

Research

The research project team has already got two projects under way[2] and three more were approved in October 1986: a flexible automation and industrial robots programme (FLAIR), involving the three universities of technology and TNO and costing 23 million guilders next year, a Software Engineering Research Centre (SERC), in which universities, ten Dutch software houses and a number of large companies are working together in "a unique way" (according to the report), and a programme to support a number of small innovation research projects, for example an intelligent assembly cell project being developed by Delft University of Technology with two hexaxial robots.

The Private Sector

The main emphasis in this section was the application of IT in small and medium-sized businesses. Some forth firms are now represented in the Information Technology Council, whose projects include the compilation of a standard encyclopaedia for software development.

The scheme to give grants for publicity on information technology was extended by one year after 1986 and 2.5 million guilders was reserved for this in 1987.

Almost 50 organisations have made use of it so far. A total of 14 Dutch companies and 11 research institutes are taking part in ESPRIT, a European Commission research programme that aims at putting the European information industry on an equal footing with those of the USA and Japan. The Netherlands is involved in 60 of the 236 projects.

Government

There are a number of projects aimed at promoting IT in government, for example courses for management-level officials, a special government IT promotion project and the privatisation of the Government Computer Centres. In July 1987 the government agreed in principle that the latter should be achieved by 1 January 1989.

Agriculture

The progress report noted that, after a slow start, the IT Promotion Plan was proceeding as planned as far as agriculture was concerned. Various parts of this will probably continue until 1990. Data models for pigs, dairy cattle, poultry, glasshouse horticulture and crops have been completed and three others are being developed. These models are important for further computerisation in agriculture. A total of 20 to 25 million guilders will be spent in this sector between 1986 and 1990.

Footnotes

1. SURF, set up on 25 March 1987 as an organisation for cooperation over computer facilities in higher education and research.

2. The speech analysis and synthesis project for developing and improving computer voice simulation and the PRISMA project in which Philips and five universities are working on a fifth-generation computer. The two projects have been under way since 1986.

/06662

BMFT Report Assesses FRG's Share of World Technological Market

3698m162 Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German No 469/470, 16 Dec 87 p 2

[Excerpt] With a world market share of over 11 percent, the FRG's economy regained a leading position in 1986, following a decline in the 1970's. High-technology and high-quality consumer technology accounted for 11 percent and 43 percent respectively of that share, totaling about 54 percent for research-intensive products as a whole (high-technology products are those for which R&D spending exceeds 8 percent of the sales value—R&D spending in the high-quality consumer technology sector exceeds the average in the manufacturing sector, which at present is about 3 percent).

In 1986, exports of research-intensive products totaled 36 percent, thus exceeding the average of industrial goods (33 percent). The growing importance of research-intensive products to FRG foreign trade was reflected by [the fact that] the FRG's economic performance was better than that of the United States or Japan: Japan 24 percent, U.S. 4 percent and the FRG 36 percent.

The FRG's most successful high-technology sectors are:

—Electrical engineering products: installations and equipment for the distribution of electric power, starters, generators, signal and control systems;

—Measurement and control technology;

—Optical instruments;

—Nuclear reactors;

—Pesticides, basic organic products (in part drugs and pharmaceutical products).

Particularly remarkable was the increase in world market share for data processing equipment, an area in which the United States and Japan have traditionally performed better. The market share in this area could, in fact, be expanded from 9 to 11 percent.

The positive performance in the field of high-quality consumer technology is to be attributed mainly to [results achieved in] the following sectors:

—Mechanical engineering;

—Segments of the electrical engineering industry (e.g. manufacturers of television sets, converters, medical equipment, or household appliances);

—Automobile industry;

—Fine mechanics, optics;

—Steelwork, construction work, and machine tools;

—Almost the entire chemical synthesis sector, including dyestuffs and plastics, paints and varnishes, inorganic chemicals, and a few special chemical products.

In 1986, research-intensive sectors were also responsible for giving the strongest impetus to employment (see Table 2).

Competitiveness is also expressed by the export-import ratio (exports as a percentage of imports), whereby a country's competitiveness is determined by its ability to export more goods than it imports from abroad.

From this point of view, if the export-import ratios for the FRG'S trade in research-intensive products (see table 5) are compared with those of Japan and the United States, the following conclusions can be drawn:

During the period under consideration there was a surplus in the FRG'S foreign trade balance with the United States in research-intensive products. Between 1984 and 1986, the performance of the high-quality consumer goods [sector] improved considerably [over the previous years]. In 1986 alone, FRG companies exported high-quality consumer goods to the United States four times as much as United States firms exported to the FRG. Regarding high technologies, the FRG was still a net importer, yet the trend began to improve [for the first time]. Over several years, FRG industry had the greatest comparative advantage in the sectors of automotive industry, mechanical engineering, fine mechanics/optics, and metal processing. The United States played a leading role in the production of fissile and fertile materials, data processing equipment, office equipment, as well as in aeronautics and astronautics.

During the period under consideration, taken as a whole, the FRG's balance regarding foreign trade for research-intensive products was negative compared to the Japanese one. However, the FRG's overall performance had remained unchanged since 1984. A separate analysis of the various categories of goods shows that certain sectors of the chemical industry performed well, while trade in data processing and office equipment, electrical engineering, fine mechanics/optics, metallurgical products, and automotive industry showed deficits.

FRG industry has undertaken intensive research and development efforts that have improved its technological standard. This is also confirmed by a study carried out by the Fraunhofer Institute for Systems Technology and Innovation Research (ISI) on the technological standard of a selected [group of] research-intensive products. The following statistical comparison refers to the selected high-technology sectors (see Table 1):

According to Table 1, the technological standard of FRG industry almost equals that of the United States in the areas of industrial robots, laser generators, biocatalysts, and sensors, while it exceeds that of Japan in the fields of laser generators, sensors, and genetically engineered pharmaceuticals.

Table 1

Technological sectors	Technological standards 1)		
	D	USA	J
Industrial robots	0.78	0.84	0.78
Laser beam sources	0.71	0.86	0.53
Biocatalysts	0.65	0.74	0.72
Sensors	0.63	0.69	0.60
Genetically engineered pharmaceuticals	0.60	0.89	0.34
Solar cells	0.53	0.72	0.70

Footnote 1) The indicators vary between 0 (low compared with world standards) and 1 (highest standard in the world). They are also aggregate parameters, and take into account technical characteristics—in the case of lasers, for example, factors like performance, radiation properties, handling, and processing technology.

Table 2—Labor in the selected export industries:

Branch of Industry	Thousands of employees			Percent change from previous year		
	1984	1985	1986	1984	1985	1986
Electrical engineering	878	923	962	0.5	5.1	4.3
Mechanical engineering	930	950	985	-2.7	2.1	3.7
Automotive industry	785	809	838	1.1	3.0	3.6
Chemical industry	553	559	570	0.3	1.2	1.8

Source: Federal Office for Statistics, estimates by DIW [FRG Institute of Economic Research].

Table 3—Research-intensive products: exports as percentage of imports. FRG Trade with the United States and Japan

	1981	1982	1983	1984	1985	1986
Compared to the United States						
High technology	27.2	36.0	39.0	46.9	45.8	54.8
High-quality consumer technology	239.9	264.5	277.2	340.5	368.0	467.5
Total	115.0	141.6	150.8	185.4	194.4	238.6
Compared to Japan						
High technology	59.9	55.4	40.0	32.4	29.6	32.9
High-quality consumer technology	30.7	35.3	33.1	31.2	34.4	32.7
Total	34.4	38.4	34.3	31.5	33.5	32.8

Source: (NIW) [Economic Research Institute of Lower Saxony]

08802

FACTORY AUTOMATION, ROBOTICS

Hungary Shows NC Machines, Robots, Machine Tools at Budapest Fair

NC Lathes, Milling Machines

26020005 Warsaw PRZEGLAD TECHNICZNY in Polish No 13, 1987 pp 16, 25-30

[Part II of article by Jerzy Zacharzewski, director of the general-technical division of the Machine Tools Research and Design Center, Pruszkow: "Hungarian Machine Tools at the Hungexpo Fair in Budapest—Characteristics and Technical Specifications of Conventional and NC Machines manufactured by the Csepel Works"]

[Text]

Machine Tools From the Csepel Works

The ERJ250 NC turret lathe is characterized by the vertical axis of rotation of its 10-item turret head and a horizontal bed. This machine is a turret lathe rebuilt as an NC lathe (a so-called inexpensive work lathe) and is used to machine objects held in a hydraulic chuck. The spindle drive has a two-speed (13 or 10 kW) asynchronous motor. The spindle can operate at 10 programmable speeds of from 63-1400 rpm. The spindle speeds are changed by electromagnetic clutches.

Travel along both axes is powered by direct-current thyristor-controlled motors. The highest travel speed is 4 meters per minute. Tools are fit outside of the lathe with the help of an optical device. The maximum bore diameter is 250 mm and the maximum bore length is 200 mm. The maximum chuck diameter 500 mm over the bed and 350 mm over the horizontal slides. A Dialog-601 CNC computer-control system is most often used but any other type of NC system can also be used.

The SD-NC 530 E/500 chuck lathe and the SD-NC 530 E/1000 center-chuck lathe are built in cooperation with the Austrian firm of Heid. They have been specially designed for numerical control (Figure 17). These lathes can be used to machine parts mounted in a chuck or centers or objects turned from billets. The maximum machining diameter is 530 mm over the bed and 430 mm over the carriage. These lathes are built with a bed titled 60 degrees from the horizontal. They include a single large tool head on the vertical axis of rotation parallel to the spindle axis. It has 8 positions in normal operation and 12 is special operation. Half of the tools are designed for external machining and the other half for internal.

The spindle is driven by a direct-current 55 kW motor in normal operation and a 45 kW thyristor-control motor in special operation. The spindles speeds are 90-2240 rpm and 45-1120 and 90-2240 rpm, respectively (speeds are changed by gears).

The spindle is set in two precision taper-roller bearings and is driven from its other end by a discharged pulley with numerous narrow V-belts banded into one wide belt (Figure 18).

The travel motion is provided by DC thyristor-controlled motors. Fast travel is 10 m/minute. The maximum workpiece diameter is 430 mm over the carriage and 530 mm over the bed. The lathe is controlled by a Hungarian Hunor PNC 712 CNC-type microprocessor system. The tailstock works on an electromechanical principle. The cutting zone is covered by a tight-fitting, removable shield with a large window and chips are removed by a mechanical transporter.

The SD-NC 610 E/1000 and SD-NC 610 E/1500 center-chuck lathes belong to the same type as the SD-NC 530 E/1000 already described. The maximum work diameter is 610 mm over the bed and 430 mm over the carriage. Center distance is 1000 or 1500 mm (Figure 19). The number of tool head positions is 12. The head-rotation time is 1.1 second for one position and 4.4 for 11. The spindle speed range is 45-1120 and 90-2240 rpm and the spindle drive motor has 45 kW of power at two speed ranges and 55 kW at one speed range.

The design and other values are characteristic of the SD-NC 530 E lathes previously described. The machine can be controlled by a Hungarian EMG-Hunor CNC 712 microprocessor system or a Siemens (General Federal Republic) General Numeric 6T Model B.

