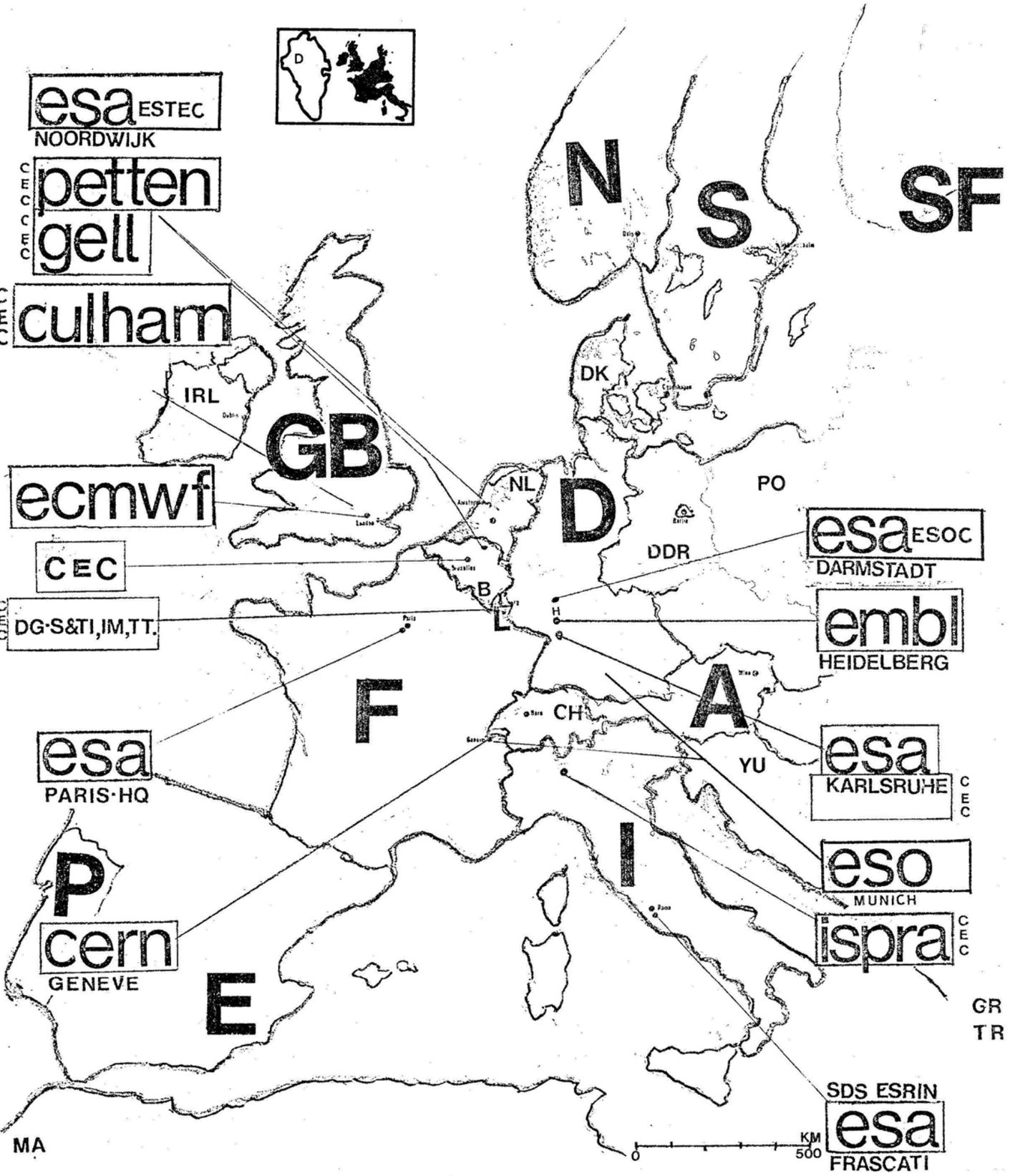



# EURO·COMMON·R&D CENTERS

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CASES : COMMUNICATION . RESOURCE SHARING NETWORKS:

The ESA - SDS - Space Documentation Service , Europes first public ON-LINE system has been operational since 1969. Via many RE-CON, REmote-CONtrol terminals ,Dial-Up Interactice Retrival Service, which offers access to most of the worlds largest files. To expand these possibilities in the Member States the recent policy includes participation in Trade Fairs and Conferences, where the services can be presented and visitors can have a Literature Search performed on subjects of interest. Twice this year in Denmark, at CHEM-TEC 1977,the chemical industries trade fair and at the conference of the Federation of European Biologist Society in August with 2000 participants . Now 20 Danish firms have terminals communicating with the ESA SDS RECON system, besides a number of libraries helping the smaller users.

EURONET is the Community's planned EUROpean NETwork for direct access to scientific, technical, social and economic information, an on-line information network.It will integrate existing and future on-line information services in the Community into a commonly shared network on a cooperative basis.
Make available a large variety of services operated on widely differing host comouters in many different countries via one single network. The basic component will be an efficient data transmission network set up by the joint PTT in Europe.

Multilingual Tools for the Six Language Community: EURO - DIC-AUTOM :
To improve the transfer of the information between the European languages the current Community activity is development of these tools is oriented principally towards three main areas:

Automatic - and semiautomatic translation services
Terminology Data Banks and Multilingual Thesauri.

The volume of translation workgenerated by the Community institutions requires the service of 1300 persons, who last years dealt with 538 000 pages.
Modern technology start offering some assistance to this work load.
EUR-DIC-AUTOM, EUROpean DICtionnaire AUTOMatique Terminals are now in operation in the Community Terminology Office in Brussels. Also on a pilot project and for research purpose at the Terminology Department at the Copenhagen School of

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Economics and Business Administration. The bank has 200 thousand entries , - list of matching expressions under thirty disciplines converted for the six

# A view of Technology Transfer activities in the larger European - Common - Research Centers.

This is a work in progress communication about the very dynamic situation of Technology Transfer (TT) from the large European Common Basic Research Centers and to European Industry. For major research undertakings - big science projects- the European countries for the last two decades have established a number of centers and some with the development of advanced technology and processes. These centers are: The European Community with the joint research centers:JRC: ISPRA in Italy, Petten in Holland,Gell in Belgium,in Karlsruhe and now Culham. With the Directorate General for JRC in Brussels and the Directorate for Scientific- and Technical Information and Information Management in Luxembourg &T.T.O.

