Indo-German Workshop on Technology Development and Transfer

New Delhi
February, 7th – 10th, 1995

edited by
R. J. Peters
H. R. Bhojwani
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In Scientific Research and Technological Development
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TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td>1</td>
</tr>
<tr>
<td>Organiser</td>
<td>3</td>
</tr>
<tr>
<td>Programme</td>
<td>5</td>
</tr>
<tr>
<td><strong>Inaugural Session</strong></td>
<td>11</td>
</tr>
<tr>
<td><strong>Session I</strong></td>
<td></td>
</tr>
<tr>
<td>National Technology Development and Transfer Structure</td>
<td>15</td>
</tr>
<tr>
<td>The structure of technology transfer in Germany</td>
<td></td>
</tr>
<tr>
<td>Dr. R. J. Peters, VDI-TZ, Düsseldorf</td>
<td>17</td>
</tr>
<tr>
<td>Indian technology development and transfer structure</td>
<td></td>
</tr>
<tr>
<td>Y. S. Rajan, TIFAC, India</td>
<td>33</td>
</tr>
<tr>
<td><strong>Session II</strong></td>
<td></td>
</tr>
<tr>
<td>Mechanism and instruments of technology transfer from domestic and</td>
<td>37</td>
</tr>
<tr>
<td>external sources</td>
<td></td>
</tr>
<tr>
<td>Mechanism and instruments of technology transfer from domestic &amp;</td>
<td></td>
</tr>
<tr>
<td>external sources</td>
<td></td>
</tr>
<tr>
<td>Dr. G. Huttel, Siemens AG, Bombay</td>
<td>39</td>
</tr>
<tr>
<td>Transfer of Technology to India in the pharmaceutical sector</td>
<td></td>
</tr>
<tr>
<td>Dr. W. Badziong, Hoechst India, Ltd., Bombay</td>
<td>41</td>
</tr>
<tr>
<td>Technology transfer in Germany - as shown in the economic region of</td>
<td></td>
</tr>
<tr>
<td>Aachen</td>
<td></td>
</tr>
<tr>
<td>V. Hepple, Chamber of Commerce, Aachen</td>
<td>47</td>
</tr>
<tr>
<td>Intellectual property rights as a means to attain technological</td>
<td></td>
</tr>
<tr>
<td>competitiveness</td>
<td></td>
</tr>
<tr>
<td>S. K. Bijlani, MOI Engineering Ltd., Mohali, India</td>
<td>53</td>
</tr>
<tr>
<td>India: The emerging economic force</td>
<td></td>
</tr>
<tr>
<td>V. Raghuraman, ASSOCHAM, India</td>
<td>59</td>
</tr>
<tr>
<td>Mechanism and instruments of technology transfer</td>
<td></td>
</tr>
<tr>
<td>H. R. Bhojwani, CSIR, India</td>
<td>61</td>
</tr>
</tbody>
</table>
### Session III (part I)

**Philosophy, strategy and experience of technology transfer: the vendors' viewpoint**

<table>
<thead>
<tr>
<th>Title</th>
<th>Author(s)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science and technology transfer</td>
<td>Prof. Dr. Ing. R. Theenhaus, Jülich</td>
<td>77</td>
</tr>
<tr>
<td>Technology transfer by Fraunhofer</td>
<td>Dr. R. E. Beyer, FHG-ILT, Aachen</td>
<td>79</td>
</tr>
<tr>
<td>Philosophy, strategy and experience in technology transfer - the case of ZENIT</td>
<td>Dipl.-Kfm. P. Wolfmeyer, ZENIT, Mülheim</td>
<td>85</td>
</tr>
<tr>
<td>How to bring a technology to the market?! Laser technology - strategy of the VDI technology centre (VDI-TZ) in organizing the technology transfer</td>
<td>Dipl.-Soz. K.-D. Nowitzki, Düsseldorf</td>
<td>97</td>
</tr>
<tr>
<td>From business innovation centres to technoparks - managing the technology transfer process</td>
<td>Dr. R. Döhl-Oelze, W-tec, Wuppertal</td>
<td>103</td>
</tr>
<tr>
<td>Technical rules and standards - a useful tool for know-how and experience transfer</td>
<td>Dr. F. W. Morell, VDI, Düsseldorf</td>
<td>105</td>
</tr>
</tbody>
</table>

### Session III (part II)

### 119

<table>
<thead>
<tr>
<th>Title</th>
<th>Author(s)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contrasting modes of technology transfer in leather sector</td>
<td>K. V. Raghavan, CLRI, Madras</td>
<td>121</td>
</tr>
<tr>
<td>Experiences of SJCE-STEP's S&amp;T entrepreneurs park</td>
<td>M. H. Dhananjaya, Directorate of technical education, Mysore</td>
<td>123</td>
</tr>
<tr>
<td>Interaction between industry and academic institutions - the FITT experience</td>
<td>A. K. Sengupta, FITT, New Delhi</td>
<td>127</td>
</tr>
<tr>
<td>Experience of technology transfer: NRDC overview</td>
<td>N. K. Sharma, NRDC, India</td>
<td>131</td>
</tr>
<tr>
<td>Technology transfer - philosophy, strategy and experience: APTICO's viewpoint</td>
<td>S. Srinivasa Rao, APTICO, Hyderabad</td>
<td>133</td>
</tr>
<tr>
<td>Technology transfer in the nuclear sector</td>
<td>H. Razdan, Bhabha Atomic Research Centre, Bombay</td>
<td>137</td>
</tr>
</tbody>
</table>

### Session IV

**Industry's experience of dealing with technology developing/transfer institutions**

<table>
<thead>
<tr>
<th>Title</th>
<th>Author(s)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some ideas how to overcome the weakness of technology transfer</td>
<td>Prof. Dr. Ing. G. Sepold, BIAS, Bremen</td>
<td>139</td>
</tr>
<tr>
<td>Advanced technologies moving into small and medium sized companies</td>
<td>Dr. J. Balbach, LaserProdukt GmbH, Alfeld</td>
<td>140</td>
</tr>
<tr>
<td></td>
<td></td>
<td>149</td>
</tr>
<tr>
<td>Title</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>Experiences of industries with technology transfer - institutions in the Aachen region</td>
<td>161</td>
<td></td>
</tr>
<tr>
<td>V. Hepple, Chamber of Commerce, Aachen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology transfer in building &amp; building materials sector</td>
<td>169</td>
<td></td>
</tr>
<tr>
<td>S. C. Rastogi, NCB, New Delhi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy conservation in industry</td>
<td>171</td>
<td></td>
</tr>
<tr>
<td>G. K. Sarin, Encon Thermal Engineers, New Delhi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choice of technology for indigenous development - role and experience of the DSM group</td>
<td>173</td>
<td></td>
</tr>
<tr>
<td>G. Goel, DSM, New Delhi</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Concluding panel discussions
Technology transfer alliances - role of bilateral and multilateral cooperation | 177  |

Presse-Erklärung | 183  |
Press release    | 187  |
Effective technology transfer is a key feature of industrial competitiveness. It mainly aims at making available new technological solutions to industrial users as early as possible.

At the second Indo-German High-Level Meeting on Science and Technology in New Delhi in April 1994 it was agreed that a bilateral workshop on technology transfer should be held in India, addressing the issues of technology development by R&D institutions and industrial units and the mechanisms of their transfer to user industries.