The FND 32N1 NC tool cutter was displayed by FOP Avia in Warsaw and Csepel in Budapest and Hunexpo 1984. It is controlled by a Hungarian CNC Hunor PNC 718 triaxial microprocessor system. The cutter spindle is driven by a 3-kW asynchronous motor. The spindle has 18 speeds of between 35.5 and 1800 rpm. Continuous travel along three axes is provided by Polish Wamel-Porter DC thyristor-regulated motors. Fast is 2 m/minute along the X and Y axes and 1 m/minute along the Z axis. The work surface of the horizontal table is 400 x 800 mm and the vertical attachment surface is 280 x 1100 mm.

The MU-51 CNC knee-type horizontal milling machine with a transverse-travel beam and a double-spiral headstock can mill surfaces set at any angle (Figure 20). The spindle with an ISO 50 point is powered by an 11-kW motor that can be operated at three automatically changed speed ranges of 22.4-290, 281-710 and 711-1800 rpm.

Travel is powered by DC motors produced under license to the firm of Gettys. The milling machine can be operated in automatic linear or right-angle cycles. The working surface area of the table is 500 x 1600 mm, fast horizontal and transverse travel is 4.5 m/minute and fast vertical travel is 1.5 m/minute. An EMG-Hunor 714 CNC-type system or a Bosch Alpha 3 system is used for numerical control.

A machine-tooling center exhibited at Hungexpo 1986 was built on the basis of an SD-NC 610 E/1000 NC center-chuck lathe. For machining, this system was given an MR08 double manipulator produced at the Rekard Factory in Gyor. This manipulator automatically changes workpieces and toothed tool tails (Figure 21).

The manipulator's modular design lets it be adapted to automatic and varied service of machines tooling disk and roller type objects. This is an electromechanical manipulator with 3-5 degrees of freedom. Its horizontal travel speed is 48 m/minute and its vertical travel speed is 40 m/minute. The maximum work sizes are 90 mm (diameter) and 800 mm (length) for rollers and 2500 mm (diameter) and 250 mm (width) for disks. The manipulator can lift two 40-kg rollers or two 25-kg disks at the same time. It is also used to service 800 x 800 mm or 800 x 1200 mm tool magazines stacked tool magazines (up to 5 pallets).

In the manipulator, along the lathe there has been set a gate stand [stojak bramowy] with a vertical bar (with horizontal paths) under the lathe. Two identical manipulators travel on these ways. The left manipulator feeds workpieces taken from a pallet into the lathe and places finished pieces onto another pallet while the right manipulator changes tools in the 12-position turret. The manipulator is guided by the machine's CNC system.

M6 and M10 standardized vertical machine centers are designed as a drilling and milling system (Figure 22). The spindle is driven by a DC thyristor-control motor and has three ranges of continuous regulated speeds which are changed by electromagnetic clutches. The tool is clamped in the spindle tip by a spring chuck with a packet of disk springs and is loosened by an hydraulic cylinder. The spindle pocket is automatically blown-out by compressed air forced through the spindle and the magazine pockets are cleaned out by rotary brushes.

Travel along two or three axes is provided by DC thyristor-regulated motors which directly drive directly screw gears. The required degree of precision in position measurement is provided by proximity switches. The fitting and control system can use contactors and relays or electronic logic elements.

The standardized family of machining centers includes drilling and milling machines that have been gradually enhanced until they have become fully-automated machining centers with operative workpiece loaders and tight housings for the entire machining process that have sheet-metal housings with large windows.

Modular block standardization makes it possible to obtain about 48 different design combinations. Thanks to the use of various spindle speed ranges, different NC control or CNC computer control systems and copying systems the number of variants will be increased still more.

The respective technical specifications for the MVI 6-11, MFT 6-11 and MVI 10-11 centers are: table size—630 x 1200/1600/2000, 630 x 1200/1600/2000 and 1000 x 2000 mm; circular table diameter—600, missing and 1000 mm; fast travel speed—6 or 10 m/minute; spindle speeds—22.5-1400, 28-1800, 36-2240 and 45-2800, 22.5-1400, 28-1800 and 36-2240 and 22.5-1400, 28-1800, 36-2240 and 45-2800 rpm; and spindle motor power—22 kW.

The employed pallets have dimensions of 630 x 630, 630 x 800 and 1000 x 1000 mm. The M6 and M10 machining centers are equipped with a catenary tool magazine with 35 or 60 pockets. The magazine is set in a vertical position to the left of the stand and the vertical-motion headstock. The tools are automatically changed by a two-handed tool loader.

In these four machining centers, the workpiece washing and drying station, measurement machinery, pallet changers, the rail pallet transporter and the pallet loading and unloading stations have become a flexible production system which is operating in the Csepel Machine Tools Factory in Budapest.

The YBM-90N standardized vertical machining centers are built on a license from the Japanese firm of Yasda. These are designed as a system longitudinal milling machine with a rectangular table holding a rotary table for automatic attachment of square pallets. The table position can be set in degree increments (360 degrees). The headstock moves vertically in a channel stand [korytowy stojak] which performs transverse movements. The symmetrical arrangement of the machine's design allows even thermal distortion of the stand and eliminates thermal side displacement of the spindle axis.

Thermal stabilization is provided by additional cooling of the lubricant. To the right of the stand is a catenary tool magazine with 60-80 pockets and a chain in a B-configuration (Figure 23). There is a two-armed tool loader on slides that move along arched ways that embrace the corner of the stand. All sides of the cutting zone are covered by a sheet-metal housing with windows. The front windows automatically withdraw to let the loader load a pallet without shutting down the machine. The spindle is driven by a thyristor-controlled DC motor. The motor power is 15 kW which can be pushed up to 18.5 kW within 30 minutes. The spindle speed range is 30-2400 rpm. The machining centers are built in three sizes. The respective technical specifications for the YBM 90N-80, YBM 90N-100 and YBM 90N-125 are: table size—800 x 800, 1000 x 1000 and 1250 x 1250 mm; maximum pallet load—1500, 1800 and 2200 kg; X-axis table travel—1000, 1200, 1600 mm; vertical Y-axis spindle travel—1000, 1000 and 1200 mm; lateral X-axis stand displacement—1000 mm.

The automatic tool-changing time is 15 seconds and pallet-changing time is 50 seconds. A special machining center with an 18-kW motor that can be overloaded to 22 kW and a spindle speed range of 40-3200 rpm is being designed. Control is provided by a Siemens Sinu-Merik Spront 8M CNC three-axis microprocessor system.

The independent machining station for body parts was designed and built by the Csepel Machine Tools Plant and is based on a YBM-90N machining center. It is equipped with a semicircular magazine of 5 pallets with various workpieces (Figure 24). The rotary loader takes a selected pallet from the magazine and moves it radially up to where it then takes a half turn and places it on the machining table. At the same time, the appropriate program for machining the given piece is called up from the computer system's memory (on the basis of the identity number of the pallet loaded onto the table).

Another variant of this station is equipped with a revolving magazine containing 6, 8 or 10 pallets. It can be used in a flexible production system which also contains a workpiece washing and drying station and an automatic measuring station. Tool sharpness is monitored by continuous check of the intensity of the electrical current feeding the travel motors and the spindle motor. This prevents excessive wear on tool teeth that increases the burden on the electrical motors.

The need to store sharp tools and adapt the automatic machining station to operator-free work over one or two shifts demand a large increase in tool magazine capacity. In this case, the use of four catenary magazines holding as many as 300 tools in a B-configuration is planned. The magazines are arranged parallel to each other on the left side of the stand and is set perpendicular to the spindle axis. The automatic machining station is also equipped with diagnostic devices.

The MK 5000 light machining center is the newest product from the Csepel Machine Tools Plant (Figure 25). It is constructed as a horizontal milling machine with a transverse-motion channel stand within which the headstock moves. On the front of the stand (over the headstock), is a rotary disk-shaped tool magazine with 24 pockets on the horizontal axis of rotation parallel to the spindle. Tools are automatically changed without a loader (Figure 26). The headstock moves vertically to the uppermost position in such a way that the adapter holding the tool is gripped indirectly by the free, open magazine pocket which then travels forward to pull the tool from the spindle end.

Pallets are automatically changed on a machining table that can be positioned in one-degree increments (total of 360 degrees). The pallet loader operates on the principle of perpendicular travel and does not rotate. All of the machining is tightly closed off by sheet metal housing with large windows. Chips are removed by an automatic chip transporter. Linear proximity switches measure travel.

The spindle is driven by by an 11 kW thyristor-control DC motor. The spindle speed range is 30-3000, 40-4000 or 50-5000 rpm, the pallet attachment surface area is 500 x 500 mm, the table's horizontal travel along the X-axis is 600 mm, the stand's lateral travel along the Z-axis is 450 mm and the headstock's vertical travel along the Y-axis is 500 mm.

The MK 500 machining center is controlled by a Sinumerik 3M (West German) CNC microprocessor system or the Hungarian Hunor PNC 722 system. The programmable PC control system serves as an adjusting and controlling system for the CNC.

The stand's body is welded. Part of the ways are made for sliding on plastic linings while the other part provides rolling movement on rollers. Thermal distortion is reduced by the symmetrical design and various heat sources are removed from the proximity of the cutting zone. Hot air from the spindle is drawn out through flexible hoses. In order to maintain a constant spindle temperature, a heat exchanger has been attached to the oil circulation system for the spindle. The heat removal system is shown in Figure 27. Thanks to this, the maximum spindle displacement due to heat distortion is 4 microns.

The center is equipped with devices to automatically monitor the state of tool teeth, measure the workpiece on the machining table and automatically correct tool positioning. The electrical motor load is also monitored in relation to set boundary values for allowing teeth dullness.

It is expected that MK 500 machining centers will be used in automated production nests for machining body parts. In such a nest, an industrial robot serves two centers and a shared magazine of workpieces. The placement and clamping of machined objects will be carried out with the help of changeable tools arranged on pallets.

RF-type radial drills. Radial drills have been produced at the Csepel Machine Tools Factory for 40 years and have since then become a "Hungarian specialty". The following are the technical specifications for the RF50, RFh75 and RFh100 radial drills, respectively: maximum drill diameter in steel—50, 75 and 100 mm; number of spindle speeds—12, 21 and 21; range of spindle speeds—45-2000, 19-1900 and 18-1800 rpm; number of degrees of spindle motion—9, 12 and 18; range of spindle motion speeds—0.005-1.25, 0.047-2 and 0.037-2 mm/minute; and power of spindle motor—4, 11 and 15 kW.

HFR radial drills (Figure 28) are characterized by the preselection of spindle rpm and travel speeds. They also have hydraulic clamps, adjustable drilling depth and an automatic hole-threading cycle.

The respective technical specifications for the HFR50, HFR75 and HFR100 radial drills are: maximum drill diameter in steel—50, 75 and 100 mm; number of spindle speeds—12, 24 and 24; range of spindle speeds—16-2000, 10-2000 and 8-1600 rpm, number of degrees of spindle motion—9, 18 and 18; range of spindle motion speeds—0.05-1.25, 0.037-2 and 0.037-2 mm/minute; and power of spindle motor—4, 11 and 15 kW.

The KM-250 thread grinder is constructed in two length variants. The KM250/500 (Figure 29) can grind threads up to 485 mm while the KM250/1000 can go up to 1020 mm. The grinder is characterized by its great flexibility as it can grind metric and inch threads (single or multi-turn), cylindrical threads and conical threads. It has hobbing cutters and rollers for threads, screws and circular nuts. Short threads can be ground by the incision method.