ESA - European Space Agency with the HQ in Paris and the following main centers:

ESTEC-European Space Research and Technology Center in Holland.

ESOC -European Space Operation Center in Darmstadt in Germany

ESRIN-Space Documentation Service in Frascati near Rome.

CERN - European Centre for Nuclear Research in Geneva,Switzerland.

ESO- European Southern Observatory working in Geneva in CERN, and Germany andChile.

EMBL-European Micro Biological Laboratory in Heidelberg, Germany.

ECMWF - European Center for Medium Range Weather Forecast in England.

The govering Council of these centers consist typically of scientific- and administrative delegates from all the Member States Governments,between two to five from each country. Time will show if increased TT activities will be supported mostly by the scientific/technological - or the diplomat/administrative delegate type in these councils.

■ INDUSTRIAL POLICY

At the moment an industrial policy for all the European countries does no exist and it is a very difficult subject, which is worked on intensively ,- for the CEC Member States in Brussels.

These centers industrial policy are well developed concerning: Industrial Contracts,Tender Specifications and Policy, Patent and Procurement Policy etc. Normally the newer centers adopt the experience,practice and policy from the older centers. Hereby an increasing uniformity in policy,which is valuable for industry offering their services. A general European TT policy,programme and cooperation for all these centers does not exist.These activities are supported in different ways and to varying degrees and priority. In the larger centers staff members are now in charge of promoting TT-activities.

CENTERS DIFFERENT INDUSTRIAL POLICY

Some centers have a high degree of in-house Technology R&D and manufacturing,- newer centers are working with an industrial policy specifying,that a majority of the advanced Technological R&D should be done in the European industry.

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By comparing information from among others Economic Utility reports from centers with different policies it should be possible to identify differences in :

Benefits in social areas - creating of new job opportunities.

Firms ability to diversify from the sale in the research market to the commercial.

Firms ability to sell on the international market,following contracts with centers

■ VALUABLE TECHNOLOGY FOR TRANSFER

In contrast to technology from most university research- which is often in a not-fully developed form- these centers technology are fully developed, often with manufacturing experience,different applications and well documented. Therefore their technology are of high value for utilization by the industries. At the 1973 TT conference at Evry in the introduction the chairman said: "The Europeans industrie's failure has been in the marketing , and not in the technical knowledge". That comment was also valid for these centers concerning their TT activities. Research must be managed so that useful results will be transferred to the user groups. Scientific information systems can be developed and managed to enhance this knowledge transfer along with the activities described below.

■ RESEARCH AND TECHNOLOGY INFORMATION - SELECTION

In this technological age the accumulation of knowledge far exceeds its applica - tion and utilization for improving the quality of life. From the industrial decision-makers point of view,there is a deluge of information,reports and data to consider.The research community must assist in finding ways to build filters into this knowledge accumulation processes. Hereby the decision makers, when searching the systems, will be supplied with clear,credible and pertient data.

■ TT-PROFILE

The scientific and technological profile for each of these centers are a very broad subject.For some of these centers,illustrations about the activites of the staff in typical working situations will give us an idea of the work done and the types of technlogy and processes in use.

■ ECONOMIC UTILITY REPORTS

Investigations about the economic impact of these centers contracts with the industrial firms are now available.They report on the results due to these firms initial contract for work,similar contracts with customers,adoption of these technologies to other purposes. This results in a technical and economic benefit

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for the countries. These economic studies result in:Utility Reports,in which the authors try to quantify the technical- and economic benefits to the European manufacturing industries involved, based on the firms own evaluation of the impact

About CERN: "A study of economic follow-effects caused by the industrial contracts of a large basic research center,with special emphasis of the technology transfer aspects"April 1977 by Michael Bruun, Institute of Management, University of Aarhus, Denmark.

Also studies at Austria Institute of Management,Dr.W. Kemmetmuller, Vienna.

■ TT - CASES

A few cases will be reported on, which have or will improve the Europeans jobs, health,home,mobility,communication and environment.An increasing number of these cases will assist the economic, environmental and social expectations of Europeans.

HEALTH:Most of the centers have a well developed Medical Service,which for a number of years have done a service and research within Occupational Medicine, and accumulated extensive experience in handling and correlating this type of medical information.Around in Europe the Governments now introduce laws in this field, so the indutries will implement programs for medical services in the larger firms and for groups of firms. The experience and the recording methods developed in these centers,could be applied in many places, and this will ease the evaluation and comparison of data and a better statistics will result on the scare data available in this field.

EUROPEAN MANAGEMENT TECHNIQUES : Over the years, the management of these centers have developed an art in composing the European staff members into R&D teams. It is based on experience and knowledge about the many European nationalities variable strengths in talents and skills. A successful team requires often an optimum composition of theoretical,scientific,innovative,technlogical and administrative skills. This management skill is highly applicable in the increasing european industrial cooperation.The recent article in the:Bulletin of the Atomic Scientist,September 1977 by Prof. Leo Kowarski "Conditions of success in international enterprices in science and technology" offer lo basic conditions,which have worked well - they apply also to industrial enterprices.

VIDEO SYSTEMS : The similarity between the increasing application of Video Systems using TV monitors as datascreens - at low cost - for monitoring and diagnosis in hospitals and similar applications in control centers for accelerators and nuclear experiments etc. , have been a fruitful TT field for the last number of years, in which I have been a little involved. Both applications need simplicity, low cost,flexibility,reliability. TT and cooperation will go on about this subject- now we have this technology simplified in our homes as the Video Games, and Text Pages are on the way for subjects of interest.

COMMUNICATION:The large number of information network and dataterminals for these centers many purposes are an example of these centers own need being solved with a suitable technology.Later these systems are promoted for applications by the Europeans , first via central technical libraries, and on the basis of a service function, which the user accepts and pays for.Now many european firms have terminals connected direct to these systems, mainly the ESA-RECON.

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nary measures,improve methods of work and use of safe equipment.They have experience covering most of the industrial sectors.This knowledge should be transferred to the countries, increasinly.In Environmental Monitoring the ISPRA Center has a broad programme and a large number of studies have been done, and one of the main subjects presented at exhibitions. They have extensive experience in Remote Sensing Techniques and the measurement of pollution.
TRACER TECHNOLOGY: Widely used for investigations in medicine and industry. Complex problems in Multi-Compartment studies for quantitative analysis of biological systems have been solved by C.Combelli in Padova, among others utilizing these centers software in the computer work required.