Experts of both nations discussed these items on a workshop in February 1995 in New Delhi. They focussed on the mechanisms, modalities, instruments and organizational set-ups for facilitating the commercialisation of innovations with special emphasis on small and medium enterprises. Best practises and successful strategies in both countries were studied and compared to derive therefrom appropriate and applicable models. The workshop recommended that both countries would exchange information on technology transfer institutions including their fields of operation and outstanding features, the technologies available and required. Also suggested was the exchange of personnel for strengthening the technology transfer mechanisms.

Positive factors for research and technology development by the German enterprises in India emanating out of highly qualified S&T personnel, well developed R&D systems and tax incentives were taken note of. The important issue of intellectual property rights to strengthen technology transfer and the R&D based in India were also discussed.

The workshop also enabled the preparation of fruitful bilateral cooperations including a cooperation in physics based technologies and the information of technical guidelines.

This workshop was considered as another milestone and good example of the successful and fruitful bilateral Indo-German cooperation in Science and Technology. It encourages both sides to follow the route of spending investments in the area of technological innovation to reach mutual benefit.

Dr. Volker Knoerich
BMBF, Bonn

November 1995
Indo-German Workshop

on

Technology Development and Transfer

COORDINATORS

INDIA
Dr. H. R. Bhojwani

GERMANY
Dr. R. J. Peters

ORGANISING COMMITTEE

Mr. Y. S. Rajan | Adviser, DST and Executive Director TIFAC
Dr. H. R. Bhojwani | Adviser & Head, Technology Utilisation Division, CSIR
Mr. Rajiv Bhatnagar | Executive Director, National Small Scale Industries
Mr. N. K. Sharma | Managing Director, National Research & Development Corporation
Dr. G. Nath | Joint Adviser, International Division, DST (Convener)
INDO-GERMAN WORKSHOP
ON
TECHNOLOGY DEVELOPMENT & TRANSFER

Venue: Auditorium, National Institute of Immunology, Near Jawaharlal Nehru University, New Delhi

PROGRAMME

Welcome
Dr. S. K. Joshi, DG, CSIR and Secretary, DSIR
Remarks
Dr. P. Rama Rao, Secretary, Deptt. of Science & Technology
Remarks
Min. Dirig. V. F. Knoerich, BMBF
Inaugural Address
Dr. S. Z. Qasim, Member (Science) Planning Commission, Government of India
Vote of Thanks
Dr. H. R. Bhojwani, TUD, CSIR

National Technology Development and Transfer Structure

Chairman
Dr. S. K. Joshi, Secretary, DSIR & DG, CSIR
German Scene
Dr. R. J. Peters, VDI, Düsseldorf
Indian Scene
Mr. Y. S. Rajan, Executive Director, TIFAC, DST

Mechanism and Instruments of Technology Transfer from Domestic & External Sources (including incentives, IPRs etc.).

Chairman
Min.Dirig. Knoerich, BMBF, Bonn
German Scene
Dr. G. Huttel, Siemens, Bombay
Mr. W. Badziong, Hoechst, Bombay
Mr. Hepple, IHK Aachen
Indian Scene
Mr. S. K. Bijlani, Chairman, CII Technology Committee
Dr. V. Raghuraman, Secretary, Gen. ASSOCHAM
Dr. H. R. Bhojwani, Science Secretary, CSIR
Philosophy, Strategy and Experience of Technology Transfer: The Vendors' Viewpoint
(part I)

Chairman
Mr. N. Biswas, Chairman, Bureau of Industrial Costs & Prices and former Secretary, Directorate General of Technical Development, New Delhi

German Scene
Prof. Theenhaus, KFA Jülich
Dr. Beyer, ILT Aachen
Mr. Wolfmeyer, Zenit, Mülheim
Mr. Nowitzki, VDI Düsseldorf
Dr. Döhl-Oelze, WTEC, Wuppertal
Dr. Morell, VDI Düsseldorf

(part II)

Chairman
Mr. H. J. Back, IES, Germany

Indian Scene
Dr. K. V. Raghavan, Director, CLRI, Madras
Dr. M. H. Dhananjaya, Director Tech. JSS Mahavidyapeetha, Mysore
Prof. A. K. Sengupta, Managing Director, FITT, New Delhi
Mr. N. K. Sharma, MD, NRDC, New Delhi
Mr. S. Sreenivasa Rao, MD, APITCO, Hyderabad
Dr. H. Razdan, Technology Transfer Group, BARC, Bombay

Industry's Experience of Dealing with Technology Developing/Transfer Institutions

Chairman
Prof. Theenhaus, KFA Jülich

German Scene
Prof. Sepold, BIAS, Bremen
Dr. Balbach, Laser Produkt, Alfeld
Mr. Hepple, IHK Aachen

Indian Scene
Dr. S. C. Rastogi, N C B, New Delhi, India
G. K. Sarin, Encon Thermal Engineers, New Delhi, India
Mr. Gautam Goel, Director, DSM Group, New Delhi
Panel Discussion - Technology Transfer Alliances: Role of Bilateral and Multilateral Co-operation

Chairman
Co-chairman
Keynote Address
Panelists

Dr. P. Rama Rao, Secretary, DST, New Delhi
German Delegate
Dr. Jürgen Bischoff, Director, APCTT, New Delhi
Prof. Sepold, BIAS Bremen
Mr. H. J. Back, IES, Germany
Dr. R. J. Peters, VDI Düsseldorf
Mr. S. K. Bijlani, Chairman, CII Technology Committee
Mr. Y. S. Rajan, Executive Director, TIFAC
Dr. H. S. Bhojwani, Science Secretary, CSIR

Press release
## INAUGURAL SESSION

**Tuesday, 7th February, 1995**

<table>
<thead>
<tr>
<th>Role</th>
<th>Speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welcome</td>
<td>Dr. S. K. Joshi, DG, CSIR and Secretary, DSIR</td>
</tr>
<tr>
<td>Remarks</td>
<td>Dr. P. Rama Rao, Secretary, Deptt. of Science &amp; Technology</td>
</tr>
<tr>
<td>Remarks</td>
<td>Min. Dirig. V. F. Knoerich, BMBF</td>
</tr>
<tr>
<td>Inaugural Address</td>
<td>Dr. S. Z. Qasim, Member (Science) Planning Commission, Government of India</td>
</tr>
<tr>
<td>Vote of Thanks</td>
<td>Dr. H. R. Bhojwani, TUD, CSIR</td>
</tr>
</tbody>
</table>
INAUGURAL SESSION

The Workshop was inaugurated by Dr. S.Z. Qasim, Member (Science) Planning Commission, Govt. of India.

Dr. G. Nath at the outset welcomed the Indian and German delegates and participants to the Workshop. He explained the genesis of the workshop in that the second high level meeting of Indo-German Consultative Group held in 1993 had recommended holding of an Indo-German Workshop on Technology Development & Transfer at New Delhi. This Workshop was first of its kind and was of interest and value to both the countries.