The use of special equipment also makes it possible to grind internal threads, hobs of small diameter and large pitch as well as teeth. Manual and automatic devices are provided for dressing grinding wheels. The grindwheel headstock can easily be moved aside and adjusted to the camber of the threads being ground. The grinder comes equipped with equipment to compensate for thermal distortions.

The technical specifications for the KM-250 are: maximum workpiece diameter—254 mm; minimum internal thread diameter—19 mm; thread pitch—0.42-300 mm; maximum taper—1:8; number of spindle speeds—20; spindle speed range—0.32-63 rpm; range of spindle speeds when saddle is removed—0.32-95 rpm; dimensions of a new grinding wheel——405 x 76 x 203 mm; and dimensions of a grindwheel with maximum wear—405 x 6 x 203 mm. At grindwheel speeds of 100, 850 and 1540 rpm, the grindwheel motor power is 4.5 and 2.2 kW and the workpiece motor power is 1.5 kW.

The KM-320 thread grinder is designed for three maximum grinding lengths of 630, 1250 and 2000 mm. There exist several versions of differing degree of automation and with manual or semi-automatic control. Thanks to its ability to grind threads in two directions, the machine has a high rate of work. It is precise enough to grind high-precision circular screws for gear transmissions and various types of worm gears.

Some of the most important characteristics of the grinder should be mentioned and they are: linear correction of thread pitch error, continuous spindle speed and travel control, a work zone tightly covered by removable shields with windows, a system for sucking oil mist from out of the work zone, the ability to grind internal threads, gear teeth and plain cuts, and manual control (with the necessary special equipment) by a programmable PC.

The technical specifications for the KM-320 grinder: thread pitch—0.4-400 mm; maximum angle of thread lift—plus or minus 45 degrees; maximum grind modulus—16 mm; maximum conical thread—1:3; maximum weight of workpiece—200 kg; grindwheel diameter—350-450 mm; grindwheel width—8-80 mm; range of grindwheel spindle speeds—0-2690 rpm; range of workpiece spindle speeds—0.1-120 rpm; motor power— 32 kW; per-unit pitch error—0.002 mm; total pitch error per 300 mm—0.005 mm.

The FKA-326-10 gear grinder works by the roll method (Figure 30). It can grind simple and helical gears with barrel surfaces and with normal or modified tooth profile. In gears with tooth modules of 0.5-1.5 mm, tooth cuts can be ground without any preliminary work.

The grinders works in a semi-automatic cycle and its output can be increased through the use of two-coil grinding worm and a device that dresses the grindwheel profile. To adjust the speed according to the number of teeth and additional turns, changeable gears are used. Grinding precision of classes 3-5 is attained through the use of a single-coil helical grindwheel while the two-coil wheel can achieve precision classes 3-6. Tooth-cutting precision is DIN 3962.

The grinder is electrohydraulically controlled by Hungarian-made Danuvia-Rexroth hydraulic elements and relay systems and if desired, a manually programmable PC logic system can also be used.

The technical specifications are: range of gear diameters—10-320 mm; maximum wheel width—150 mm; number of ground teeth—10-260; range of modules—0.5-6 mm; maximum tooth camber—plus or minus 45 degrees; tooth contact angle—14°30'-30°; grindwheel diameter—320-450 mm; grindwheel aperture—203 mm; grindwheel widths—63, 84, 104 mm

Figure 17. The SD-NC 530 E/1000 NC center-chuck lathe

Figure 18. The headstock for the SD-NC 530 lathe.

Figure 19. Layout of the SD-NC 610 E/1000 NC center-chuck lathe.

Figure 20. The MU-51 CNC knee-type milling machine with a laterally moveable arm, double-spiral headstock and numerical control.

Figure 21. MR08 Rekard manipulator for automatic changing of workpieces on an NC lathe.

Figure 22. A horizontal machining center from the standardized M-T family.

Figure 23. Layout of the catenary magazine for the YBM-90N machining center.

Figure 24. Independent station for machining body parts.

Figure 25. Light horizontal MK 500 machining center in the form of a machine cell.

Figure 26. An opened MK 500 machining center.

Figure 27. System for removing heat from an MK 500 machining center: 1. spindle; 2. cooling sleeve; 3. spindle drive; 4. main motor; 5. oil container; 6. oil cooler; 7. upright; 8. cool air intake; 9. hot air outlet.

Figure 28. HFR radial drill.

Figure 29. KM-250 thread grinder.

Figure 30. FKA 326-10 gear grinder.

Trends in Robots, Machine Tool Industry

26020005 Warsaw PRZEGLAD MECHANICZNY in Polish No 14, 1987 pp 14-16, 25

[Part III of article by Jerzy Zacharzewski, director of the general-technical division of the Machine Tools Research and Design Center, Pruszkow: "Hungarian Machine Tools at the Hungexpo Fair in Budapest—Characteristics of Machines and Industrial Robots and Conclusions About the Development of the Machine-Tool Industry"]

[Text]

Machine Tools From Other Factories

The Femipari Vallalat FEMI Light Machine Tools Plant built in 1962 in Dunavecse is a producer of light conventional drilling machines and frame and band cutting machines. FA-type table drills and FO column drills have the same headstocks.

The basic technical specifications for the FA 13, FA 15, FO 13, FO 15 and FO 20 drills are, respectively: maximum drilling diameter in steel— 13, 15, 13 and 20 mm; table working surface—220 x 220 mm; range of three spindle speeds—620-1890, 420-1680, 620-1890, 420-1680 and 315-1400 rpm; maximum drilling depth—80,80,80,80 and 90 mm; and drive motor power—0.55 kW.

HS column drills are produced under a license from Cordia. The series includes models with manual spindle travel, mechanical travel and automated hole-drilling and threading cycles. The spindle sleeve is ground and moves within an aperture in the headstock housing. It is also equipped with an electrical clamp. The spindle is driven by a three-speed asynchronous motor. Its four speeds are changed by cam-guided gears. The drill has a total of 12 spindle speeds.

The technical specifications of the HS30, HS30V and HS35V drills are, respectively: maximum drilling diameter in steel—30,35 and 30 mm; spindle speeds—42-1450, 42-1450 and 38-1450 rpm; drive motor power—1.5-1.7-2.3, 1.5-1.7-2.3 and 1.8-2.0-2.6 kW; range of spindle travel speeds—fixed spindle, 0.1-0.25 and 0.1-0.35 mm/revolution; maximum drilling depth—160 mm; table attachment surface—450 x 450, 450 x 450 and 500 x 500 mm.

The KFD250 frame cutting machine has hydraulic stroke and can employ three cutting speeds. The cutting force is continuous-regulated. Once cutting is finished, the frame and saw are automatically lifted up. Cutting length is set by a hard stop.

The KFD250A frame cutter with am automatic loader is designed to be operated by the same personnel to do several jobs. The length of material to be cut and the number of cut pieces are set. Once the program is finished, the cutter stops automatically. The cut material falls automatically into a wheeled container and the system also has an automatic chip remover. The rate of automatic material feed is 10-750 mm/minute.

The KFD400 frame cutter (Figure 31) is characterized by hydraulic stroke and all of the features of the KFD250. However, this model is bigger and has a cutter diameter of 400 rather than 250 mm.

The technical specifications for the KFD250, KFD250A and KFD400, respectively, are: maximum cutting diameter (in a rectangular cut)—250,250 and 400 mm; length of saw stroke—104, 104 and 150 mm; number of strokes per minute—56/90/145, 56/90/145 and 40/66/100; drive motor power—1.5, 1.5 and 2.2 kW.

The SZFD-250 band cutter is semiautoamtic. The maximum cutting diameter is 250 mm, drive motor power is 1.5 kW and the cutting speed is 20-110 mm/minute. Stroke is provided by an hydraulic system.

The Mezogazdasagi Gepgyarto Vallalat Light Machine Tools Factory in Niregyhaza produces two MSE-250 and EU-400-01 center-chuck lathes (Figure 32). Their respective technical specifications are: maximum turning diameter over the bed—260 and 400 mm; maximum turning diameter over the carriage—160 and 222 mm; center spacing—750 and 1000 or 1500 mm; spindle speeds—31.5-2240 and 33.5-2120 rpm; drive motor power—2.2 and 5.5 kW.

The Hiteka Communications Machinery Factory in Budapest produces standing drills, the newest of which is the F032-20 (Figure 33). It has a very pleasing and modern look and a flexible form that meets the principles of industrial models. Its spindle is driven by a continuous belt drive with a V-belt and removable shields on the belt pullies and a two-speed geared transmission. A special springless belt-tightening device also serves to set the needed spindle speed within a continuous range.

The maximum drilling diameter in steel (R_m = 50 daN/mm2 is 32 mm, the spindle speed range is 80-400 and 400-2000 rpm, spindle travel speeds are 0.1, 0.2 and 0.3 mm/revolution, the motor power is 2.2 kW, the maximum spindle stroke is 200 mm and the table attachment area is 400 x 450 mm.

Industrial robots

There were no Hungarian robots at the Hungexpo-1984 Fair. Hungary then imported from Bulgaria the type of robots that can service NC machines. Two years later, the fair began to show Hungarian-made manipulators and industrial robots.

The Rekard Factory in Gyor manufactures RT280 welding robots and the Csepel Heavy Machinery Factory in Budapest makes MR208 manipulators and two families of industrial robots used chiefly in the steel industry and manufactured under license from the Daido Steel Co. Ltd. of Japan (Figure 34). These are mechanical robots with Csmeg-Daido electrohydraulic control and a lift capacity of 30-1000 kg. They are also useful for automatic service of machines.

Technical Data for the ATR Family of Robots:

	HS-30	HS-100	HD-100	HD-200	HD-500	HD-1000
Lift capacity, kg	30	100	100	200	500	1000
Maximum speed on the horizontal axis, mm/s	762	1200	1600	2000	3000	3000
	(900)	(1200)	(800)	(800)	(650)	(450)
Maximum speed on the vertical axis, mm/s	762	1000	1600	2000	3000	3000
	(900)	(1000)	(600)	(600)	(450)	(400)
Turning angle	240	240	240	240	240	240
Maximum arm speed, mm/s	90	100	60	45	30	20
Angle of forearm contraflexure	180	180	240	240	240	240
	(90)	(90)	(60)	(45)	(30)	(20)
Maximum forearm turning angle	180	180				
	(90)	(90)				
Repeatability in the horizontal and vertical axes, in mm, plus or minus	0.7	1	1	1	2	3
Repeatability in the turning axis, plus or minus mm	1	1.5	1.5	1.5	3	4

The lift capacity achieved with the help of the HS-30 and HS-100 robots with an articulated forearm is 10 and 30 kg respectively.

Figure 35 shows the geometric parameters of the ATR-HS family of industrial robots and Figure 36 gives those for the ATR-HD family.

Final Remarks

The production of lathes in Hungary already has a 100-year-old tradition. After World War II, the production of radial drills was especially intensified. Hungary purchased many foreign licenses and signed contracts with many well-known international firms producing new universal and specialized machines.

Since 1963, Hungary has been producing NC machines. At the present time, the overwhelming majority of Hungarian machine-tool production consists of NC machines and machining centers.

Hungary is manufacturing its own design for NC systems and microprocessor CNC control for machine tools. This is a family of standardized Hunor systems. Hungary also produces its own taper-roller drive. The purchase of licenses from well-known foreign firms has made it possible to gradually eliminate the dollar import of machine parts needed to automate the operation of these machines. An example of this is the production of a hydraulic apparatus under license from the firm of Rexroth (German Federal Republic) at the Danuvia Factory in Budapest and the production of lathe motors on license from the American firm of Gettys. Japanese electronic components continue to be imported.