■ PERSONAL CONTACTS

One of the most important in TT processes are supported via:Fellowship-programs, Cources, Meetings,Exhibitions in the centers and at Trade Fairs,Visitor Services and Staff Members visit to manufacturing plants all over Europe. These helps to build up knowledge about - and establish contacts to these research centers ,so vital for a fast and efficient localization of needed technology or processes.

■ TECHNOLOGY TRANSFER MEETINGS

A few meetings on this specific subject for industry have taken place: At CERN in April 24-26,1974 with the:"Meeting on Technology arising from High Energy Physics",with publication of two volumes of the report:CERN 1974-9 with 13 review papers and 225 technology notes,7oo pages with 6oo references. The large number of posters and set-ups prepared for that meeting have since found a permanent place in the central exhibition and the many exhibition points visited on a tour of this center.

■ VISITORS

Each year many engineers and scientists enter these centers on Fellowships, Visitor Programs,as Research Associates,Summer Students,all mainly for scientific purpose. Most of these persons are on leave from their university and return to it. Therefore they normally result in little direct transfer to industry.Some return to industry with a specialized skill, which in smaller countries can be difficult to utilize.Their knowledge of whom to contact in the center for a needed technology can be very valuable for their employer.Short visits at the

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center to study the latest developments and know how and obtain specific information and documentation can be an efficient way of TT for the parts involved.

years the ISRPA COURCES have covered a broad range of subjects, which engineers and scientists from industry have utilized.Similar activities should be offered by the larger of the other centers on their subjects of work. An increased participation in these courses could be obtained - due to lower cost and less travel - if courses were located in connection with the larger European technical - and trade fairs, like HANNOVER,MESUCURA,INTERCAMA etc. Normally staff from both the centers and industry participates in these,and therefore very little extra effort is required. Industry increasingly utilized this possibility.

■ EXHIBITIONS WITH R&D and TECHNOLOGY TRANSFER STANDS.

Increasing these centers participate to present technology available for transfer. At Europes largest trade fair in Hannover April 1977 the Communities Joint Research Centers, CERN and some of ESA's contractors had exhibitions in the Hall 7, specially for the presentation of R&D results.This year the area was doubled. Technology Notes were available on a large number of promising subjects. A few firms presented industrial productions based on Technology Note subjects. Much improvement are needed for bringing this service to the full attention of the industrial and public user group. Also better searching aids related to the users subjects of interest, specially for the smaller- and medium size business. Also an evaluation should be done concerning types of stands, - one large stand with all on display and staff , or a number of satelite stands located in the halls matching the interest and needs of the visitors , or a mixture.

■ TECHNOLOGY TRANSFER DOCUMENTATION

From the point of view of the industrial user about this documentation from the many centers on TT subjects it will be convenient for the perception, screening,utilization and filing, if it was prepared more uniformly ,keywords, terminology, format,synbols , - as common as possible for all these centers. Also in line with the TT programmes in many Member States promoting utilization of national developed technology. A number of coordinated activities would benefit the receiving industries and also for the centers increasingly applying technology available for transfer.

■ WORKSHOP TECHNIQUES

Technicians and workers from the Member States scientific institutes and industrial contractors work for periods in these centers, and hereby get familiar with the latest techniques, and can transfer it home for national applications.

■ EUROPEANS NEEDS - GOVERNMENTS PLANS

For Europes industrialized countries - mostly highwage countries - the road ahead is extension of the means of production and services - with high-added value. This means in many cases products and services with a high technological content. Knowledge about TT is of high importance for their development, and in the strategic planning processes by managers in industry.
Governments policy for science will increasingly be related to technology and to industry,-programmes of STP:Scientific and Technical Policy.
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Governments find it important to support conditions that foster small and medium

firms and with joint research associations - as one of the means of promoting their technical advance.

■ UNIVERSITY - INDUSTRY COOPERATION

Most of the Governments of Europe are now formulating a policy for technological innovations including technology transfer and marketing innovations. It will be important for the fields chosen for development , at a time when Europe are embarking on a long - term restructuring of its industry.

The increasing number of reports from the "Research on Research" scientist and others now available, are studied by the Governments Departments and the University Administrators. They implement changes to improve communications and faster applications of research results in society. At universities they establish: Information - and Contact Secretariats, Industrial Liasion Officers and support activities to increased Contracts Research work by the staff. These changes help to lower some of the barriers for transfer. The academic attitudes to collaborating with the industrial world are changing. Now the universities are more active with transfer and arrange OPEN HOUSE for the public. At their exhibitions they also present the research and technology of these centers. Booklets and abstracts are written about R&D performed or planned, and in a language , which can be understood by a user. Now higher priority is given to communication and the transfer of results to society and industry.
In the earlier stages of these national activities the scientists and engineers of these centers increased their TT activities.

■ CHANGING RESEARCH POLICY

There is a growing public demand for research of more direct benefit to society, and a faster and more efficient utilization of the results to assist society with solving the long list of problems and industrial and economic development. TT helps in fulfilling these demands.

Two extreme forms of research policy exist :
Science oriented administrators support research and the other
Society oriented administrators purchases research.
During the last years varying degrees of these funding policies have been implemented in the Member States, by using new routes of channeling of research funds. Some for payment for applied R&D and for contract research, and favouring lines of

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investigations likely to make earlier dividends and solutions to specific problems, at the expence of speculative long term research.
These policies have also affected these centers to a certain degree, and they

■ REPACKING VIA INSTITUTIONAL LINKAGE

Certain technology and processes need first to be transferred to national research - and technology centers for adoption to local needs,conditions, standards etc. Hereby an valuable connecting link is established between basic research and industrial application, and hopefully in an innovatine environment. Mature and correctly timed they are presented and utilized by industry.Staff in the universities and centers are now more interested in locating technology in the European centers due to their potential for application to solution in own R & D work,or for solving located needs,-possibly in connection with contract work for industry or in the public functions.

■ OFFICIAL CONTACTS

The official channel from these centers to the Member States are in Denmark through the Ministry of Education with Science Councils and Research Secratariat. Industrial organizations and firms are now familiar with the functions of these, as they receive important information and documents about tenders,contracts etc. For Technology Documentation the fastest and shortest route to the user should be used.Increasingly direct routes are established between the centers and industrial organizations and firms, as knowledge about technology interest profiles and needs get understood.