Dr. S.K. Joshi Secretary, DSIR & DG, CSIR in his welcome address said that he was overwhelmed by the response and the large turnout of participants from Germany. He felt that this was due to the fact that the theme covered an area of significant importance to both the countries, and perhaps more to India. Dr. Joshi pointed out that India and Germany had strong historical ties more so in science & technology. Another dimension to these ties was added by the signing of an MOU between CSIR and FhG recently; whereby the two organisations would collaborate in the areas of research and development aimed at transfer of technology and S&T services for third parties not only in the two countries but also in third countries. According to Dr. Joshi the tie up would enable CSIR to share the experiences of FhG, which was presently earning 70% of its budget from contract R&D. Dr. Joshi said that CSIR had also undergone reorientation recently and was more market responsive and driven. This had resulted in increasing its external cashflow to Rs. 1100 million of which 1/3rd was from the industry as compared to a mere 1/10th a few years back. According to Dr. Joshi this showed that Indian industry was interested to work with R&D institutions and the German experience would be of significance to India. Dr. Joshi emphasised that science & technology were going to be the key factors for achieving economic growth & industrial competitiveness for a country and Germany had a proven track record of exploiting S&T. The Workshop thus offered an opportunity to Indian participants to learn from the German experience.
Dr. Rama Rao had great expectations from the Workshop as the theme was very meaningful for developing countries like India. Dr. Rama Rao dwelt at some length on the 'Technology Proving Phase'; whereas the R&D institutes/laboratories were 'exploratory' in nature, the industry was 'exploitative'; the technology proving phase brought together the two. He illustrated the importance of technology proving phase through a case study relating to technology development of 'OFE copper' products, the technology for which had been developed by DMRL (of which he was at that time the Director). DMRL had decided that the proving share should be undertaken jointly with the industry; (so that it became committed to use the technology at a later stage) and it should depute its persons to actively participate in the upscaling (leading to industrial culture in the working of the laboratory personnel). Thus the technology proving phase was a joint effort between DMRL and the National Aluminium Company (NALCO), Hindustan Zinc Ltd. (HZL), Hindustan Copper Ltd. (HCL) and Bharat Aluminium Company (BALCO) who between then contributed around Rs. 100 million. The technology was proven on a 100 tonnes level and was finally adapted on commercial scale. The laboratory-industry consortium also helped in identifying and developing value added products of OFE copper thereby increasing the economic viability of the project.

Dr. Knoerich recalled that the idea of holding a Workshop on Technology Development & Transfer was brought up in the second meeting of Indo-German Consultative Group in 1993 and was approved by the Indo-German Science & Technology Committee as well. Dr. Knoerich informed that after the general election in last October in Germany there had been a restructuring of the administrative set up and the Ministries of Research & Technology and of Education were merged to form Ministry of Education and Science & Technology which often was referred to as the 'Ministry of Future' thus reflecting the importance given to S&T by the German Government. According to Dr. Knoerich there was a close relation between education and science and technology as education motivated people towards using science & technology.

Dr. Knoerich recounted the status of S&T cooperation between India and Germany which had just completed twenty years. Dr. Knoerich added that the trust and friendship between the two countries formed the basis of strong S&T cooperation. The recent visits of German Chancellor to India and of the Indian Prime Minister to Germany had given further boost to the strong ties between the two countries. Germany looked at India not merely for investment opportunities but as a potential valuable partner for S&T cooperation. Presently around 130 joint research projects were in progress in diverse areas of space, energy, life sciences, biotechnology, materials etc.; the scientific results of which were being published in around 100 publications per year besides around 200 exchange visits of scientists of the two countries took place annually. Dr. Knoerich acknowledged that Indian scientists did face some language problem however the German exchange programmes generally provided for imparting working knowledge of German language and also most of German scientists had adequate knowledge of English.
Dr. Knoerich stated that the Workshop offered an opportunity to enlarge upon the cooperation to utilise the science & technology for betterment of the people of the two countries. According to Dr. Knoerich technology transfer should be the precondition of any technology development programme, an aspect hitherto often neglected. He stated that lot of care seemed to have been taken to prepare the programme of the Workshop and he was sure that there would be many interesting presentations which would throw up numerous ideas on furthering cooperation between the two countries in the important area of technology development and transfer.

Dr. Qasim in his presidential address recalled his interaction with German scientists during the building up of the Indian research vessel 'Sagar Kanya'. He had been highly impressed with the speed of execution of work and the rigorous quality control procedures practiced by Germany, as the entire ship was built in a period of just eleven months! He said that Germany was in the forefront of modern technology which was based not on heavy machinery or equipment but on system approach, software applications and thus could be easily updated, modernised and adapted. Dr. Qasim stated that the New Industrial Policy announced by Government of India in 1991 had done away with regulatory controls to a very large extent. There were fewer or no restrictions on the entry of foreign firms, foreign investments, repatriation of profits etc. India with its large markets and liberalised industrial policy offered highly attractive investment opportunities. According to Dr. Qasim, India had the advantages of being a stable parliamentary democracy. Also, it was the largest growing economy of the world with a large market estimated at 300 million strong & growing at the rate of 8% annually. Besides, India had a very large manufacturing sector with a highly trained and adaptable industrial workforce. All these aspects presented an environment conducive for foreign investments. Dr. Qasim suggested following areas of cooperation between India and Germany;

I. Energy (as additional 100,000 MW of power to be added in next 10 years),
II. Coal and Petroleum exploration,
III. Efficient use of fuel for power, transportation and industry,
IV. Agrobased industry,
V. Software,
VI. Electronics,
VII. Drugs & Pharmaceuticals,
VIII. Petrochemicals, polymers and new materials,
IX. Leather,
X. Civil Aviation and
XI. Pollution abatement technologies.

Concluding Dr. Qasim emphasised the necessity of building up databanks on technological expertise & capabilities in the two countries which could be exploited for mutual benefits. He wished all success to the Workshop.
Dr. Peters thanked the organisers on behalf of German side. He hoped the workshop would make concrete recommendations for enhancing cooperation between the two countries in the area of technology development and transfer.

Dr. Bhojwani proposed the formal vote of thanks.
SESSION I

NATIONAL TECHNOLOGY DEVELOPMENT AND TRANSFER STRUCTURE

Dr. R. J. Peters       VDI Düsseldorf
Mr. Y. S. Rajan       Executive Director, TIFAC, DST
Effective technology transfer (tt) is a key feature of a national economy's development. Besides the normal case of a market-driven tt we also face a gap between results produced by technological R&D and their industrial exploitation due to misfits between supply and demand structures resulting e.g. in informational deficits. To close this gap a lot of attempts have been made in Germany for the last 25 years on the political level. The resulting technology policy fosters tt to an extent difficultly to quantify. Technology programmes with respective components like collaborative research as well as tt-offices established a highly decentralized tt-scene with growing network character in Germany.

The profile of tt-institutions in Germany is mainly ruled by features like
- organizational integration
- supply vs demand orientation
- technology vs general orientation
- geographic range
- target group orientation
- tt-instruments used

A key feature of tt in Germany is the very often to meet orientation on small and medium sized enterprises as the backbone of Germany's economy.