The first Hungarian NC machines were the so-called inexpensive designs in the form of a standardized family of EEN-type center-chuck lathes produced by the Szim Works and the ERJ-250 rotary lathes for gripper parts produced by the Csepel Machine Works. Both producers then started making lathes with slanted bed, the numerical control and Hungarian designed EPA320 and 630 (designed at the Szim Works) lathes and the SD-NC 530 and 610 machines made in cooperation with the Austrian firm of Heid (at the Csepel Works).

The next stage in the development of machines for rotary parts were automatic rotary tool magazines with a manipulator, an automatic roboticized machining nest and lathing centers with a double manipulator that automatically changes workpieces and tools.

For machining body parts, the horizontal MC 630 machining center and the very original horizontal MC 403 three-spindle machining center have been developed. There have also been designed the M6-M10 horizontal drilling and milling centers, the YBM-90N horizontal machining center (made under license from the Japanese firm of Yasda) and the original Hungarian-designed MIX 500 light horizontal ,machining centers. All of the Hungarian machining centers are palletized.

The next stage in the development of machines for making body parts is the independent machining station with turning or semicircular pallet magazine and a roboticized automatic machining nests. A grinder numerically controlled by the Hungarian Hunor PNC 715 system has been developed for grinding cylinders.

Hungary is producing many specialized machine tools such as the KM-250 and KM-320 thread grinders and the FKA-326-10 gear grinder. This country is continuing to produce a large number of the radial drills which have become the "Hungarian specialty". They are also producing heavy (conventional and NC) machines for body parts.

In NC machines, the spindle is directly driven by a V-belt drive which eliminates the need for noisy gear drives.

In machines numerically controlled to a magnitude of 32, there are two tool heads, the upper one having 12 positions and the lower with 6. In the larger NC lathes, there is a single 12-position head. The EPA 630 machines use a concrete bed. To cast the beds of machine tools, Hungary is using high-quality cast iron produced under license to the American firm of Meehanite.

Horizontal single-spindle centers for machining body parts use a catenary tool magazine suspended horizontally. Only the MK 500 light horizontal machining center has a disk magazine that operates automatically without the help of a tool feeder.

In independent stations for machining body parts, Hungarian designs automatically monitor the state of tool teeth by continuously checking the load on the electrical motors. Once certain load values for these tools are exceeded, any excessively worn tools are automatically changed.

To reduce lateral displacement of the spindle axis caused by distortions of the headstock housing from heat from the bed of the headstock, machining centers use oil cooling while the MK 500 center also uses an additional oil system to internally cool the spindle sleeve.

Hungary is also producing manipulators and industrial robots for machine tool systems.

Figure 31. KFD400 frame cutter made by FEMI.

Figure 32. The EU-400-01 light center-chuck lathe made by Mezogadzdasagi Gepgyarto Vallalat.

Figure 33. The FO 32-20 upright drill made by Hitek.

Figure 34. The Csepel ATR-HD industrial robot.

Figure 35. Geometrical parameters of the ATR-HS industrial robots.

Figure 36. Geometrical parameters of the ATR-HD industrial robots.

12261

AEROSPACE, CIVIL AVIATION

Structure of Brazilian Aerospace R&D Reviewed

36990049 Sao Paulo ANUARIO AEROSPACIAL BRASILEIRO in Portuguese Oct 87 p 22

[Unsigned Article: "The Big Warhead Factory"]

[Text] The point of departure of the Brazilian aerospace industry, including the aeronautical division, the space division, the airport infrastructure, and the war materiel or military use division, is the CTA [Aerospace Technology Center], an agency of the Ministry of Aeronautics, including the Research and Development Department.

With 6,000 employees, about 20 percent consisting of high-level engineers, the CTA is active in the fields of education, research and technological development as well as industrial promotion, distributed over its five institutes, three of which concentrate on the research and development connected with products and systems, with another one devoted to higher education and the last one with the job of combining the activities of CTA with Brazilian industry as a whole.

The first to be established, the ITA [Technological Institute of Aeronautics], became operational in 1950 with the objective of training high-level specialists for aeronautical activities. Ever since it was founded, it trained 3,016 engineers in the fields of aeronautics, electronics, aeronautical infrastructure and aeronautical mechanics, in addition to turning out 441 personnel with master's degrees and 40 individuals with doctoral degrees. The ITA is a pioneering school in the national context and assigns priority to high-tech technological sectors, particularly those that are not getting priority attention in other schools throughout the land.

Applied Research

- An aircraft engine powered by alcohol;
- solution of vegetal kerosene;
- domestic carbon fibers;
- special structural ceramics; a high-temperature superconductor;
- low-density and high-rigidity lithium alloyed with aluminum;
- and carbon for orthopedics.

These are current problems which are nearing solution in the IPD [Research and Development Institute] whose primary mission is to do research on, experiment in, and develop aeronautical activities. It has five divisions which operate in the following areas:

- aeronautics (a division from which EMBRAER [Brazilian Aeronautics Company] was created),
- electronics,
- mechanics,
- materials and
- flight tests.

Among the numerous technical projects already developed by the Institute, we might single out the Bandeirante aircraft which provided a big impetus to Brazil's aviation industry and turned out to be a success both in Brazil and abroad.

The IAE [Space Activities Institute] has the primary mission of research and development on space activities deriving from Brazilian space policy. It is basically organized in the form of specialized divisions—with a total of seven: atmospheric sciences; military systems; chemistry; instrumentation and controls; testing; projects and mechanics— which operate in an integrated, sector style for the development of projects in progress. Outstanding among these is the satellite launch vehicle project which is a part of the Complete Brazilian Space Mission, an integrated program which calls for the design, construction, and operation of satellites, boosters, and the launch base.

The newest institute of the CTA is the IEAv whose mission is to conduct research and development of technologies and advanced studies of national interest, particularly for the Ministry of Aeronautics. It is organized along the lines of functional divisions and projects. The divisions constitute the institute's backbone, providing basic and advanced training and supplying specialized manpower and support facilities necessary for the various projects. The IEAv (Institute of Advanced Studies) is doing research in high-energy and low-energy physics, research of a basic scientific character in nuclear physics; research in the physics of plasmas; research and development on spectroscopic techniques and precision lasers; development of scientific and administrative software and development of digital systems based on microprocessors for the remote processing and data acquisition area.

Promotion and Acceptance

The IFI [Industrial Coordination and Promotion Institute] constitutes the link between the technology institutes and the users, particularly the aerospace industry. It is responsible for coordination so as to take care of the finishing and subsidiary industry as well as the users of aerospace products.

It was established during the decade of the 1970's, tied to the CTA, with the primary mission of ensuring the pursuit of the objectives of Brazilian aerospace policy in the industrial sector, promoting, coordinating, and supporting activities and undertakings aimed at the consolidation and development of the aerospace industry in the country. It engages in aerospace metrology activities and is responsible for the acceptance and validation of enterprises and products so as to guarantee the existing quality levels and technical precision. This work is done along two main lines: the varied activities of industrial promotion and coordination and the specific activities of aeronautical acceptance and validation. The IFI promotes and supports adequate enterprise analysis at various levels and provides support in the aerospace field. In addition to these five institutes, there is another one belonging to the DEPV [Flight Safety Department] and recognized as national agency for studies and projects on matters relating to flight safety for Latin America; this is the IPV [Flight Safety Institute] which is one of the divisions of the CTA. Widely active in providing basic training and refresher courses for personnel earmarked for air traffic control jobs, the IPV gives courses such as those for air controllers, aeronautical information technicians, and search and rescue coordinators; to accomplish this mission, it has modern simulators and all kinds of equipment that make it possible to improve the learning process in this sector.

05058

SCIENCE & TECHNOLOGY POLICY

Brazilian S&T Assistance Program's 3-Year Performance

36990054a Brasilia INFORME PADCT in Portuguese Nov 87 pp 1-13

[PADCT Report (CNPq [National Council for S&T Development]/MCT [Ministry of Science and Technology], FINEP [Funding Authority for Studies and Projects]/MCT, CAPES [Coordination of Advanced Training for Higher-Level Personnel]/MEC [Ministry of Education and Culture], STI [Secretariat for Industrial Technology]/MIC [Ministry of Industry and Commerce] - Jan 87]

[Text]

Bulletin of the Program for Assistance to Scientific and Technical Development, Brasilia, DF, November 1987

To the Reader:

In 1987, the Program for Assistance to Scientific and Technical Development is 3 years old. On this occasion, the program is undergoing an evaluation phase wherein its successes, failures, and very continuity are being analyzed.

To better account for the status of the PADCT activities, the Executive Secretariat, SE/PADCT, intends to publish this report periodically. In this issue a retrospective view of the program with its goals and objectives, an overall view of imports, as well as a synopsis of five subprograms are given. In the forthcoming issues, the following, among other topics, will be discussed:
—continuation of the synopses of the other subprograms;
—report of the GEA (Special Monitoring Group), meeting from 9 to 20 Nov 87;
—main topics in the report of the IBRD Mssion, last September;
—results of the meeting of the Temporary Commission, on 11 Dec 87;
—PADCT in the context of each of the affiliated agencies

Antonio Maria Amazonas MacDowell, Executive Secretary of PADCT, Brasilia, November 1987

1. Background

PADCT was conceived as one of the instruments for implementing the policy on S&T development, through the coordinated activity of the leading federal agencies for development (CAPES, CNPq, FINEP, and STI), operating in areas previously determined by the Federal Government, with the establishment of specific goals to be attained.

2. Organization and Resources

PADCT is comprised of 10 subprograms, divided into two groups, namely:

a) S&T Development Subprograms:
1. Education for Science Subprogram - SPEC;
2. Biotechnology Subprogram - SBIO;
3. Chemistry and Chemical Engineering Subprogram - QED;
4. Earth Sciences and Mineral Technology Subprogram - GTM;
5. Instrumentation Subprogram - SINST;
6. S&T Planning and Management Subprogram - PGCT;

b) Support and Services Subprograms:
7. S&T information Subprogram - ICT;
8. Maintenance Subprogram - SPR;
9. Equipment Subprogram - SPIN;
10. Basic Industrial Technology Subprogram - TIB

In its current form, the program calls for a total investment during the period 1984/90 equivalent to $235 million, and, according to origin, the funds are distributed as follows:
a) $101 million - Treasury;
b) $6 million -Agencies (CNPq, FINEP, STI, and CAPES);
c) $56 million - matching funds from the executive entities;
d) $72 million - World Bank

Table I shows the total budget by subprograms, and Table II, the amounts of outlays made by the agencies for the projects as of 17/9/87, subdivided into local expenses and expenses abroad.