The centers Newsletters and Bulletins are now read in industry and should be utilized much more in the transfer processes due to the low cost in using this well established and selective information channel.In some of them industrial advertisments are half of the content now. so a wider distribution would benefit all .

■ LISTING OF IMPROVEMENT IN TT FROM THESE CENTERS.

■Transfer processes increasingly planned as an integral part of Technological R & D programmes and its implications to project management be understood in the centers.

■Increasing communication and working relationship between the center and users.

■When possible the TT must early and closely be keyed to actual demand for it.

■Small pieces of R & D must be joined together and presented to be visible for users.

■More regonition of the importance of interdiciplinary work.

■For the important technology and processes listing of these in systems, which can be searched from all Member States and if possible via Telex or Dataterminals. French R & D results are available in this way . CERN are considering these listings.

■Passive TT information, - request cards abstracting technology notes introduced.

■At the larger trade fairs and conferences more and better exhibitions and sup - plemented with short cources and seminars on the centers technology subjects.

■Centers Newsletters and Bulletins should inform about successful transfer cases.

■At Scientific Conferences short survey papers about TT related to the experiments.

■Integration of technological innovation with marketing innovation in the countries.

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■Integration of technological innovation with marketing innovation in the countries.

- Between these centers cooperation should be increased , as it will result in a faster exchange of experience about TT processes , and result in improvements. Also to obtain a certain uniformity in European TT and with maximum programme value at lowest cost.
- Continued attention to improve the TT processes as experience develops.
- The nature of technology demand and the transfer processes varies greatly between one type of industry and another , - for a better understanding of this more research.
- The innovation processes peculiar for these technologies must be better understood.
- And as mentioner earlier , Group Visits, Guest Visits, National TT meetings .
- Improvements in some of the centers Industrial Policy and its implementation.
- Publications or notes of the Technology Profile of the centers.
- Improvements in receiving conditions in Member States Industries.
- In Annual Reports - Annexes with Technology Transfer Program Information.
- A European Technology Transfer Program comparable with the American Program.

Organizations - Member Countries . 1977.

Organizations - Member Countries . 1977.

| A | B | CH | D | DK | E | F | G | GB | I | IRL | L | N | NL | P | S | SF | TR | YU |
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The Hanover Fair is the only Fair in the world where the compound offer of more than 24 large trade markets is displayed. Some 502 000 people visited the Hanover Fair in 1976, including 68 000 from abroad; they were able to compare and choose between the products of 4826 exhibitors from 42 countries.

30 per cent of the business visitors at the Hanover Fair are top managers, 18 per cent are technical staff, and 33 per cent belong to middle management.

Forschung und Technologie

Research and Technology

**NB: Hannover-Messe '78**
19.–27. April 1978

# Hannover Messe'77

Mittwoch, 20. April - Donnerstag, 28. April

# Technologie

## List of exhibitors
**Research and Technology**

**Deutsche Messe- und Ausstellungs-AG**
**Messegelände · D-3000 Hannover 8**

100 SIRA Institute/GB
100 Lucas Aerospace/GB
100 Central Electricity Generating Board/GB
100 Ministry of Defence/GB
101 Scientific Consulting
102 Spindler & Hoyer
103 Institut für Impulstechnik
105 Deutsche Forschungsgesellschaft für Blechverarbeitung und Oberflächenbehandlung
106 Drabert Söhne
107 Reuter Technologie
107 Innova Treuhand
108 Bundesversuchs- und Forschungsanstalt Arsenal/A
109 Saab-Scania/S
110 MC-Gesellschaft
200/300 Messerschmitt-Bölkow-Blohm
200 a Verband der Patentwirtschaftler e. V.
201 Ing. Chr. Maier
202 Verlag Chemie
203 NEDAP N. V./NL
204 Busse design
205
206/307 Technische Akademie Esslingen
206/307 Technische Akademie Wuppertal
207/308 Deutsche Wagnisfinanzierungsgesellschaft
208/309 Bergbau-Forschung
301/302 BAYER
805/806 Arbeitsgemeinschaft
905/906 Spacelab-Nutzung
807/808 Bundesministerium
907/908 für wirtschaftliche Zusammenarbeit (BMZ)
901 CERN/CH

1000/1100 Dornier System GmbH
1001/1101 Motoren- und Turbinen-Union München
1002/1102
1003/1103 Zentrales Büro für Internationalen Lizenzhandel/DDR
1004/1104 Transform AG

303 artec design
304 Team fest
305 Innovation GmbH
306 Bundesanstalt für Materialprüfung – BAM –
400/500 Batelle Institut
400a/900a Arbeitsgemeinschaft der Großforschungseinrichtungen
401/501 Daimler-Benz
402/502 TNO/NL
403/503 Deutsche Industriewartung
404/405 Arbeitsgemeinschaft
504/505 industrieller Forschungsvereinigungen AGF
406/407, 506/507 Volkswagenwerk
600/601 Arbeitsgemeinschaft der
700/701 Großforschungseinrichtungen
602/603 Arbeitsgemeinschaft der
702/703 Großforschungseinrichtungen
604/605 Bundesministerium für
704/705 Forschung und Technologie
606/607 Fraunhofer-
706/707 Gesellschaft
800/900 Reuter-Technologie GmbH
CEC – DG 13 –
802/902 Heinrich-Hertz-Institut
803/804 Bundesministerium
903/904 für wirtschaftliche Zusammenarbeit
1005/1105 Zentralstelle Dokumentation Elektrotechnik e. V. beim VDE
1006/1106 Pietzsch-Forschungsgruppe
1007/1107 Stiftung „Jugend forscht" e. V.
1008 Verband unabhängig beratender Ingenieurfirmen e. V.
1009 Poiexpo/PL
1109 Navimor/PL
1200 Bundesinstitut für Berufsbildungsforschung
1201 Ciba-Geigy/CH

## The Innovations Market Research and Technology 1977 in Hall 7

The Hanover Fair's innovations market "Research and Technology" is basically different from the other specialist markets at the Fair because it does not offer products, but rather technical solutions to problems made available through research and development. Its spectrum ranges from the product idea through to the protoype. The innovations market "Research and Technology" at the Hanover Fair is intended to improve the possibilities of transferring the results of research and development into industrial usage. So the exhibitors in the innovations market are research centres and company research departments; they offer information, advice or co-operation in solving technical problems, commercially applicable research and development results as well as assistance in transferring these results into industrial usage.
This "market prior to the product" complements the other specialist markets and as an innovations market reaches into any and every branch of industry. Following its premiere in 1976, which even as a purely national affair was already very successful, "Research and Technology" is open to exhibitors from all over the world as from 1977, as are all the other specialist markets at the Hanover Fair.