The European aspect of tt is becoming growing importance. The growing complexity of technological development supports the importance of effective tt-structures in the future too resulting closes cooperation between tt-institutions. The partnering of these institutions seems to be one of an effective way to deal with the complexity of future technological development.
The Structure of Technology Transfer in Germany
The Gap

- Users' (mis)knowledge about new technological solutions or possible suppliers

- Suppliers'/researchers' (mis)knowledge about needs, applications or possible users

- Innovativeness of users

- The favoured use of ripe technologies

- Innovation only if markets/competitors force users

- "NIH" not invented here-factor

Losses in national economy
Losses in international competitiveness

Political action
The structure of technology transfer in Germany

The Basic Situation of Technology Transfer

- the technological solution
  - research supply technology push
- the technological problem
  - industrial user demand market-pull
The Two Cases of Technology Transfer

The problem

gap

The ideal

market-driven

the problem
technology policy activities

the ideal
Technology Transfer - Political Action -

Technology program

Helpful intermediaries

Supply

Demand

Federal Government

Consortia

European Union

State Government

DM
Technology Programmes and Technology Transfer

solution

problem

funded collaborative research

tt-aspect
The structure of technology transfer in Germany

- Organizational integrations

- Supply vs demand orientation

- Technological expertise vs general orientation

- "Geographic" orientation

  North Rhine-Westphalia, Germany, Europe

- The instruments of TT

- The target groups
Organizational Integration of TT-Offices

Research-based organizations
- universities, technical colleges
- national research centers
- Fraunhofer Society
- Max-Planck-Society
- "Blue-list"-institutes
- ...

technical and scientific associations

chambers of commerce

special organizations founded for the purpose of technology transfer
Special TT-O rganizations

Main organizational forms
- limited liability company
- registered association
- working parties without legal status

Features
- members / shareholders representative
  for the innovation chain
- best fit of supply vs demand
- minimized legal and financial risks
- political, social and economic influence
  of members / shareholders supports
  and balances TT-activities

Examples
- technology parks / centers
- regional TT-institutions
- demonstration centers
- technology initiatives
- ...
Technological vs General Orientation of TT-Institutions

Focus on one technology
- demonstrations centers (CIM, CAD, CFS, Laser, Microsystemtechnology, surface analysis, thin film technology)
- technology initiatives: PLATIN, FUZZY initiative NRW, ESPRIT-CLUB, parallel processing NRW
- working parties (superconductors, PISe, ...)

Multitechnological orientation
- some "special organizations"
- university TT-offices
- national research centers TT-offices

General orientation
- normally only basic technological background
- often regional orientation
- platform character
- good general knowledge about technology ressource
Geographic Range of TT-Institutions

Regional orientation
- close regional value chains
- stimulate regional economy
- SME prefer technological support from their region
- mainly general orientation or focus on key technologies with broad diffusion potential

"Nationwide" orientation
- very often technological orientation

European orientation
- stimulate and establish European technological cooperation
- making available technological supply
  - from CEC-funded projects
  - from Eastern Europe
  - ...

VDI TECHNOLOGIEZENTRUM The structure of technology transfer in Germany
Ways and Instruments of Technology Transfer

- consulting
  - first-contact
  - cooperation partner search
  - technological solution
  - market valuation
  - technology implementation
  - ...
- demonstration and development
- brokerage
- training and education
- print media
- electronic media
- exhibitions and special trade fairs
- start-up support for technology-oriented young enterprises
- support in patent protection and licencing
- technical regulations and norms, standardization
- project management support
Target Group Orientation of TT-Institutions

Key feature for successful TT

Examples
- industrial branches
- SMEs
- chief executives
- shop floor level
- construction engineers
- production engineers
- ...

The guidelines
- Choice of key target groups for most effective diffusion
- Choice of the best TT-instrument for the key target group's typical way of information acquisition
- What do they really want to know?
The Role of SMEs

- 85% of German enterprises < 1000 employees
- Backbone of German economy
- Very limited human resources for information acquisition and R&D
- Complaining about informational supply not suited to SME's modalities

special focus of technology policy

strong SME-orientation of TT-institutions
Dr. Y.S. Rajan stated that the national investment on S&T was presently of the order of Rs. 5000 crore, around 0.83% of the GDP, having declined from nearly 1% of the last few years. Dr. Rajan informed that the Indian S&T system comprised government sector and private sector, the former dominating, accounting for nearly 80% the national expenditure on S&T, the private sector on the other hand contributed merely 12% of this expenditure. The Govt. S&T sector consisted of various S&T Departments and economic Ministries of the Govt. of India which had research organisations with a large network of national R&D laboratories/ institutions under them. Thus the Department of Space had Indian Space Research Organisation, Department of Scientific & Industrial Research had Council of Scientific and Industrial Research (CSIR), Ministries of Health and Agriculture had Indian Council of Medical Research (ICMR) and Indian Council of Agricultural Research (ICAR), respectively, Railways had Research Design and Standards Organisation (RDSO) as its research wing and so on. In addition some of the Ministries were having Scientific & Technical Advisory Committees responsible for meeting the R&D needs by funding R&D projects in the national laboratories. As regards the Indian industry, S&T activities in the industry were being carried out by in-house R&D units of the industry, non-profit private Scientific & Industrial Research Organisations (SIROS) and Industry Cooperative Research Associations. Dr. Rajan informed that presently there were 1200 registered in-house R&D units, 400 SIROS and around 13 industry Cooperative Research Associations, however the industry’s spending on R&D was merely 0.57% of its turnover.

Dr. Rajan stated that development and transfer of indigenous technologies of industrial uses were being mainly carried out by Council of Scientific & Industrial Research (CSIR), Indian Space Research Organisation (ISRO), Bhabha Atomic Research Centre (BARC), Centre for Development of Telecommunication (C-DOT), Technical Institutes. Organisations such as his i.e. TIFAC, NRDC, Financial Institutions etc. were providing promotional linkages for commercialisation of indigenous technologies. Dr. Rajan then explained the Technology Transfer (TT) mechanisms operating in different S&T agencies. Thus Bhabha Atomic Research Centre (BARC) responsible for providing R&D support to generate nuclear power and peaceful application of atomic energy was having an Internal Committee which evaluated and monitored the development and implementation technologies for use by BARC or by the Department of Atomic Energy. The spin off technologies were
transferred to the industry through Technology Transfer Group or through National Research Development Corporation (NRDC). According to Dr. Rajan successful adoption of laboratory technology depended upon technical, financial and market factors. The technology transfer from BARC covered the technical aspects only however BARC provided guarantees clauses on quality and yield on the scale developed and also provided conceptual designs for scaling up with consultancy backup. This thus necessitated ground work by the entrepreneur to assess the technoeconomic viability, scale of operation and market acceptability of the laboratory developed technology. At ISRO a group Technology Transfer & Industrial Consultancy (TT&IC) Group had been established at the Hqrs. which was responsible for all matters relating to transfer of technology developed at various laboratories of the Department of Space. The technology transfer activities at ISRO comprised careful assessment of readiness of technology, judicious selection of recipient agencies i.e. entrepreneur, technical consultancy backup to licensee after knowhow transfer, quality surveillance by ISRO personnel during production at the licensee’s premises etc. Which ensured successful implementation of the laboratory technology. Dr. Rajan informed that ISRO had transferred 225 technology so far for diverse products to enterprises, majority being SMEs. ISRO had recently established a separate organisation ANTRIX Corporation, its major objectives being marketing of indigenous space technologies, technologies for components and related products and services, with thrust on exports. The Corporation would also utilise expertise available in and facilities of Indian industries for indigenous development of technologies.

The technology transfer mechanism at C-DOT comprised announcement of technology for a product, system familiarization training for the recipient, assistance in fabrication of prototype model by the recipient, production model clearance by C-DOT before commencement of regular commercial production. C-DOT interacted continuously with recipients to sort out problems during various phases of technology transfer. Dr. Rajan also elaborated on technology transfer and acquisition mechanisms at the two public sectors namely Bharat Electronics Ltd. (BEL) and Central Electronics Ltd. (CEl). Both these companies had successfully adapted indigenous technologies developed in their own in-house R&D or in the national laboratories. Dr. Rajan briefly touched upon the activities of NRDC, the only technology transfer agency of its kind in India and the neighbouring countries. The Corporation had recently adopted a new approach to strengthen its technology transfer activities for domestic technology and envisaged NRDC to become an International Technology Transfer Organisation. The new initiatives by NRDC included development of closer links with generator of technologies, enlarging technology resource base, undertaking of design engineering programmes for upscaling of laboratory technologies, technology consultancy services to industry, export of indigenous technology acquisition of foreign technology & its transfer within and outside India.