Table I - PADCT - Subprograms Budget (in US$1,000's)

	Initial Budget		Emergency Program		New Budget(5)	
Subprogram	IBRD (1)	Matching Funds (2)	IBRD	Matching Funds	IBRD	Matching Funds
SPEC	1,500	8,340	75	83.4	1,425	8,256.6
SBIO	11,300	15,500	565	155.0	10,735	15,345.0
QEQ	14,900	21,460	745	214.6	14,155	21,245.4
GTM	10,300	15,500	515	155.0	9,785	15,345.0
SINST	3,900	11,920	195	119.2	3,705	11,800.8
PGCT	1,200	2,680	540	884.4	660	1,795.6
ICT	800	1,670	460	577.8	340	1,092.2
SPM	3,400	4,770	340	396.5	3,060	4,383.5
SPIN	3,900	3,580	390	386.5	3,510	3,193.5
TIB	18,930	485	189.3	9,215	18,740.7	
Unallocated	6,420	-	3,000	-	3,420	-
Administration	4,680	2,650	-	-	4,680	2,650
Total	72,000	107,000	7,310 (3)	3,151.7 (4)	64,690	103,848.3

(1) Amounts defined in contract with IBRD
(2) National matching funds with the executors' portion excluded
(3) The total authorized for the Emergency Program is $7 million; the difference will be apportioned among the subprograms later.
(4) The total authorized for the Emergency Program is $3 million; the difference will be apportioned among the subprograms later.
(5) The portions withdrawn for formation of the Emergency Program are deducted.

Of these financial resources, approximately $50 million from the IBRD loan and $80 million from the national matching funds have been committed (excluding the portion from the executing entities).

Table II - Outlays Made by the Agencies for Projects

a) Local Expenses - Treasury Funds (in US$1,000's; Cruzados converted into dollars at the exchange rate for the purchase on the date of the outlay.)

Agencies/Years	1984	1985	1986	17/9/87	Total
CAPES	12	1,485	4,970	1,259	7,726
CNPq	2	972	1,966	515	3,454
FINEP	-	3,201	8,582	1,482	13,265
STI	56	2,072	1,812	416	4,357
Total	70	7,301	17,330	3,672	28,802

b) Expenses Abroad - IDB Loan (in US$1,000's)

Agencies/Years	1984	1985	1986	17/9/87	Total
CAPES	25	86	329	397	837
CNPq	-	99	383	1,121	1,604
FINEP	-	6	2,498	1,502	4,007
STI	-	1	214	49	263
Total	25	192	3,425	3,069	6,711

At the present time, a discussion is under way on the continuity of the PADCT Program with additional loans from IBRD of approximately $265 million, and national matching funds in cruzados equivalent to $502.9 million. The very fact that this preliminary proposal has been submitted to IBRD by MCT now represents new hopes for all the institutions involved in education and research in this country.

3. Organization and Control

PADCT is associated with the Scientific and Technical Council (CCT) and the Temporary Commission (CT).

The Scientific and Technical Council, headed by the Ministry of Science and Technology and comprised of six state ministers and five representatives of the community, is the top-ranking association for determining scientific and technical policy in the country.

The Temporary Commission (CT),headed by the MCT general secretary, is a commission of the CCT, for the specific purpose of dealing with matters relating to the program; constituting a top-level body for deliberating on PADCT.

The Executive Secretariat (SE/PADCT) executes the CT's decisions and coordinates the activities of the four development agencies (CAPES, CNPq, FINEP, and STI), in the program's implementation.

The Special Monitoring Group (GEA) is a body created for the purpose of providing the Brazilian Government and the World Bank with an independent, detailed evaluation of PADCT's development, and giving recommendations aimed at its improvement.

The GEA, consisting of 15 members (eight Brazilians and seven foreigners), engages in monitoring the high scientific and technical quality of all the subprograms. Currently serving in the GEA are:

Brazilian members:

- Aristides Pacheco Leao - chairman of GEA (UFRJ [Federal University of Rio de Janeiro])
- Lindolpho de Carvalho Dias - vice chairman of GEA (IMPA [Institute of Pure and Applied Mathematics])
- Caspar Erich Stemmer (UFSC [Federal University of Santa Catarina])
- Isaac Kerstenetzky (PUC [Pontifical Catholic University] of Rio de Janeiro)
- John Milne Albuquerque Forman (Five For, Ltd.)
- Marcos Luis dos Mares-Guia (Biobras)
- Oscar Sala (USP [Sao Paulo University]
- Walter Baptist Mors (UFRJ)

Foreign members:

- Antonio Lima-de-Faria, Sweden
- David Waddington, Great Britain
- Dieter Kind, Federal Republic of Germany
- Henry Taube, U.S.A.
- Jean-Jacques Salomon, France
- Wallace Olsen, U.S.A.
- William Sefton Fyfe, Canada

The GEA, convening during the period 9-20 November 1987, held its fourth regular session. To carry out its tasks, the GEA used as a basis:

- Report of the PADCT Executive Secretariat;
- Meeting with heads of the financing agencies;
- Reports from the CT coordinators; and,
- Visits, for example, to certain institutions executing PADCT projects

The Technical Groups (GT's) are responsible for devising proposals, monitoring, providing subsidies for the preparation of the annual operational plans, preparing notifications, and maintaining permanent contact with the community involved. There is a Technical Group for each subprogram, with an average of 14 members in each, four being representatives of the agencies involved in the program, and 10 from the S&T community. The latter are selected by the CT, through an extensive consultation of the S&T community. The composition of the Technical Groups will be changed during the first half of December 1987, at a meeting of the CT, with the replacement of half of its members. On 7/8/87, the SE/PADCT issued Official Memorandum No 183/87 to all of the country's institutions associated with education and research, requesting nominations for replacements in the aforementioned Technical Groups.

Activity of the S&T Community

The Brazilian S&T community participates actively in all phases of the program, from the planning (preparation of the guidelines, priorities, objectives, and goals, by the GT's) to the analysis and monitoring of the projects; activities which are carried out by the ad hoc consultants and advisory committees.

Submission of Projects

The submission of projects is done through a response to various calls in notifications. These are disseminated by the PADCT Executive Secretariat to all the institutions associated with education and research in the country. The projects are sent by the parties concerned to one of the four agencies.

Judgment

The preliminary analysis of the projects is made through a judgment by peers, using ad hoc consultants, who are specialists related to each project to be analyzed. The consultants provide substantive opinions in order to aid the Advisory Committees in their decisions.

The Advisory Committees (CA's) are established especially to assess the projects. Making use of the assistance from the ad hoc consultants and technicians from the agencies, the CA's determine the order of priority of each project.

4. Results Attained

Several factors have hampered the anticipated development of the program. Noteworthy among them are bureaucratic problems in importing, delays in contracting and release of funds, deterioration of the national currency, and discreditation on the part of the scientific community. Efforts were expended to provide solutions, the most significant results of which are noted briefly below:

a) Greater Speed in the Contracting of Projects

During Phase II of PADCT, a reduction was achieved, particularly in the period of time between the judgment of proposals, the contracting on the part of the agencies, and the release of financial resources. The period between the judgment of projects by the CA's and the signing of contracts was recently from 60 to 90 days, and that for the release of funds, over 30 days.

b) Correction of Budgets to Cope with Inflation

In the FINEP area, projects are already being contracted for on the basis of OTN's [National Treasury Bonds]. In the CAPES and STI area, contracts have been concluded in cruzados and readjusted periodically. In the CNPq, these contracts have been converted into OTN's since September, based on Decree No 94,684, according to the provision in Article 14.

c) Considerably Accelerated Importing of Equipment

Despite the dedication and efforts of the CNPq importing sector to deal with the great increase in demand resulting from imports of equipment in the PADCT Program, the delays and slowness in imports have been the target of very strong criticism from researchers, from the GEA, and from the IBRD missions. Faced with a slow rate of imports, in the range of $200,000 per month, the situation reached the point of threatening the program when outlays from the World Bank came to an end.

As a result of this, action was taken by the CNPq and MCT, together with the Finance Ministry and CACEX [Foreign Trade Department], aimed at removing the administrative obstacles relating to PADCT imports of equipment that is so necessary for modernizing the research laboratories.

Some positive results were achieved, with the speed-up of that process:

- simplified customs clearance;
- study of similarity to be made by CNPq;
- exemption from tariff classification;
- and acceptance of orders by suppliers independent of the opening of a letter of credit in the Bank of Brazil-New York, within the limits of the contract.

With these measures, it has become possible to hasten the process of imports in CNPq to an average of $3.4 million per month, $2 million of which relates to PADCT. The average amount for PADCT import bills of lading is approximately $13,000. This information enables us to obtain an idea of the number of bills of lading that must be processed monthly; added to the fact that the CNPq is responsible for the entire importing process, from preparation of the import bill of lading request (PGI) to customs clearance and consequent delivery to the benefiting institution.

In view of the volume of administrative work involved in importing, the periodic supplying of information on the progress of the processes to researchers has been harmed. The Executive Secretariat is attempting to reduce this shortcoming through a system for disseminating information that is still being studied.

The increase in PADCT imports, with special emphasis on the months of June to September 1987, is shown in the following Table III.

Table III - Progress of the PADCT Import Processes

Phase	Stage of the Process	No of Processes		Value of the Orders (US$)	
		12/86	10/87	12/86	10/87
1	Awaiting invoice	59	25	1,007,292.56	119,471.53
2	PGI preparation	136	254	1,179,720.72	2,680,141.50
3	In CACEX	69	144	1,170,190.83	2,461,181.88
4	In SEI	6	12	71,817.10	408,034.90
5	In CNEN	1	1	178.97	1,458.56
6	Letter of credit	53	309	405,411.86	4,166,372.87
7	Awaiting shipment	108	182	1,531,299.26	2,464,838.98
8	Clearance	15	62	62,596.75	929,202.74
9	Concluded	164	370	2,865,919.48	5,742,512.10
10	Cancelled	12	20	519,543.44	200,596.18
	Total	623	1,379	8,813,970.97	19,173,811.24
	Difference		756		10,359,840.27

5. Synopsis of Subprograms

Education for Science Subprogram

Since it began its activities in 1983, the Education for Science Subprogram has acquired a sizable number of science and mathematics teachers and students, including professionals and students with first, second, and third degrees, participating in the SPEC projects distributed throughout the entire country.

It is not yet possible to specify the number of Brazilians benefited by assistance from SPEC, and the improvement in education that it proposes can only be proven in time, through the future performance of those students and teachers, and a heightening of the quality and quantity of national scientific production; in short, through the reflection of a training that is more geared to the current stage of science in the world.

However, some indicators of the subprogram's impact may be cited. One of them is the participation of renowned representatives of the Brazilian scientific community in SPEC. They are active not only in devising its policy, guidelines, and orientation for financing projects, but also in evaluating them, meeting in the Technical Group (GT), the Advisory Committee (CA), and the Evaluation Committee (CAv).

Another indicator that can give an idea of SPEC's impact is the number of persons involved in one of its 164 projects. According to information collected to date, in Piaui, for example, nearly 7,000 students have received instruction associated with the subprogram; inPernambuco, there are almost 15,000; and, in Sao Paulo, the number of almost 5,000 students and 1,000 teachers. Also significant is the number of instructors with doctorates who are coordinating SPEC projects; which means a higher quality rating of the proposals backed by the subprogram.

The partnership with universities and state and municipal education secretariats in varying degrees of commitment also indicates an impact that the subprogram has on the official education system for first and second degrees, in the curricular, teacher training, and substantive areas.

Still another indicator of impact may be cited: the formation of a critical mass in the country, through the SPEC provision of 94 study grants for master's and doctoral degrees in Brazil and abroad.

Hence, these are a few indicators that make it possible to visualize the impact caused by SPEC in its area of activity, discounting the individual development of the persons trained by it, and the changes to improve education that may emanate from those persons.

As a multiplying effect for the subprogram, from 17 to 24 November 1987, in Recife, the Second Northeast Congress on Education in Science and Mathematics will take place, sponsored by PADCT/SPEC and the Federal University of Pernambuco.