**Conference Research and Technology**
"Activated technology transfer"

**Information Symposium of the Fraunhofer-Gesellschaft**
"Research and development for medium-sized industrial companies"

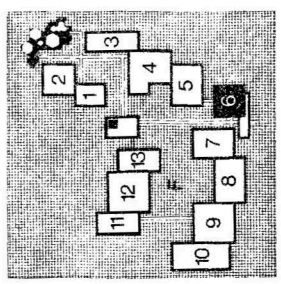
INTERKAMA

The exhibition, presenting the state of technology, is supplemented by user-related courses organized by the exhibiting companies, and by a congress devoted to fundamental questions of future developments. These events help bring together experts from science, development and from the user side. In addition, a special show organized by scientific institutions within the framework of the exhibition, provides a link with research.

This comprehensive synthesis provides the basis for the success and the very positive response the Interkama has met with for many years. It is to be hoped that this will be confirmed by Interkama '77!

Sonderschau „Angewandte Forschung"

## Halle 6/1 (Erdgeschoß) Stände 1–18




Düsseldorfer Messegesellschaft mbH
- NOWEA -, D-4000 Düsseldorf 30
**Date:** October 6 to 12, 1977

C.E.C **GD 13 – TT**

5 Rheinisch-Westfälische Technische Hochschule Aachen, Laboratorium für Werkzeugmaschinen und Betriebslehre, Abt. Meßtechnik für die automatisierte Fertigung
5 Technische Universität München, Lehrstuhl für Prozeßrechner
5 Technische Universität München, Lehrstuhl und Laboratorium für Steuerungs- und Regelungstechnik
5 Universität Dortmund, Lehrstuhl für Förder- und Lagerwesen
5 Universität Stuttgart, Institut für Verfahrenstechnik und Dampfkesselwesen
5 Universität Stuttgart, Abt. für Regelungstechnik und Prozeßdynamik (IVD)
5 Rubow, Weber, Unternehmungsberatung, Hamburg
6 Institut of Measurement and Control, London
7 Zentralstelle Dokumentation Elektrotechnik e.V. beim VDE, Offenbach/Main
8 Physikalisch-Technische Bundesanstalt, Braunschweig
9 Kernforschungsanlage Jülich GmbH
10 Institut für Meßtechnik im Maschinenbau, TU Hannover
11 Fachhochschule Ulm, Fachbereich Technische Informatik
12 Bundesanstalt für Materialprüfung (BAM), Berlin
13 Institut für Grundlagen der Elektrotechnik und elektrische Meßtechnik, TU Braunschweig
14 Institut für biomedizinische Technik, München
15 Technische Akademie e.V., Außeninstitut der RWTH Aachen, Wuppertal
16 Universität Stuttgart, Institut für Systemdynamik und Regelungstechnik
17 Technische Universität München, Lehrstuhl und Laboratorium für Steuerungs- und Regelungstechnik
18 Institut für Prozeßmeßtechnik und Prozeßleittechnik, Universität Karlsruhe

1 Institut für Regelungstechnik, TU Braunschweig
2 und 4 Institut für Informationsverarbeitung in Technik und Biologie (IITB), Karlsruhe, mit folgenden Instituten:
5 Patentstelle für die deutsche Forschung; Institut für Aerobiologie; Institut für angewandte Festkörperphysik; Institut Mikroskopie; Photographie und Kinematographie; Institut für Physikalische Weltraumforschung; Institut für zerstörungsfreie Prüfverfahren
5 Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V., München: Institut für Informationsverarbeitung in Technik und Biologie; Patentstelle für die deutsche Forschung; Institut für Aerobiologie; Institut für angewandte Festkörperphysik; Institut für Mikroskopie, Photographie und Kinematographie; Institut für physikalische Weltraumforschung; Institut für zerstörungsfreie Prüfverfahren
5 Sternwarte Bochum
5 Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Oberpfaffenhofen
5 Gesellschaft für Kernforschung mbH, Karlsruhe, mit folgenden Instituten: PDV Projekt Prozeßlenkung mit DV-Anlagen; PNS Projekt Nukleare Sicherheit; IDT Institut für Datenverarbeitung in der Technik; IKVT Institut für Kernverfahrenstechnik; IRB Institut für Reaktorbauelemente
5 Norddeutscher Rundfunk, Hamburg
5 Rheinisch-Westfälische Technische Hochschule Aachen, Lehrgebiet für Industrieofenbau, Wärmetechnik im Hüttenwesen

BS/HH/SH November 1977

TECHNOLOGY TRANSFER IN INDUSTRIALIZED COUNTRIES

TECHNOLOGY TRANSFER IN BELGIUM : AN INDUSTRY PERSPECTIVE

## 1. INTRODUCTION

Before defining what we mean by "technological transfer", let us first take a quick look at the transfer situation as far as Belgium is concerned. Our country is an open market, completely so to other members of the Common Market and with hardly any restrictions to the other industrialized countries.

We accept and encourage foreign investment of all kinds ; just one figure will illustrate this - nearly 1 200 US firms have offshoots in Belgium in a wide variety of sectors : industry, banking, consultancies, subsidiaries, agencies and so forth ....

For foreign investments as a whole, it is above all the rate of investment per job which is constantly growing, meaning that either our equipment or the personnel involved is of a higher technical level than before. Another illustrative figure : from 2.1 million BF in 1972 investment per job had risen to 3.3 million in 1976, an increase of 50 per cent.

For a technology transfer to be valid, the receiving country must be able to absorb all the aspects of the new development, both hardware and software, without relying on any support that the transferring country may be able to provide.
In this regard, Belgium has proved that in all fields, it has either the engineering capacities required, in human terms, or the will to equip itself in such a way as to build up its technological potential.

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The examples I'll be giving later on will show how true this is.

As we consider that "technology" in the transfer context covers not only the technique itself but also the management of programmes, we might also mention a few positive experiences in this sphere.
The global expression "transfer of technology" in fact implies a number of things which are only distantly related to the technology itself, and although the actual passing of know how and processes poses no major problems, because it is done by and between "technicians", the same is not altogether true of the other aspects of the problem.