Dr. Rajan stated that recognising the crucial role of technology in the economic & industrial development of the country, the Government of India established
Technology, Forecasting and Assessment Council (TIFAC) as an autonomous body under the Department of Science & Technology. TIFAC started function in mid 1988. The main the objectives of TIFAC were to undertake technology assessment and forecasting studies in key areas of national economy, keeping technology watch on global technological trends and formulation of preferred options for India and establishing a nationally accessible technology information system. In pursuit of such objectives, TIFAC had brought out many study reports containing information on emerging technologies. More than 120 such Technology Forecasting (TF), Technology Assessment (TA) Studies and Techno-Market Surveys (TMS) have been generated in sectors such as steel, materials, energy, biotechnology, human habitat, agro-based industries, pollution control etc. TIFAC had also set up a number of industry led Task Forces to bring out reports on various industrial sector including one on 'Future Technology For India in 2020.' TIFAC had recently signed an MOU with Confederation of Indian Industries to promote various industrial technologies. In addition TIFAC was strengthening linkages between research institutions and industry by supporting commercialisation of technologies developed in these institution by the industry under its scheme of `Support to Home Grown Technologies'.

Dr. Rajan stated that technology transfer was a complex issue. There have been many successes as well as failures in transfer of indigenously developed technologies. The reasons of failures, according to Dr. Rajan were:

- commercial or market reasons,
- 'technology' pursuit problems,
- labs not aware of end users,
- poor mechanisms of technologies transfer including post transfer assistance,
- lack of confidence of industry in indigenous capabilities,
- lack of in-house strength in the industry to absorb/adopt laboratory technology.

Concluding Dr. Rajan stated that though these factors were hampering development and transfer of indigenous technologies, some new encouraging trends were emerging due to changing economic and industrial scenario which he felt would help in greater utilisation of indigenous technologies and capabilities. These included growing domestic competition in industries, increasing demand by industry for technology to retain competitiveness, formation of multi institutional/ multi partnership projects using the synergistic approach, TIFAC, increasing role being played by promotional agencies such as emergence of new technology facilitators such as FITT and BICL Financial institution/ Venture Capital Company and last but not the least, the recent Government's initiatives giving higher tax incentives and creating Technology Development and Application fund for development and application of indigenous technology.
SESSION II

MECHANISM AND INSTRUMENTS OF TECHNOLOGY TRANSFER FROM DOMESTIC & EXTERNAL SOURCES (including incentives, IPRs etc.)

Dr. G. Huttel Siemens AG, Bombay
Dr. W. Badziong Hoechst India Ltd., Bombay
Mr. V. Hepple IHK Aachen
Mr. S. K. Bijlani MOI Engineering Ltd., Mohali, India
Mr. V. Raghuraman ASSOCHAM, India
Dr. H. R. Bhojwani Science Secretary, CSIR, India
I. The Situation

Over decades India tried to be technologically independent from the world.

⇒ Shortage of technological know and R & D
⇒ Collaboration needed and wanted.

II. Approvals

- Different approval procedures (RBI, Secretariat for Industrial Approvals, FIPB)
- Automatic approval only in high priority industries and subject to various conditions (foreign equity, imports new)
- Limits for payment for know how (lumpsum < 10'Rs, 5% domestic, 8% exports, 7 years, ...)
- 100% foreign ownership allowed in 100% EOU's
- Repatriation of profits regulated (≤ 16% RoI in power, > 5 years)
- Rs not fully convertible
- No one window clearance
- Lengthy approval process (> 1-2 years, numerous approvals from numerous authorities)
III. Protection of Intellectual Property Rights

- Unpatented technical know how not sufficiently protected
- No adequate arbitration available in India
- Intellectual property rights not sufficiently protected
- Enforcement not sufficient

IV. Other aspects

- Incentives for start ups vary with location
- Labor Laws protect even inefficient workers (and managers)
- Maximum tax rate of 44 % for salaries > 120,000 Rs p.a. also applicable for expats
TRANSFER OF TECHNOLOGY TO INDIA IN THE PHARMACEUTICAL SECTOR

Dr. rer. nat. W. Badziong
Hoechst India Ltd., Bombay

What are the Incentives to transfer the Technology for still patented Pharmaceuticals to India

The View of the Multinational Pharmaceutical Companies

After 1991, the economy in India has been liberalised and performing business has got much easier than in the past. Almost every sector of industry has been included in the liberalisation. However, some sectors including pharmaceuticals have been left out. This is, till today, an obstacle for transferring technology to India and a profitable business in this sector. Now, however, also this area is tackled mainly because the Indian government has signed the GATT agreement and is joining the World Trade Organisation (WTO) at the earliest time possible. This will include also that international standard of Intellectual Property Rights will have to be accepted in the near future. Although there is a political controversy on this subject. It is obvious that this issue has to be accepted in order to avoid that India is a loser in the world economy of the future.

The Policy of the Indian Government in general is welcomed

- Signing of the GATT agreement
- Accepting of international standards in patents
- Joining of WTO at the earliest time possible

The multinational pharmaceutical companies had different strategies to deal with the situation in India in the period from 1970 till today. Since that time no
product patents are allowed in the pharmaceutical sector and therefore everybody who is in a position to alter the process of synthesis can enter the market and this usually at much lower prices than the inventor. This policy on one hand had given access of standard pharmaceuticals to the Indian consumers but had on the other hand also violated international law in respect to Intellectual Properties. Of course, the Indian Pharmaceutical Industry has got stronger during this period of time and is now reluctant to accept the fact that the regulations have to be changed if India wants to be a member of the WTO.

The government has given directions that would solve the problem in a quite acceptable way. However, the bureaucracy has to implement this policy and there are indications that every chance will be taken to maintain the current situation that there are different yardsticks for Indian companies and Indian subsidiaries of foreign multinational companies.

How have bureaucracy implemented this policy?

The impression cannot be avoided that the Orders issued by the Government of India in the recent weeks favor Indian Pharmaceutical Companies at the cost of Indian Subsidiaries of Foreign Multinational Pharmaceutical Companies

The following 3 examples are given that indicate that these attempts are the fact.

Example 1

India has claimed that it is a developing country of the least standard, claiming that it can opt for 10 years transition period for introducing the Intellectual Properties rights of international standards. The multinational companies being active in India however face strong competition of Indian drug manufacturing companies that have even multinational activities and are competitive in difficult markets like USA and Europe. These companies have the approval of the most stringent licensing agency of the world which is the FDA, USA for their production facilities. Even though it is true that India is a developing country, the pharmaceutical industry is fairly developed and this transition period of 10 years is too long and is given an unjustified advantage for Indian companies.
Example 1:
10 Years Transition Period

- Indian multinational pharmaceutical companies are existing
- Those companies have even the approvals of the FDA (USA) for their production facilities

In the group of developing countries India is fairly developed

Thus the period of 10 years is too long!