In addition to focusing on problems relating primarily to methodology of experimental education in science and mathematics, the congress will have as a central topic "The Issue of Scientific Education in Brazil."

Biotechnology Subprogam

The results of this subprogram have not yet been assessed, inasmuch as the projects financed during the test phase are being completed, and the projects of the 01/85 phase were contracted for in 1986. However, the subprogram has proven very important for evoking an interest in biootechnology in the country. The integration of groups of laboratories of different institutions was fostered, and the creation, reinforcement, and maintenance of new groups was made possible. PADCT/SBIO contributed to the awareness that there was in the country a community competent in biotechnology, but with facilities far short of what was presumed to exist. It served to rehabilitate laboratories already quite deteriorated; making possible a better understanding between the academic and technological areas; and, on the national level, arousing a consciousness of the importance of biotechnology.

The policy adopted by the Technical Group in the preparation of notifications reflected, at the start of the program (notification onthe Test Phase), the concern for supporting all the groups already working directly or indirectly, or with potential for using biotechnological techniques and/or processes. The scope of the notification covered all the priorities described in the basic document, to allow full participation by the entire community.

On the second occasion (Notification 01/85), the GT attempted to direct the notification toward projects with objectives associated with products. Hence, the scope covered priorities related to the sectors of health, agriculture and livestock, and "energy."

These notifications made it possible to contract for 135 research projects, with financing for infrastructure and equipment.

In 1986, the GT started to be concerned over fostering the training and qualification of human resources in the most diverse fields, areas, and sub-areas of information, and the mastery of techniques in the institutions for research, development, and industrial production. This prompted the issuance of Notification 01/86, aimed directly at the training of human resources on all levels.

Currently, the GT has submitted to the Executive Secretariat a proposal for the issuance of a new notification intended to use the already existing resources. The idea includes making two calls for proposals:

(1) technological development projects that would achieve integration of research laboratories with the productive sector;

(2) studies of the technological market and supply in biotechnology.

These calls are aimed at:

(1) fostering exchange between the research institutions and the business sector, and

(2) procuring information on the installed or potential competence existing in the country, to make possible a better application of resources in the second phase of PADCT.

S&T Information Subprogram

PADCT activities in the S&T Information (ICT) area are conducted based on two complementary strategies:
a) horizontal activities, those aimed at the general development of the ICT sector's structure and permeating all fields of S&T activity in thecountry;
b) vertical activities, those carried out in the context of particular PADCT subprograms, with a view toward specifical backing with information to their activities.

The aforementioned horizontal activities have been the target of consecutive funding cuts, which ended up limiting their budget to almost a quarter of the initial amount; representing approximately a fifth of the funds allocated for vertical information activities by the Chemistry and Chemical Engineering, Earth Sciences and Mineral Technology, Biotechnology, and Instrumentation Subprograms.

Owing to the shortage of funds and the excessive fragmentation of projects in the origianl proposal for the Subprogram, the GT decided to concentrate the activiies on a small number of projects, the fundamental criterion being the transforming effect that each project might have on the situation of country's ICT sector, which is avowedly lacking in a supply of products and services, from both a qualitative and a quantitative standpoint.

As for the sectorial projects (or vertical activities), the strategies have varied depending on the requiremens of each area.

In the Chemistry and Chemical Engineering area, special attention was given to complementing and maintaining collections of basic referenceworks and periodicals most consulted in 20 regional libraries, and tointensifying the collection of a main library.

In the Earth Sciences and Mineral Technology sector, the emphasis was placed on the establishment of an information system, covering a whole range of services and products necessary to back the sector's S&T activities.

In the Biotechnology area, the activities were divided among the fields of health, energy, and agriculture and livestock, aimed at access to a data base and the supply of copies of periodical texts.

The Instrumentation area also aimed for access to data bases and supplies of copies of periodical texts, as well as the preparation of a catalogue of instruments and a catalogue of prototypes.

Generally speaking, the sectorial activities are being implemented satisfactorily, and it may be anticipated that the set objectives will be attained to a large extent.

Analyzing in more detail the horizontal activities, that is, the ICT Subprogram per se, we should underscore, at the outset, the Public Access to Data Bases System, which was identified by the GT as the one with the greatest potential for transforming the current status of the ICT sector in Brazil. In fact, despite the existence of several isolated institutions offering access to data bases associated with the respective fields of interest, in most instances, this access benefits only the users in the institution itself, thereby indicating the non-existence of a public service. The project entailed making a study of the current situation, and a proposal for a national public access system, also including the location of documents and the furnishing of copies. Moreover, thanks to the recycling of funds taken from other projects with a lesser transforming effect, two pilot projects were created, one aimed at connecting two centers for mutual access, and the other intended for automation of bibliographical exchanges, also between two centers. Both pilot projects are under way, with the first results expected by the middle of next year, when the embryo of the system that has been advocated will be have been established through them.

Another point on which the GT attempted to place emphasis was personnel training, through post-graduate courses in information science and specialized courses. In the later regard, the results have not been compensatory: a course contracted for was not held, with the contracting entity returning the funds; and a second course announced in anotification did not receive any applicants to warrant holding it. The reason for this is that there are no institutions with the requirements of experience in operating information systems and setting up structured courses; and, most likely, agreements between institutions with complementary experience would not have succeeded.

As for the projects executed directly by IBICT, basically those relatedto systems implementation and service maintenance, all of them have progressed normally.

The GT's decision to concentrate the activities on a small number of projects is a highly positive factor, and will enable the subprogram to reach the end of this phase with some palpable results, and in a position to indicate the path that should be taken by the ICT sector in the country.

The consequences of PADCT's activity in the ICT area may be rated as quite positive. The principal one may have been that of paving the way for a solution to the sectorial problems, with the participation of nearly all the sectors concerned; which has allowed for an awareness of the key issues to be resolved during the next phases. The reinforcement of university and research center library collections, the supply of services for quick access to bibliographical and factual information,the maximum use made of the already existing information structure and its complete coordination, the improvement of the bibliographical exchange mechanisms, the training of human resources for the processing and use of information, and, in particular, the reduction in costs of courses for this fundamental component in technological research, are the fundamental goals to be pursued over the short and medium terms.

The aforementioned goals must be attained, particularly with regard to the establishment of a public system for access to data bases. In this connection, the pilot projects must be completed and, based on them, the creation of the system, which must be a constant endeavor making possible the addition of new centers, as they emerge, must be initiated.

As we reach the end of this phase (Test and 01/85), we can make an assessment of the PADCT as it applies to the ICT sector. The Technical Group is of the opinion that, rather than adding series of requirements that would lead science and technology in Brazil to a weak state, PADCT should have a greater impact, acting intensely in the mostcritical areas, and creating irreversiblity in the transformations that have occurred.

For this reason, the GT favors the continuity of PADCT and, as part of it, that of the ICT Subprogram, which would make it possible to achieve these goals.

Maintenance Subprogram

a) Qualitative Analysis of the Subprogram's Implementation

In 1987, new notifications were not published, because the recommended projects, still under negotiation, did not allow for a quantification of the available resources.

Since the implementation of SPM/PADCT in 1984, three sets of notifications were published, Test Phase, Phase 01 (1985), and Phase 02 (1986), respectively.

The progress of the response to the notifications is shown in the following data.

Based on the philosophy established in the basic document, the following were implemented:

a) Test Phase: two nuclei, eight centers, and 10 units;

b) Phase 01 (1985): one nucleus, six centers, and six units;

c) Phase 02 (1986): one nucleus; four centers, and 13 units.

Comment: The Test Phase Center (NUTEC) was promoted to Phase 02 Nucleus;
-the Test Phase Unit (UFPa) was promoted to Phase 02 Center;
-one Phase 02 Nucleus was already backed in the Test Phase;
-one Phase 02 Unit was already backed in Phase 01.

The other contracted projects which are not included in the foregoing specifications are associated with specific backing, such as case studies, maintenance contracts, courses, etc.

With regard to the original proposal for the Basic Plan, that is, 15 nuclei, 25 centers, and 100 units, we find that 26 percent, 72 percent, and 29 percent, respectively, were achieved.

Considering the fact that nearly all the funds allocated to the subprogram have been applied, it has become necessary for more funds tobe provided, so that the proposed goals may be attained.

An analysis of the demand makes it possible to ascertain that it has grown, indicating the need for additional funds.

The estimated requirement must be considerably in excess of the real demand, and this is due partly to the lack of awareness on the part of the country's educational and research entities.

The advent of SPM has unquestionably contributed much to the position assumed by the heads of our entities toward maintenance problems.

The activity of SPM, as well as of the entire PADCT, was greatly harmed by the delays in the contracts and release of funds, the respective inflation, and importing difficulties. These problems have now beenconsiderably diminished, resulting in the restoration of credibility in the subprogram among the scientific community.

Despite all the problems, and even with the goal not attained (primarily for lack of funds), it may be claimed that the subprogram represents a substantial contribution to the solution of a crucial problem that the educational and research entities have been facing for years.

A series of projects now approved represents a fundamental infrastructure, ensuring the operation of equipment essential to the development of research in Brazil.

The currently existing infrastructure,in terms of physical space, human resources, instruments and tools, and replacement parts, allows for effective action to meet the maintenance requirements of most of the educational and research equipment in the area of its coverage.

As a conclusion for the qualitative analysis, the following data show the current status of the Test and 01 Phases.

Test Phase (1984):

- total of 24 projects backed;
- 45.9 percent with normal progress;
- 33.3 percent with good progress;
- 20.8 percent with unsatisfactory progress.

01 Phase (1985):

- total of 21 projects backed;
- 66.7 percent with normal progress;
- 9.5 percent with good progress;
- 23.8 percent with unsatisfactory progress.

b) Administrative Aspects

Generally speaking, the administrative aspects had no significant negative effect that could hamper the satisfactory development of the subprogram.

The GT/CA relationship has always been one of complete meshing, and the same holds true of the GT/Agency relations. In the case of the FINEP Agency, a substantial positive change may be cited in its position toward PADCT in general, and the Maintenance Subprogram in particular.

A minor incident occurred in the CA/Agency relations at the time of the analysis of the Phase 02 projects, which led to the cancellation of the judgment meeting, entailing the holding of a second meeting, with a resultant delay in the final process of the notification.

c)Positive and Negative Aspects of a General Nature

The negative aspects possible to identify are:

- importing difficulties;
- delays in the project contracts;
- delays in the release of funds;
- lack of credibility on the part of the scientific community;
- deterioration in the purchasing power of the national currency.

Positive aspects:

- backing for maintenance structures, making the operation of nuclei, centers, and units possible;
- change of mentality toward maintenance problems;
- training of human resources in the maintenance of educational and research equipment;
- gradual creation of a data bank associated with the maintenance of educational and research equipment;
- recovery of maintenance manuals;
- recovery of equipment considered inrecoverable because of the high cost of labor in technical assistance enterprises.

d) GT Policy on Preparation of Notifications

The fundamental policy adopted by the GT for the preparation of notifications is based on the premises contained in the Basic Document, nevertheless attempting to place emphasis on backing for the existing maintenance structures.

This action of the SPM has already succeeded in bringing about a considerable change in the mentality of those responsible for equipment maintenance, and even among the heads of institutions. As a concrete result, many of the institutions backed by the SPM are making their structures official, planning them with budget funds.

Also noteworthy here is the First National Seminar on Maintenance of Equipment for Education and Research (I SEMP), during the period 26-30 October 1987, at the COPPE/UFRJ, attended by nearly 250 persons, with contributions submitted and collected in the yearbooks distributed to all the participants at the opening of the seminar.