In fact, a transfer consists of :
either taking out a licence, exclusive or not
a transfer of know how
a joint study contract
or an investment in software
or in hardware
or in personnel
or co-production, etc.....

Furthermore, a licence may be part private, part public ; co-production may be teamed with "reasonable competitiveness"; prices may be stipulated :

either in the licensor's or the producer's currency
or with or without exchange cover.
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The contract may also qualify for facilities such as
- export loans

## 2. PAST EXPERIENCE

### Example in the aeronautical industry

One of the first examples is the F-104 ; Belgium worked on the air frame, the engine and the rigging out of this - avionics, radar, etc.... In this case, the licence was taken out by the government and, something rather unusual, some of the elements were manufactured under the "unique source" system.

It was a simple performance contract involving no research and development. While the airframe was in production, however, the licensee studied, and solved, a number of integration problems, acquiring a solid experience in servocontrol which he put to good use in later contracts, both aeronautical and spatial.

As far as electronics are concerned, the contract was won mainly thanks to the knowledge that the tenderer had acquired during his experience with the HAWK system.
He was familiar with the American licensor's methods of management, his turn of mind, psychology, and way of presenting offers and also understood exactly the implications of the contract and the very specific vocabulary used in administrative dealings. Although it was a licence, the contract carried no guarantee as to the efficient working of the system, constructed with scrupulous respect for the data supplied by the licensor.

In spite of this, the licensee felt that the technical assistance the licensor wanted should be charged to him, and this was accepted.
The other factor that worked in the licensee's favour was his thorough knowledge of certain printed circuits. The licence enabled him to create an industrial production line for a product which until than had been made one by one in the laboratory (multi-layer circuits). Later on, he was able to transfer his technology to a third country which had

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Example of aircraft engines

This example concerns a series of jet engines built under licence from several countries - the United Kingdom, the US, France and Federal Germany.

In this case, the licence was taken out because, at the start, available technical, commercial and financial resources were overstretched.
The licence finally covered :

- manufacture of spare parts (combustion chambers and turbine blades)
- maintenance and overhaul of entire engines and their accessories, making it possible to prolong the use of assembly and testing equipment
- manufacture of parts for the licensors' own needs and re-conditioning of other manufacturers' engines
- manufactures in :
  . industrial gas turbines in cooperation with Boeing, under an arrangement whereby the two firms - F.N. and Boeing - collaborated in research and development and later on, in other innovations.
  This joint working led to the design and production of gas turbines for tanks, turbo-compressors for jet-engine ground take-off
  . Hawk rocket launchers and the Blue Streak, Viking and Ariane rockets
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  . Hawk rocket launchers and the Blue Streak, Viking and Ariane rockets
- development of prototype engines in collaboration with foreign partners.

- precision forging and precision foundrywork (arms and exports)
- vacuum brazing, electrochemical machining
- various surface treatments.

Derived activities included :

- civil engine parts subcontract work
- small industrial turbines and turbostarter units
- components for rocket engines
- nuclear machinery for civil use
- miscellaneous research and development.

The resulting progress in refractory materials, the use of new alloys, the introduction of titanium, the cooling of blades and the adoption of new design concepts (two-spool, bypass and fan, etc....) made it possible to increase turbine inlet temperatures and pressure ratios, improve the efficiency of compressors, combustion systems and turbines and led to the introduction of after-burning. In this way, the firm found itself excellently placed for producing such modern engines as the F-100 and the CFM-56.

Example in the nuclear industry

In the case of nuclear technology transfer, the licence in question covered :

- sub-systems (software and integration process)
- equipment (hardware)
- technical assistance (personnel transfer).

The licence itself was comparatively inexpensive but the technology transferred was out-of-date ; the main thing in its favour was that the licensor had already tried and tested the manufacture. With this licence, however, there was no possibility of getting competitive offers as the elements had already been manufactured and were by then outdated - it simply covered the assembly work and for this, the licensor provided technical assistance.

- technical assistance (personnel transfer).

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At a later stage, the licence was expanded to cover manufacture of elements on order but, over the years, its field of application shrank and the licensee became a mere subcontractor with no possibility of research and development, marketing or competition.

Know how was acquired by the licensee sending a 40 qualified engineer years to the licensor, at the risk of losing him.

The basic reason for proceeding in this way was the fear of creating a potential competitor and the result was that the licensee concluded there must be an agreement between supplier and customer before beginning the transaction. In fact, this particular case gave the licensor the opportunity of penetrating the market without conceding the licensee full responsibility for the whole thing and without granting him marketing possibilities.

In practice, things went like this :

- an experimental reactor was built with parts supplied ; the licensee was allowed to produce spares and ancillary equipment
- then an operational reactor, designed in association with the United States, was produced entirely in Belgium, except the fuel
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Another case of transfer in the nuclear industry, this time

contribution to the project, and thanks to their experience we have been able to familiarize ourselves with the use of plutonium oxide. Besides this, Belgium has been able to play the part of industrial architect thanks to help from the EEC (EURATOM) via the CEA (France)-EURATOM agreement for French breeder reactors.

In this case, there was a full input and exchange of know how and this continues to be so, despite the complexity of the financial structure (see diagram).

Example in the field of electronic equipment for armaments (radar, etc....)

At the start, we merely produced faithful copies of American equipment, with no licensing obligations (SCR 584) but for subsequent projects (HawK, F-104), licences were taken out by the government. This gave the firms involved the advantage of being able to manage large-scale programmes, learn about quality control and configuration management, quite apart from the technical knowledge they gained such as spot-welding, reflow soldering, high density current printed circuits, the use of magnesium sheet, high power printed circuits, moulding of electronic components, etc....

In the proposals concerning radar for the F-16, however, the two digital signal processor units, the thick layer elements and the parametric amplifiers for the receiver are not covered by the licence. I shall come back to this at the end.

Here, as in aeronautics, there is an interesting case of indirect transfer : a study contract awarded to a Belgian firm by a foreign country. This type of contract may eventually serve as a model for future transfers where the necessary personnel and software are available but funds are not.

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Example in heavy engineering

Now let us look at the case of the installation abroad of a new factory, by a multinational corporation, for example. In the true illustration I have chosen, things evolved as follows :

- two years for Assembly
- part-manufacture of complete units (for rationalization within the group) including tooling (design and production)
- production and design of new types of equipment.

At the outset, the investor loaned personnel to help with management but gradually reduced their number. Later, the new plant sent some of its own staff to the parent firm. From the start, the new plant's design office studied modifications to adapt the product to various markets (units of measure, presentation of plans, languages, manufacturing and product standards, etc....)