Example 2

The draft of the new patent law that shall be introduced in the future is including an instrument that is giving some advantage to inventors of new drugs. However, is this instrument really an advantage?

Example 2:
'Black box & 5 Years EMR ?'

Drug Development time frame

1-2 Years
Concept

2-3 Years
Screening

2-10 Years
Preclinical Development

3-9 Years
Clinical Development

1-2 Years
Registration

7 - 15 years between patent application and marketing of the product

If a new drug has been patented after 1. January 1995 the inventor can put this patent in a so-called 'Black Box' and after getting the licence for marketing this product he will get a 5 years exclusive marketing right. If you, however, look into the time course of a drug development it becomes evident that these 5 years of exclusive marketing rights are usually expired already before the product has been launched as the development usually takes 7-15 years between the patent application and the launch of the product. As the marketing licence can never come together with the patent application almost all
compounds patented after 1995 will reach the market only after 2005. The 'Black Box' and the 5 years of exclusive marketing rights are without value.

**Example 2:**

'Black box & 5 Years EMR ?

- The marketing license can never come together with the patent application
- Because of the development time frame the EMR is without value
- All compounds patented before 1995 are not covered although they may reach the market only after 2005

**Example 3**

The new drugs price control order active since 1 January has still a clause giving companies that copy patented drugs the incentive to be exempted from price control. Keeping in mind the 10 years transition period and that only 5 years of exclusive marketing rights is granted to the inventor, this still allows Indian drug manufacturers to introduce all current state-of-the-art drugs into the Indian market by still violating international patent rights.

**Example 3:**

Incentives to copy in the new DPCO

- The new DPCO still has a clause giving companies that copy patented drug the incentive to be exempted from price control just by changing the process of synthesis
- Together with the 5 years EMR this is a loophole to violate patents within the 10 years transition period

The multinational companies, therefore, still have the impression that the Indian government is not fair to foreign companies that are ready to invest in India. Although there are big opportunities in the Indian market even in the sector of Pharmaceuticals where 2 digit annual growth rate has been observed over the
last years and is likely to continue in the future, the transfer of technology to India is hampered and is denying the Indian customer access to international standard drugs. Furthermore, the violation of patent rights in this sector is also not favourable to attract transfer of technology in other areas and India would set a very good example to change the policy. This certainly will attract further investments in the pharmaceutical sector.

International companies have the impression that the Indian government is not fair to foreign companies ready to invest in India.

This impression is not favorable to attract the transfer of technology and may have a bad influence on the reputation of India abroad.
Technology Transfer in Germany -
as shown in the Economic Region of Aachen

Volker Hepple
Chamber of Commerce, Aachen

February 08, 1995

The competitive power of German industry and new long-term jobs are
depending, to a large extent, on the development and production of highly
technological goods. Technologically advanced productions only which are
based on innovation and novel procedures will be the decisive factor for the
locational advantage of the Federal Republic of Germany and also the Aachen
region in the global technological contest. It is therefore essential for
entrepreneurs to develop new products and procedures and, at the same time,
reduce their manufacturing expenses for optimum manufacturing techniques,
saving cost for energy and considering environment, in order to ensure
competitive operation.

There is also the fact that technical development is continually gathering speed
and many products on the market today did not exist only five years ago. Research and Development today are determining the product range of the
next few years. Competition among companies, regions and/or countries is
increasingly carried by technology, that is, through future-technologies.

Thus Research and Development are two decisive components of innovative
management. Companies who are aware of such procedures will give important
impetus to the growing economic development and security of employment
within a region. They are remarkably more dynamic and safe in periods of
general economic difficulties than many other industries.

With the increasing technological integration on the one hand and the rising
complexity of scientific research on the other, a large number of small and
medium-sized companies are often faced with two alternatives - either to carry
out research and development on their own account or to have such measures
effected by competent research organisations outside their own enterprise.

However, small companies simply cannot afford to pay for permanent
development on their own premises. If they aim at developing a highly
technological product ready to be put on the market, competent scientists and
engineers from various fields will have to be engaged - physicists, processing
specialists, manufacturing experts up to sales managers.

There are of course solutions to these problems. In fact, the high potential of
research and development institutions of the Aachen region can offer decisive
locational advantages and possibilities of cooperation in the field of growth
technologies to the manufacturing companies. This potential includes, as you
know, the Technical University („R.W.T.H.“), the Research Centre of Jülich, the
Aachen Technical College („Fachhochschule“), two Research Centres of the „Fraunhofer“-Institute and also a number of private Development companies.

All these R & D organisations are a supreme resource of technology and innovation right in the centre of Europe and they are also extremely important for the technological location of the Aachen region and the manifold companies operating here.

Another decisive factor is the economic value of such scientific centres for companies in our region. The annual budget of these centres amounts to more than 1.5 billion Deutschmarks. Furthermore the Technical University and the Nuclear Research Centre of Jülich employ and train the largest number of people in the Aachen region. Accordingly, some 15,000 employees and about 46,000 students are also an interesting factor for consumption - a factor for the regional economy and for catering which should not be neglected. Furthermore more than 240 Institutes provide for substantial orders to local firms.

With this unique assembly of world-wide reputed research centres the Aachen region is offering excellent perspectives. Such perspectives, however, can only be used to the benefit of all and everyone if scientific potential on the one hand and economic resources on the other are connected in view of realising transfer of inventions and developments towards new productions and new procedures.

To contribute towards such transfer of research to industry, special transfer points, innovation advisors and technical experts have to be provided for.

The Aachen region is offering a close network of transfer institutions, innovation advice bureaus and consulting offices - all of them oriented towards helping companies in the region to realize innovations and introduce new technologies in their specific field. Accordingly, the „Innovation Advice office“ of the Aachen Chamber of Commerce provides relevant information to Aachen companies, arranges for cooperation contacts on request and offers help in obtaining financial aid. On the other hand the Technology Transfer Bureaus of the Technical University of Aachen and also the Office for Transfer and Science at the Technical College ensure, in a way, the „marketing“ of the manifold research offers. The Technology Transfer office of the Jülich Research Centre provides the Know-How by arranging lectures, visits of Institutes and individual counselling.

„Knowledge“ transfer, however, cannot cover science and technology only, but must be applicable to all fields of philosophy, political economy and socio-political science. There, too, new markets have been discovered. The full range offered covers industrial psychology, industrial organisations, business administration, marketing and economic data processing.

Of course, such transfer of scientific data into industrial production has to be realised by a number of contracts. Accordingly, a variety of cooperation agreements have been concluded by the regional Chamber of Industry and/or
of Handicrafts, representing local industries, and the individual research institutes. Those agreements cover a large variety of individual measures and activities, such as meetings with representatives of special branches of industry, working groups, as well as manuals and text books, technical advice services, joint use of examination and laboratory facilities as well as the support by technology centres for newly established companies.

For this purpose, a large number of "components" are available to prospective users, such as a Research manual describing the different research institutes one by one, a Manufacturers manual listing products, procedures and know-how, for potential users or licensees from our Region to make a preliminary choice of such products or procedures. There is also a Manual of Engineers and a list of Engineering bureaus, Development companies and technical experts who will be indispensable for eventually implementing new technologies within the firm.

Furthermore, a number of leaflets in special technologies is available illustrating the technology potential of our Region. Such leaflets include a full list of research institutes and their particular field of action as well as the various industries with their product range. These leaflets show where and by whom similar fields of research and production are covered as, for instance, in the car and motor technologies, in biotechnology, automation techniques, in microelectronics, data processing, environment protection, textile engineering and medical engineering.