On this occasion, we conveyed our appreciation to Prof Sergio Neves Monteiro, chairman of the organizing commission for I SEMEP, and to his group, who were responsible for the success of the event.

At this meeting, it was decided to prepare a document intended for the government authorities, aimed at making them aware of the need for releasing more financial resources, for the purpose of recovering and maintaining the equipment already installed in the country.

Basic Industrial Technology Subprogram

Basic Industrial Technology includes Metrology, Standardization, Industrial Quality, Industrial Property, and Technology Transfer; and is an activity run by the Ministry of Industry and Commerce's IndustrialTechnology System, consisting of the Secretariat of Industrial Technology (STI), the National Institute of Metrology, Standardization, and Industrial Quality (INMETRO), and the National Institute of Industrial Property (INPI).

The Basic Industrial Technology area has been receiving significant support through the specific subprogram under the direct responsibility of STI, in the context of PADCT, wherein nearly $38 million is being applied during the current phase of the program, to which are to be added other funds allocated directly by STI, INMETRO, and INPI.

PADCT's Basic Industrial Technology Subprogram is being executed through calls contained in the Notifications of 1984 (Test Phase), 1985, and 1986, and also through contracts for direct execution, intended toattain goals programmed in four major groups of activities.

1) Industrial Technological Policy Studies

Execution of 13 studies, divided into two groups: In the first an analysis is made of problems in the context of the development of Brazilian technological infrastructure (Studies 1-7); and, in the second, the specific features of that infrastructure (Studies 8-12). Both groups submit proposals on government policy measures for the area and on the conduct of the other agents participating in the process (Partial Summaries and Final Summary - Study 13).

2) Basic Metrology
—Backing to consolidate the INMETRO Primary Laboratories and the National Observatory (Hour Service Time and Frequency Laboratory, SHO).
—Backing to consolidate the National Calibration System, by installing 15 Metrological Laboratories.
—Backing to install three Test Laboratories in the field of referencematerials.
—Backing to establish quality guarantee systems in at least eight National Calibration System Laboratories.

3)Information on Industrial Technology
—Establishment of the Industrial Technology Information Nuclei System, consisting of:
—Three Basic Nuclei for Technical Standards Information; One Basic Nucleus for Patent Information;
—Three Regional Nuclei for Information;
—Nine Sectorial Nuclei for Information in the fields of leather and footwear; metal-working; textiles; agricultural machinery; energy conservation; lumber and furniture; plastics and rubber; industrial design and food;
—First Post-Graduate Course on Technological Information in the area ofspecialization.

4) Human Resources Training and Qualification
—Creation and production of a standard course in industrial quality;
—Creation and production of a group of educational films on industrial quality;
—Identification of requirements for short and medium-term courses for professionals active in 14 industrial sectors;
—Holding of 140 short-term and 50 medium-term courses to train professionals active in the 14 industrial sectors targeted in the identification of requirements;
—Provision of individual study grants in the country and abroad, for programs in specialization, and for master's and doctoral degrees, in areas of basic industrial technology interest;
—Establishment of institutional programs for training STI, INMETRO, and INPI personnel;
—Creation and establishment of the Program for Specialization in Quality Management (PEGQ), through which STI intends to train a minimum of 400 qualified professionals as well applying quality management concepts and techniques in the area of P&D enterprises and institutions, and entities rendering services. PEGQ is structured in a network of mulitiplying,nucleated institutions located in different parts of the nationalterritory. In its current phase, PADCT/TIB is virtually depleted in terms of the commitment of funds. It is still possible that proposals for projects for individuals grants and for the supply of short-term courses (up to a month) in specific industrial sectors, and medium-term courses (1 to 12 months) may be submitted, for the application of TIB funds, depending on the budgets and terms of reference available in STI.

Note: This synopsis of subprograms resulted from a condensation of the reports submitted by the coordinators of the pertinent GT's.

Program for Assistance to Scientific and Technological Development (PADCT)

Composition of the Executive Secretariat

Executive Secretary: Antonio Maria Amazonas MacDowell

Assistant Executive Secretary: Ernesto Costa de Paula

Technical and Administrative Group:
Maria Helena Brito Macedo
Helena Catsiamakis Queiroga
Regina Celia Franca
Antonio Joao Goncalves de Azambuja
Maria da Graca Fernandez
Marise Fonseca
Ivonildo Machado de Assis

In Charge of Processing: Maria Helena Brito Macedo

PADCT Report, 01/87 Program for Assistance to Scientific and Technological Development (PADCT), Ave. W/3 North - Block 507 - Unit B Tel.: (061)274-0525, or 274-1155, Ext. 403 70,740 - Brasilia - DF

2909

Brazil Imported, Developed Less Technology in 1987

36990054b Rio de Janeiro O GLOBO in Portuguese 1 Feb 88 p 16

[Text] In 1987, Brazil spent $157 million (13.2 billion cruzados) on imports of technology, nearly 15 percent less than the total spending during the previous year, which was $184 million (15.5 billion cruzados), and the lowest amount in the past 14 years. The funds spent last year exceeded only the $132 million (11.1 billion cruzados) spent in 1973 to purchase technology abroad. The reduction in expenditures on imports would be good news if, on the other hand, the country were heightening its technological development. But this has not occurred, as O GLOBO was told by the head of the National Institute of Industrial Property (INPI), Mauro Fernando Arruda.

He explained: "This decline in technology imports has left us extremely concerned because, as a counterpart, investments in technology in the country are also decreasing. The result of this twofold decline (in imports and in domestic technology development) is obvious: an increasingly greater technological lag in comparison with the technologies existing abroad."

The observation that less technology is being purchased, and less created in the country, appears in a report by the economic and financial consultant, Domingos Rodrigues, published in the INPI journal, PANORAMA DE TECNOLOGIA. The report shows that the ratio between technology imports and the gross domestic product (GDP), which was 0.3 percent at the beginning of the 1970's, dropped to 0.1 percent during the past 8 years. At the same time, the volume of investments made in technological research and development in the country is insufficient, because it fluctuated between 0.5 and 0.7 percent of the GDP between 1979 and 1984.

According to the consultant, it would be necessary to invest about $3 billion (210 billion cruzados) per year, starting in 1988, in order to compensate for the technological lag. To reverse this negative picture, the INPI head cited the adoption of a well-defined industrial policy as a solution.

And, to cooperate with this plan, INPI wants to lose its previous image as an old, antiquated storage place for records and patents, and become an efficient instrument for stimulating the advent of new technologies.

He claimed that extensive changes have already occurred in INPI; so that it may cease to be a repository of archives, and become more active and efficient. One of the institute's plans is to grant tax incentives to business firms which invest in technology through the Technology Investment Program.

INPI would become an organ for development, assuming new authority, such as that for granting tax incentives for technological development.

Another INPI goal is to double the number of national patents over the medium term. At present, 70 percent of the most important patents are foreign, and only 30 percent belong to national business firms. INPI has initiated the Automatic Technological Information Supply Program (Profint), at the disposal of business owners on any subject desired.

2909

Arms Manufacturers AVIBRAS, ENGESA To Lay Off Workers

36990054c Sao Paulo GAZETA MERCANTIL in Portuguese 25 Jan 88 p 12

[Text] AVIBRAS [Brazilian Aviation, Inc] and ENGESA [Specialized Engineers, Inc], the two leading arms manufacturers, are laying off a considerable number of employees in spite of promising export prospects, according to Jose Luiz Goncalves, chairman of the metalworkers union of Sao Jose dos Campos, Sao Paulo, where the companies are located. The union has about 25,000 members.

AVIBRAS, which produces missiles and the Astros II surface-to-surface rocket launcher, has dismissed some 1,000 workers over the last six months, Goncalves said. Pedro Vial, director of official relations at AVIBRAS, claimed, however, that the arms maker was merely cutting down on excess personnel.

Goncalves also said that workers at armored car maker ENGESA have been granted leave, and could be dismissed shortly, if the company loses a giant tank contract in Saudi Arabia.

2909

TELECOMMUNICATIONS

Brazil Develops Sophisticated Telecommunications Equipment

36990052a Sao Paulo DADOS E IDEIAS in Portuguese 88 pp 22, 23

[Installment II of article by Rodolfo Lucena: "Digital Leap in Communications"]

[Text] Next month, the TELEBRAS [Brazilian Telecommunications, Inc] Research and Development Center (CPqD) will begin transferring to industry the documentation making it possible to produce some plates to be used in the Brazilian satellite data communication system. By the middle of the year, CPqD expects to have the prototype of its satellite terminal station ready; and, by the end of 1988, EMBRATEL [Brazilian Telecommunications Company] is due to purchase at least two terminals for field tests. If everything proves successful, the imported equipment currently installed in the first major users of satellite digital communication (IBM, Gerdau, and Banco Itau, among others) may be replaced by native products, at prices lower than the foreign ones.

Jurandir Moreira Pitsch, chief of CPqD's systems engineering and satellite signal and communications processing area, remarked: "Digital data transmission is currently the major market, with users who can pay the prices." Therefore, a team of 80 technicians (including personnel from Microlab, Splice, and Sul America) has been working on the project since 1986. The first studies began the year before and, according to Pitsch, the development work, which is due to be finished this year, has cost about $3 million.

Until the arrival of digital communications, the CPqD personnel are doing all the work to make it possible to use satellites for conventional transmissions. At the center in Campinas, Sao Paulo, the various equipment comprising the system's "ground segment" has beendeveloped. According to the CPqD engineer, by the end of

1986 the national industry was capable of supplying complete stations for various types of service: telephony, and high and low capacity connections.

Lagging Timetable

Nevertheless, several of the 30 ground stations for satellite communications still have imported components, such as low noise amplifiers used to receive radio frequency signals. Only now is this equipment being analyzed for purchase by EMBRATEL, because it has no competitive price.

At present the stations market is basically the TELEBRAS system, but Pitsch thinks that, soon, even small and medium-sized companies will be potential purchasers.

Ground Stations

The ground stations consist of an antenna, radio frequency equipment, and terminal equipment.

In the antenna field, CPqD began developing equipment 10 meters in diameter to pick up signals from the Intelsat satellite. Upon the launching of Brasilsat, with a more powerful signal than the other satellite, there was no longer so much need for antennas of that size. Currently under development is a 3-meter antenna, which could even be installed by the end users themselves.

According to Pitsch, in addition to CPqD, the Matra company is also developing an antenna of that size on its own, which "has great market potential," also on the basis of its price: between $2,500 and $3,000.

Radio Frequency

The ground stations' equipment for radio frequency operates in the signal reception and transmission areas. In the reception area, the low noise amplifier (known internationally as LNA), was developed in conjunction with USP's [Sao Paulo University] Microelectronics Laboratory. The technology was transferred to the Sul America, Control, Telemulti, and ABC Teleinformatica companies. The equipment is installed next to the antenna, and amplifies the signal received. It is the most critical part and the one with the greatest technology in the reception system, Pitsch maintains, noting that what typifies it is the noise temperature (the lower, the better). "We began with 150 degrees K (-123 degrees C), next using 100 degrees K (-173 degrees C), and the last one was 80 degrees K (-193 degrees C). We are working on one with 65 degrees K (-208 degrees C), but the 80 degrees K is virtually the international standard in professional stations."