The new ideas garnered from a variety of markets resulted in the Belgian plant heading a complete research and development programme for a new piece of equipment. All though the process, the firm gathered experience in management and organization methods as well as research and development possibilities.

These acquisitions, in turn, had an impact on the "on the job" training of personnel and filtered through into the region's technical education network, to both teachers and students.

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In the same way, by exchanging technical information with

The exchange of technology is absolutely free within the group and any associated firm capable of it can undertake research and development, the results of which are accessible to other members.

Besides this, each firm can combine the technologies of its partners in the group to develop original products, doing any extra research and development necessary itself to improve, adapt or integrate.

The only restriction on sharing knowledge that can arise is if research and development has been in any way State financed. This, then, is a "multi-research and development" system that may in some cases result in parallel multi-production.

Each member can also purchase a foreign licence from the group or invest abroad. At private sector level, this liberty of action has sometimes been thwarted by foreign states who reduce the firm to pure and simple subcontractor status without the slightest possibility of modification. For other contracts, however, also with a foreign partner within the group, the initial idea may have been imported but the research and development stemming from it have been shared on a reciprocal and equitable basis and, the original co-production arrangement has evolved into co-development.

In this context of exchange, the firm has maintained a high technological level which has enabled it to be always in a position to react positively to requests from officialdom, particularly in the military telecommunications field.

It has established an infrastructure by investing in tooling and administrative property, training of personnel and in environmental laboratory.

A very important consequence of this, in today's Belgian economic context, is that the competitiveness of brainpower

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A very important consequence of this, in today's Belgian economic context, is that the competitiveness of brainpower makes up for the uncompetitiveness of manpower. Perhaps this should be a lesson for the future.

## 3. OUTLOOK FOR THE FUTURE

Future prospects are very much influenced by past experience and by positive changes made to factors or elements which, in the past, either put a brake on transfers, made them over-complicated or quite simply stopped them happening at all.

### Importance of Research and Development

The first factor, chronologically and by order of importance is the rôle of research and development.

IBM's views on this are rather surprising :
"The creation and dissemination of technologies is such a fluid process that, in fact, in IBM's development services we do not talk about "technological transfer". Transfer is something more specific to development and production. In the third world, the transfer of a manufacturing technology is important because it contributes to the absorption capacity of the infrastructure".(1)

This may be acceptable for the third world, but it is not for an industrialized country and private industry in Belgium certainly does not share it.

On the contrary, in all contracts involving the transfer of technology, Belgian industry looks for the maximum of research and development compatible with its capacity. Our big neighbours doubtless share this view : one has to the absorption capacity of the infrastructure".(1)

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On the contrary, in all contracts involving the transfer of technology, Belgian industry looks for the maximum of research and development compatible with its capacity. Our big neighbours doubtless share this view : one has only to look at the cutthroat competition which has been going on between nations since the beginning of NATO to

As far as I know, there has never been a research and development programme, even a long term one (15 years or more), that has enabled a joint R and D action to get off the ground ; one country or other has always pushed for the results of its own research and development to be used as a starting point and tried to pressure its future partners into accepting it.

If we start from the principle that intelligence is a most widespread thing, all the industrialized countries will always be able to produce people capable of integrating themselves into a joint research and development programme which will be of benefit to all involved.

To conclude, Belgian industry's wish will always be for technological transfer via research and development, which we believe to be the key to our future.

Type of contract

When choosing between taking out a licence, exclusive or not, exchanging know how or launching a joint study, the decision depends basically on the case in point. Restrictive clauses on supply (and the know how connected with it) are constraints that should be outlawed, at least between NATO countries who claim to be interested in a common economic as well as a common defense policy. In addition to this, the exchange of improvements and innovations made during manufacture should be mandatory.

Whereas the choice of transfer method is fairly limited, the opposite is true of "restrictive" factors which are very numerous and have reciprocal implications. Indeed, how can one separate the question of "unique source" from that of reasonable competitiveness and price fixing ?

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It is obvious that a sole source would be preferable for the industry at the receiving end of the transfer, especially in today's world of inflation and floating currencies. When a contract does not contain this clause, which is very often the case, one finds oneself faced with that wonderful formula, dear to the United States, "reasonable competitiveness" !

A clear definition of this formula is nowhere to be found - each side interprets it as he thinks fit which, in a contract where the two parties should be equal, may seem rather absurd.

This clause brings us directly to the question of costs and prices. A current example of the consequences of the clause is the case of the F-16, even if the dollar rate was fixed at a reasonable level for a period of three years.

In fact, if the US dollar rate rises, European governments will pay more for the aircraft and if it falls, the European firms will no longer be "reasonably competitive" and the job of producing some elements will slip through their fingers.

But ..... who knows what the rate for the dollar will be when the three-year period runs out ?

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And when it comes to building aircraft for third countries, some time in the future, potential clients will be faced with the same contradiction.

While we are still talking about future prospects, what chances has European industry got in these circumstances ?

These veritable "limitations" on technological transfer weaken the licencee's position vis-à-vis the licensor and are hardly conducive to transfers, with all the consequences that that may have on the smaller or medium-sized industrialized countries' technological development in the long term.

And these are not the only restrictions on the free transfer of technology ; there are also the financial aspects - exchange cover, rate of inflation, the unit of payment, credit insurance, the granting of credit, legislation on industrial property, sales restrictions, and so on ....

As an example, we might take the compensation orders that the Belgian aeronautical industry received from France ; the profitability of these is now very questionable due to exchange problems.
In principle, problems of this type should never have arisen. When the "Mirage 5" order went through, all the contracts were drawn up in French francs and so were the clauses concerning economic compensation. It was also clearly stated that, in the event of changes in exchange parities, the necessary modifications would be made to get back to an equivalent price in Belgian francs. This was in fact done but, strangely enough, only for a limited period of time. As the French franc has eroded considerably in the past few years, and as the monetary rectification clause has not been applied for some long time, the firms involved with the M-5B compensations are suffering heavy exchange losses. Not only is Belgian industry having difficulties because of this, but also regrets, for from every other angle, this unique industrial source programme is giving excellent results, well beyond the limits of the contract.