Many of our enquirers appreciate the excellent services of our Technology Exchange - some companies try to obtain licenses for their own technical improvements, others, in turn, offer letters patent, licenses or "unprotected" know-how for sale. For this reason our Chamber of Commerce cooperates with other Chambers and the Federal Government in issuing, twice a year, a Technology Exchange handbook listing up to 2,000 technology offers and demands. Offers for such technology exchange come in from research institutes engineering bureaus as well as individual companies. We are pleased to note that regular use is made of this Exchange service.

Data bank research is another prominent field of activity. Accordingly, our group has entered a partnership with an association providing access to more than 1,600 national and international data bank in view of obtaining information on engineering, Research and Development, letters patent, production, distribution or marketing. We understand that in Germany up to 30 per cent of development expenses can be saved when (and if) a company searches for relevant know-how all over the world, right from starting the development of a new product.

Apart from the technology counselling points at important scientific universities and research centres as outlined above there are a large number of institutions operating their own technology transfer and, in many cases, contacting companies that may be interested in their services. Among those are, for instance, the "Fraunhofer" Institute for Production or for laser technology, and,
to give you some further examples, the „Institute for Plastics Processing“, the German „Wool Research“ Institute of the Aachen University, the Institute for Rationalisation Research, the „Helmholtz“ Institute for Bio-Medical Engineering, the „FEV Motorentechnik“, the CIM-Center of the Land North Rhine-Westphalia and also the „Technology Agency“ for industrial ceramics. All those organisations are in close contacts to the various industries in view of offering innovative techniques, new structures of organisation and laboratory facilities. This enables, in particular, small and medium-sized companies who have no research and development departments of their own, to avail themselves of such manifold services „at their doorstep“ and thus have their profitable share in the world-wide competition with highly-technological products and equipment.

There is the problem of getting such scientific services closer to the smaller companies. For this, a number of transfer media have been set up in the various scientific institutes and in the chambers of commerce. For instance, the Aachen Technical University has set up a „demonstration laboratory“ for Integrated production techniques.

Furthermore, the Land North Rhine-Westphalia is setting up a variety of Technology agencies and engineering initiatives in view of effectively combining specialized capacities for a particular region or an industrial sector. Those agencies also arrange for counselling and qualification measures, cooperation projects and the execution of such projects with the aim of obtaining new and better results in the technological as well as the economic field. There are, for example, the agencies for letters patent and for innovation in Aachen, in Bielefeld and in Dortmund, for environment technology, for microelectronics, for sensory engineering etcetera.

Such technology initiatives are intended to concentrate existing know-how in particular fields of engineering, then process the information thus made available and, by way of technology transfer and technology marketing, feed it towards small and medium-sized companies. To give you some examples, here is the so-called „Fuzzy“ Technology, but also optics, parallel data processing, neuro-data processing and plasma technology which are channelled in this effective way.

The Aachen Chamber of Commerce, of course, is aware of the danger that the various transfer agencies resident in the Aachen region may fail to cooperate effectively or even enter into competition to each other (what we call „transfer assiduity“). In order to avoid such unfortunate incidents, a number of working groups has been set up, to exchange experience and information on projects, such as

- the Working Group for Technology Transfer representing all the regional transfer points
the Sub-Working Group for Technology Transfer ensuring crossborder cooperation among transfer points within the so called „Euregio“ and mutual use of research facilities and

the Working Group for Euregional Technology Centres covering some twenty individual centres for technology and for setting up new companies within the entire Euregio. This Working Group is headed by a chairman and the members continually meet for talks and exchange of information.

There is one important aspect for linking science with economy - namely, the transfer of personnel - which is, in fact, the connection between University and economy described as „the transfer of heads“, comprising essentially

- in-company training as well as students' the sises on subjects proposed by a particular company. „Most students invest a high degree of their background knowledge and efforts in their thesis which then may well be used to solve the one or the other research problem or some operational failure,“ in particular in medium-sized firms. The management also has the possibility of „having a closer look at a trainee in view of eventually engaging a highly qualified graduate“;

- the government-sponsored research exchange programme which provides for the temporary exchange of research personnel between the company and the research institute, thus improving the medium-sized company's competitiveness by technology transfer via „the heads“ rather than via material.

One very important component of technology transfer has been the foundation of the Technology Centre of Aachen (TZA). Until today one hundred technology-oriented junior entrepreneurs have been accepted here some 90 per cent of them being graduates from the University. More than 40 such firms have left the centre after completion of a full programme of training and establishing themselves in the region. This scheme has had a considerable impact of employment in many fields of growth-oriented engineering ranging from bio-medical engineering to data processing and microelectronics to mechanical engineering and high-technology materials.

A „technology centre“ is defined as a group of essentially newly-founded companies on particular premises and organised by the operating company. Such newly-founded companies must be directed towards developing future-oriented, innovative products in the field of high technology. As a rule such a centre offers facilities at favourable conditions and according to the square metres required on the premises. Furthermore, extensive central services, according to requirements, are available to participants, such as a common secretariat, communications systems, meeting rooms, lecturing rooms as well as a full advisory and training scheme at the start and during the next few years. After the initial stage, however, and for the further development of a project, the companies which have to be covered by further training in
management, business administration, personnel and financial planning as well as marketing.

Our wide-range experience with the original Aachen Technology Centre has grown into a full network of, at present, ten other Technology and Trade centres complementing each other by different focuses of interest, under one generell master plan.

The development of all these innovation centres is directed towards the development of local and regional potentials for the establishment of new companies. Accordingly, technology centres are intended to improve technology transfer - that is, the research results to turn into new products and procedures. The other target of these centres is to promote economic structural change. Another medium-term target is, of course, for companies to create new jobs, in view of long-term stability and certainly the increase of tax revenue.

In the Aachen region, some new 220 companies are operating in the different centres, employing more than 2,000 people. In all, over 90,000 square metres industrial floor space are available in these centres for production and service companies.

AGIT, „Aachener Gesellschaft für Innovation und Technologietransfer mbH“ was originally founded to operate the Technology Centre of Aachen. This company is now acting as a regional development organisation for technology transfers oriented on specific projects, with a large variety of individual projects. Furthermore, the company cooperates with the Aachen chamber of commerce for specific action with firms outside the Aachen region, who are interested in working with the economic potential of the Technical University. Such firms are aware of the beneficial chance of know-how exchange and availability of engineers if required. In this context, two spectacular results of these efforts should be mentioned - namely, the settlement, largest in Europe, of a Japanese semiconductor works, and also the development centre of a telecommunications group have taken place not so long ago - owing to our highly-reputed Technical University right in the heart of Europe.

As I come to the end of my lecture, let me remind you that all these research institutions have decisively contributed towards a structural change in the Aachen region, and a wide range of strategies have been developed in cooperation with the industry. That structural change can now be seen everywhere in the region. Where lignite pits had to be closed down, truly innovative ideas are coming up to create new and long-term employment. Accordingly, the area of the Aachen technology location is a prominent example of large-scale regional restructuring.