In the transmission area, there are low and high power amplifiers. The low type (5 and 10 watts) is transistorized, and used for small-sized stations. The high power type (100 watts) is valved. In all of them, the design is Brazilian, but the components are imported. CPqD is working on the develpment of a 20-watt amplifier, which Pitsch claims to be "state of the art on the international level." He reports that the Brazilian low power amplifiers have competitive prices internationally, costing only between 20 and 30 percent more than the FOB price. None of this equipment is yet installed in ground stations, but it is already installed in approximately 1,000 microwave systems.

Equipment for Telephony

CPqD has also developed terminal equipment. For high capacity telephony, it consists of message receivers and exciters, which can transmit from 12 to 1,870 telephone channels. There are already receivers produced by ABC Teleinformatica which are operating in stations in Amazonia. This year, NEC is due to deliver the first message exciters.

For medium capacity telephony, the SCPC (single channel per carrier) terminal was developed, "the most successful from a commercial standpoint," with over 1,000 units already delivered to EMBRATEL by Control. These systems equip stations with up to 60 interurban channels.

Pitsch explains that the SCPC terminals are part of the plan for smallsized ground stations (ETPP), which must use antennas 4.5 or even 3 meters in diameter. They are indicated for installation at isolated points, particularly for rural telephony. The idea is to have complete "turnkey" stations, a project that CPqD considers viable.

Digital Leap

According to Pitsch and the CPqD development personnel, however, all this is already a thing of the past. The interest is now directed toward data communication via satellite. This is the SAM/SAT (Multiple Access System by Satellite) project. The system calls for stations with antennas 6 meters in diameter, a low noise amplifier, a 10 watt amplifier, and baseband equipment (the SAM-/SAT terminals). With these terminals, the installation of private data communication networks within the public network will be possible.

Based on the plan, EMBRATEL would have two "reference" stations installed at different sites, which would control the entire network, and the users could have as many SAM/SAT terminals as they needed. CPqD's development effort is currently focused on these terminals.

The equipment is installed in the client's CPD. It may have from one to 16 terminals receiving information at a speed of from 1.2 to 384 Kbits per line. The exit speed of the SAM/SAT signal to the satellite is 534 Kbits per second.

Pitsch thinks that it is this machine that could advantageously replace the imported equipment currently installed in the networks. The fact is that, at present, the link between stations is point-to-point (if there were 10 stations in a network, each would have to have nine channels, and the steering follows stringent regulations, which is no longer necessary in the SAM/SAT system, in which the steering can be programmed by software, also being developed by CPqD. As for price, the terminal, sufficient for an entire network, will cost between $25,000 and $30,000; whereas at present each channel costs nearly $15,000.

Also working on this project are Microlab, Splice, Sul America and Teleinformatica. According to the plans, next month the documentation on some terminal plates will be turned over to industry; and the prototype should be ready by the middle of the year.

2909

Brazilian Meteorological Satellite Detailed

36990052b Sao Paulo DADOS E IDEIAS in Portuguese Jan 88 pp 24, 25

[Article by Rodolfo Lucena: "Heat and Cold, Winds and Rivers:the Data From Brasil"]

[Text] As early as this year, the first Brazilian satellite for collecting environmental data will be equipped for flight. Land platforms will send information which, when retransmitted through the space equipment, will have applications in meteorology and hydrology.

With delay, but still this year, the first Brazilian satellite being produced by the National Institute of Space Research (INPE), in Sao Jose dos Campos, in the interior of Sao Paulo, should be ready. There is not as yet any prediction about the launching, also to be done with a Brazilian rocket ("launch vehicle," according to the official terminology), being developed by the Aerospace Technological Center (CTA), also in Sao Jose dos Campos. The timetable for the Brazilian Complete Space Mission (MECB) calls for the launch of the experimentalsatellite from the Alcantara base in Maranhao, next month. But several reasons, among which the budgetary one is not the least important, have contributed to the failure of the plans to materialize.

The MECB, proposed by the Brazilian Commission on Space Activities, and approved by the government in 1980, involves development of rockets andlaunchers, development, manufacture, and operation of satellites, and installation of the launch base. INPE is in charge of the satellites. There are four: two to collect environmental data, and two for remote sensor activity. All should be in space by 1993.

The first to be ready is experimental, to collect data. Ground stations equipped with a group of instruments (gauges of pressure, temperature, wind speed, etc.) transmit signals to the satellite, which retransmits them to the operational plant. The remote sensor satellites "photograph" the earth. They have "imagers" (cameras) which can be operated in various bands of the spectrum (infrared, and some visible light frequencies). The different images of the same region can be combined, allowing for precise assessments of the size of a harvest, for example.

Meteorology

One of the main applications of the data collected by satellite that will be ready this year is for weather forecasts. Plinio Tissi, chief of INPE's Telecommunications Department, explains that there are other possible uses. For example, hydroelectric power plants can learn in advance the high tide level, making it possible to predict the ebb tide level, and thus affording better planning of water resources.

The Brazilian satellite for data collection will be 1 meter in diameter and 1.45 meters tall (including the antennas), weighing a total of 115 kilograms. It will be placed in circular orbit, at a height of approximately 700 kilometers. The useful life of the experimental satellite will be only 6 months. The course of the orbit will last approximately 1 hour, covering a band 150 kilometers wide with each passage.

Tissi reports that the only subsystems not developed in Brazil are the solar cells and batteries: the satellite's energy source. Electronic components and certain materials are also imported. But the essential parts are being developed here: the on board computer, transponders for data collection (broadcast and reception, radiocommunications in the 2GHz and 401 MHz bands), and telemetry and telecommand transponders.

The experimental satellite is in a test phase at the Integration and Testing Laboratory, a complex on 10,000 square meters that has been operating since September and was officially opened at the beginning of December by the president of the republic, Jose Sarney.

Data Collection

At present, the meteorological data received by Brazil are sent by foreign satellites such as GOES, Metelsat, and the French Argos. The information transmitted by the latter is collected by data collection platforms (PCD's) developed by INPE.

As early as 1976, INPE began the studies that led to its own development of platforms for use with the Tiros-N and GOES satellites.The Brazilian collection platforms will have to undergo some changes so as to be able to communicate with the national satellite, based on the latter's features. The platforms, supplied by solar cells, operate autonomously, transmitting the data at short time intervals.

Dollars and Cruzados

Obviously, all this costs money. MECB's basic budget, decided in 1981, called for investments of approximately $800 million, to be applied until 1993. The INPE portion (satellites and "earth segment") alone has a planned appropriation of $250 million, according to Oscar Pereira Dias Junior, INPE's planning and control manager.

The "earth segment" involves construction of signal reception premises and stations; a satellite control center; two ground stations for picking up signals (one in Cuiaba, Mato Grosso, and another in Alcantara, Maranhao); two broadcasting centers (one for each type of satellite); and a system for communication between the various centersand premises for satellite preparation at the Alcantara base (preparation rooms, building for dangerous operations, one for non- dangerous operations, etc.). In addition, the development team uses the facilities of INPE's Integration and Testing Laboratory, which cost $30 million. Dias Junior estimates that, to date, 40 percent of the funds has already been invested, an amount totaling about $90 or $100 million.

But expenses always exceed what is planned, or funds fall short of what has been requested. The INPE planning and control manager thinks that the budget specified in 1981 would suffice to carry out the project; however, it is being dismantled year after year, with the necessary corrections.

For example, in 1987 a request was made for supplementary credit amounting to 260 million cruzados, and was left unheeded. Dias Junior claims that the budget for this year is "short of what was expected and of the programming made in 1981." The funds to be spent throughout the year total 1.5 billion cruzados, an amount which, in values of November of last year, represents 650 million cruzados. According to the calculations made by the planning and control manager, if the initial programming had been followed, the budget for 1988, at November 1987 values, would be 2.1 billion cruzados.

Strategic Technology

But, after all, what is the reason for all this? All the information that the future Brazilian satellites will obtain and transmit is currently being received by Brazilian stations, through transmission by satellite from various countries: France and the United States, among others; and there are even negotiations for receiving data from a Soviet satellite. And even when the national equipment is in space, it will be impossible to immediately stop depending on the information from foreigners.

On the economic level, a simple calculation (because it covers only one aspect of the question) gives impressive results. In 1985, Brazil was paying $100,000 per month for the use of images from Landsat (of theU.S.). Since the satellite program (INPE's share alone) is budgeted at $250 million, it would be equivalent to nearly 200 years of leasing!

Hence, the matter is not so simple. Dias Junior gives a reminder that, still on the economic level, the country must make new expenditures with every change in the foreign satellites, made at the convenience of their owners, depending on the progress in technology; and this obviously entails further expenses.

Technology is the key word in the Brazilian program: acquiring the knowledge so as not to remain dependent. Not to mention the always indicated "strategic interests," a reference to interests of the Armed Forces in having their own equipment for data collection. There arealso other commercial reasons: For example, Brazil could become a supplier of satellite sub-assemblies, or lease the Alcantara launching base, which is very well positioned, next to the Equator. It is the economic motivation, pure and simple: After all, speculators on the international stock exchanges are making their bids based on harvest forecasts procured by remote sensor satellite images.

2909

10

Foreign Broadcast Information Service (FBIS) and Joint Publications Research Service (JPRS) publications contain political, economic, military, and sociological news, commentary, and other information, as well as scientific and technical data and reports. All information has been obtained from foreign radio and television broadcasts, news agency transmissions, newspapers, books, and periodicals. Items generally are processed from the first or best available source; it should not be inferred that they have been disseminated only in the medium, in the language, or to the area indicated. Items from foreign language sources are translated. Those from English-language sources are transcribed, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [ ] are supplied by FBIS/JPRS. Processing indicators such as [Text] or [Excerpts] in the first line of each item indicate how the information was processed from the original. Unfamiliar names which are rendered phonetically or transliterated by FBIS/JPRS are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear from the original source but have been supplied as appropriate to the context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by the source.

SUBSCRIPTION/PROCUREMENT INFORMATION

The FBIS DAILY REPORT contains current news and information and is published Monday through Friday in 8 volumes: China, East Europe, Soviet Union, East Asia, Near East & South Asia, Africa (Sub-Sahara), Latin America, and West Europe. Supplements to the DAILY REPORTs may also be available periodically and will be distributed to regular DAILY REPORT subscribers. JPRS publications generally contain less time-sensitive information and are published periodically. Current JPRS publications are listed in *Government Reports Announcements* issued semi-monthly by the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161 and the *Monthly Catalog of U.S. Government Publications* issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

U.S. Government offices may obtain subscriptions to the DAILY REPORTs or JPRS publications (hardcovers or microfiche) at no charge through their sponsoring organizations. DOD consumers are required to submit requests through appropriate command validation channels to DIA, RTS-2C, Washington, D.C. 20301. (Telephone: (202) 373-3771, Autovon: 243-3771.) For additional information or assistance, call FBIS, (703) 527-2368, or write to P.O. Box 2604, Washington, D.C. 20013.

The public may subscribe to either hardcover or microfiche versions of the DAILY REPORTs and JPRS publications through NTIS at the above address or by calling (703) 487-4630. Subscription rates will be provided by NTIS upon request. Subscriptions are available outside the United States from NTIS or appointed foreign dealers. Back issues or single copies of the DAILY REPORTs and JPRS publications are not available. New subscribers should expect a 30-day delay in receipt of the first issue.

Both the DAILY REPORTs and the JPRS publications are on file for public reference at the Library of Congress and at many Federal Depository Libraries. Reference copies may also be seen at many public and university libraries throughout the United States.