With this costly experience behind them, the Belgian aeronautical industry has managed to convince the government how important it is to have a compensatory mechanism which would play a similar rôle to "Coface" in France ; future contracts

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of this type will therefore be drawn up in Belgian francs and, in addition, the Delcredere Office will intervene - exactly how far has not yet been announced,to prevent industrialists having to suffer the consequences of monetary fluctuations over which they obviously have no control.

It is a fact that in a case of full cooperation, Belgium can offer itself as a totally reliable partner only if it can count on such intervention. The first concrete case has now arisen. It is the question of Belgian participation in the Alpha Jet which will be backed by Delcredere intervention if there are any fluctuations in the Deutsch mark and the French franc.

When a contract involves "compensation", it is best if this is arranged solely by the licensor's country buying a highly developed product from the licensee's. This often enables the licensee to obtain a quality label which can open up other markets for him.

As for the effect on standardization, a "sole source" transfer contract could lead to fears of monopoly. If prices are prohibitive, however, there are always firms on the market ready to take over the products at reasonable prices from which they reap sufficient reward.
The various opinions voiced at a colloquium on this subject as it affects armaments, in March 1977, indicate that

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standardization is far from desirable, not to say unacceptable, for a number of reasons.
Cooperation

And as for collaboration beyond the Atlantic - one cannot help feeling skeptical about its future when one reads in President Carter's six point statement on arms sales policy in April this year that "we may stipulate that we will not entertain any request for retransfer". Any impartial observer, however, recognizes that investments in advanced technology activities have a more positive effect on employment than labour intensive investments.

But this is one of the main problems facing Belgian industries. "Our country, which represents 3% of Europe and 1% of the industrialized world, cannot claim to create for itself all the scientific knowledge and all the techniques it will be using tomorrow. These will come from abroad in a proportion which may perhaps exceed 95%. (Mr. G. Geens, Minister for Science Policy). Because of this, Belgium is ready to tackle any advanced technology but to do so, relies absolutely on cooperation because of the enormous investments involved.

Indeed, in the aeronautical sector over the past twenty five years, as unit costs have increased continually (labour .....) and as unit performances are considerably improving, production runs are getting smaller whereas the investments needed to produce them are becoming greater, leading to higher depreciation and, as a result, a proportional decline in potential. Production runs have been cut from 1000 to 600, then to 250 and after that to 125.

An FAë representative for Belgium has confirmed this trend : from 1955 to 1975, the number of fighters was practically halved ! One of the reasons the representative gave for this is the cost of developing aviation equipment and getting the production lines going.

The problem of recurrent manufactures is therefore an acute one and, for a small country, there is no other solution than cooperation.

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But Belgium considers that prospects of this type are worthless if they do not include research and development right from the start of cooperation.

Indeed, Belgian industry refuses relegation to a purely subcontracting rôle which, vis-à-vis the United States, for example, would rapidly bring it down to the same level as the developing countries vis-à-vis the industrialized world.

Another important point to be added to these comments is the fact that technology transfers between industrialized countries are gradually dwindling as the years go by. There are four reasons for this :

a) the European countries have made headway, either by their own research and development efforts or by using what they learned from transfers during the first few years after the second world war.

b) as far as transfers from the USA are concerned, there seems to be some American hesitancy about continuing for a number of reasons. Take the case of the Hawk, for example ; Europe had a full licence for the hardware and full management control of the system but in similar proposals for the Helip, the management stayed in American hands and so did the advanced technology for the missile.

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In the case of the Lance missile, there was no transfer of technology. In highly sensitive fields where the

AW & ST published a comment that "there is a growing imbalance between high technology in US weapons systems and less well equipped allied forces, therefore the US must encourage rationalization of the European R & D effort, even at the expense of the US industry, in order to make allies more competitive, officials believe in NATO".

Furthermore, "early release of technology is mandatory. The way should be low-cost or no-cost licensing to improve the technology balance between US and its allies. This is especially important for the smaller member nations to avoid resource waste."

c) to absorb an advanced technology, a technological potential in the very limited field concerned is now more than ever necessary, meaning that a minimum of research and development must also have been done, so as not to have just the "finishing off" jobs to do.

d) and finally, the components themselves are more and more often high technology products, and one comes up against what is, in fact, a producers' monopoly.

I should like, however, to offset these not very promising prospects with something a bit more positive - the industrialized countries must turn to better quality products, more finely finished and different ; in this respect, the example of the space sector is the best one can give at present.

As far as personnel transfer is concerned, human problems can arise for if people are posted for long periods to the country of transfer, they risk losing contact with their firm and the progress it makes and might, in extreme cases, have to look for another job.

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In fact, for the industry in the country concerned, it appears better for the licensee to transfer staff from his firm to the licensor.

I won't go into detail here on the difficulties that European cooperation has run into, difficulties which do not enhance the industrial prospects for a little country like ours.

Crossing the Atlantic, one feels there may be some room for hope when one reads that Mr. Brown, the Defense Secretary, very recently said :

I quote : "he asked the Armed Services to examine opportunities for more common R & D .... and for buying, licensing or co-producing European as well US equipment to create more of a two-way street.

"There are strong indications that European producers will insist on maintaining their own research and development base even if they choose to build from US designs.

"A more efficient alliance research and development and production system should increase job levels by providing the resources to procure additional weapons that NATO badly needs.

"Improved alliance defense should govern the transfer

"There are strong indications that European producers will insist on maintaining their own research and development base even if they choose to build from US designs.

"A more efficient alliance research and development and production system should increase job levels by providing the resources to procure additional weapons that NATO badly needs.

"Improved alliance defense should govern the transfer of US technology ....

"The US must give more in the sense of buying some European

But to conclude, I should like to say this : when thinking about cooperation across the Atlantic, a country like Belgium is very understandably worried and mystified when it reads, in the publication, "Aviation Week and Space Technology", the following comment .....

Quote ..... "two NATO members - Italy and West Germany - are negotiating with the U.S. Dept. of Defense for bilateral memorandums of understanding on participation in high technology programs and in defense sales and coproduction. A third, France, ..... also wants a MOV similar "to one signed in 1975 by Britain ....." unquote.

Some details follow on the U.S. - British MOV.

Furthermore, I quote :

"Britain also enjoys the umbrella of a Treaty of Secrecy with the U.S., which allows it - as another similar treaty allows Canada - to participate in the high-technology areas of U.S. defense hardware now denied to other NATO partners". Unquote.

Without comments !

What is the outlook for Belgian industry in a political context such as this ? I'll leave you with this question mark.

Thank you, Mr. President.

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