Thank you.
TECHNOLOGY AS ECONOMIC ADVANTAGE

Mr. Bijlani initiating his presentation said that a nation's advantage in trade no longer grew merely out of its natural endowments, e.g., raw materials, labour, capital and land, but out of its ability to innovate and manage technology. Companies and nations had now started competing by sharpening their technological edge, and the emerging economies in Asia had amply demonstrated that possession of natural resources was not a prerequisite for economic development. Mr. Bijlani said various countries, as a deliberate policy had moved away from relying on their 'traditional' strengths, and as an example he cited the case of Malaysia, where tin and rubber were no longer the dominant factors in economic development. It had consciously moved into value addition and application of technology in its products, he said. Conversely, possession of national resources did not in itself lead to technological eminence as exemplified by the oil rich countries in middle east.

Mr. Bijlani said that over the years, the critical role of technology as a driver of economic growth had come to be acknowledged and overwhelming empirical evidence showed that the per capita economic growth of the industrialized countries had been driven by innovation resulting in technological progress, and not by aggregate capital investment per se.

NATURE OF INNOVATION

Mr. Bijlani pointed out that neo-classical economic theory attributed growth in output to increase in the level of factors of production, namely, labour and capital and assumed technological progress essentially as an exogenous phenomenon. He said that understanding of the mechanisms that drive economic growth in the world were at variance with this view which still regarded technology as 'free good'. But by its very nature, technology was private property in creation and public property in productive use or consumption, he pointed out. If it was made 'free' for use, who would bear the cost associated with its creation? Mr. Bijlani said technological progress occurred precisely as a result of entrepreneurial activities in anticipation of profits from innovations. The objective underlying patent laws was to encourage inventions by giving for a limited period exclusive rights to use the
invention to their holder. He pointed out that the history of industrial property licensing showed a definite correlation between the economic development of a country and patent protection granted by that country. In the early phases of industrial development, there was a weak system to protect intellectual property, but as the technological advancement accelerated and industry grew countries began to strengthen their IPR base.

The manner and intensity in which industrial property licensing system was used to promote technological and economic development, therefore, differed from country to country.

REGULATORY REGIMES

Mr. Bijlani felt that pre-occupation of many developing nations with a colonial past, had led them to adopt postures which sought to avoid a 'repetition' of history, namely, of economic and technological subjugation in place of political one. Comprador capital was viewed by most as one of the 'vehicles of neo-imperialism', he said. As a result, regulatory regimes had evolved in many countries and restrictive policies with respect to foreign investment, technological collaborations, hiring of foreign personnel, licensing, etc had been put in place.

He said that the historical and political environment, in addition to the level of economic development were thus, important contributing factors that influenced the degree and ways in which countries evolved policies and implemented their industrial property systems.

Mr. Bijlani pointed out that India too was no exception to this syndrome. The Industries (Development and Regulation) Act, 1951, controlled much of the industry through its First Schedule, making compulsory the registration of undertakings, licensing for expansion, production of new articles, change of locations as well as initial locational choices, he elaborated. In reality, he said, all protection policies lead to higher prices for consumers. He then dwelt upon the general form of protection:

a) Tariffs: Imposition of duties on imported goods to raise revenue and to protect domestic industry;
b) Quantitative Restrictions: Global quotas and other numerical limits on imports, sometimes legal within the GATT, sometimes not;
c) Voluntary Export Restraints: These were the most costly kind for an importing country as they allowed foreign suppliers to charge higher prices than would be possible under a tariff or a quota restriction;
d) Subsidies: Paid to domestic producers to help them compete with imports by keeping their costs artificially low. In reality, they acted as cushions for operational inefficiencies;
e) Anti-dumping and Countervailing Duties: GATT rules permitted Governments to impose extra duties on imports where products had been shown to be 'dumped' and where its effect damaged the home industry. In
actual practice, however, much weightage was not given to consumer interest while imposing such penalties;

f) Technical Trade Barriers: Through imposition of standards of safety, quality, public health and environmental protection, often in the name of consumer protection as was now been lonely example;

g) Intellectual Property Rights: Restricting protection through inadequate legal and enforcement network relating to Patents, Copyrights and Trademarks.

RESTRICTIVE TECHNOLOGY FLOWS

Mr. Bijlani said it was generally argued that technology imports would overwhelm local industry and stifle local R&D. Hence, technology policies were framed to encourage indigenous technology and concurrently restrict technology imports to 'selected' areas appropriate to what were viewed as national priorities. He referred to studies carried out in India particularly those by Ashok Desai, Ghayur Alam, Martin Bell and Don Scott-Kemmis on the conditions underlying international technology transfer and said that technological activities of Indian firms were very sensitive to the Government policies pertaining to the nature of the market and the industrial structure. He pointed out that those explicitly aimed at promoting technology development have, in fact, had very little effect. These studies revealed that greater the restrictions on transfer of technology imposed by the recipient countries, the lesser was the 'unpackaging' of technology by the donors. He said it implied that higher restriction on down payments, royalties and on intellectual property rights, lead to weak transfer of technology. Mr. Bijlani felt that in the process aspects of 'know-why' as opposed to 'know-how', were withheld and the quality and depth of technology transfer was sacrificed. The process of 'access' and 'control' of technology remained incomplete and genuine assimilation in terms of mastering of technology had thus failed.

He said the stated objectives of government's restrictions on technology transfer were to develop indigenous capabilities and support 'infant industries'. In practice, however, State interference in these areas had lead to greater isolation and stifled competition, with the result that a high cost economy had evolved. Mr. Bijlani felt that shift of emphasis towards exports and international competitiveness could show results only when general policy directions in the economy were towards greater deregulation and towards promotion of freer flow of technology.
ROLE OF INTELLECTUAL PROPERTY RIGHTS

Mr. Bijlani emphasised that the main objective underlying the protection of Intellectual Property Rights was to give exclusive rights to their holders so as to stimulate technical innovation and to:

a) Encourage researchers and motivate inventors to spend resources to develop innovations;
b) Disclose inventions instead of keeping them as trade secret and;
c) Provide incentive to invest in capital and convert inventions into commercially viable products.

Mr. Bijlani pointed out that the use of patents was not confined to merely commercialisation of inventions, the less publicised aspects of use of patents were:

a) Monitoring of technological trends in specified fields of activity and providing a basis for future technology developments;
b) Identify investment opportunities;
c) Studying of corporate performances;
d) Avoidance of repetitive developments and;
e) Speeding up flow of technology to industry.

He felt that two elements were essential for promoting technological development were:

a) Provision of incentives for inventive activity, which was a driving force for development of indigenous technology; and
b) Dissemination of technical information which could be easily utilized by ordinary skilled persons in their respective fields. This worked as an instrument of effective transfer of technology.

Both required a strong patent protection system, he stressed.
Mr. Bijlani was of the view that lack of awareness on Industrial Property Rights had lead to a number of misgivings in the minds of policy makers and entrepreneurs in developing countries. A number of bureaucrats and economists had also contributed to harbouring these misgivings namely that:

a) Patents lead to monopoly;
b) A strong IP Protection stifled indigenous industry especially local R&D;
c) Technology transfer to developing countries was restricted;
d) Process patents were sufficient protection. Product patents were not necessary;
e) Strong IP Rights lead to high prices;
f) Monopolies were created in the market at the expense of indigenous companies.

Although these misgivings could be convincingly answered but the more rationale process was to spread the awareness more systematically across different sections of those who influenced legislation and implementation in the field of Industrial Property, Mr. Bijlani stressed that to overcome the misgivings, the awareness programmes should seek to balance the exclusivity aspect of the system with its promotional or developmental functions namely the information and transfer function of patents.

CONCLUSION

Concluding his presentation Mr. Bijlani said of late the need to strengthen the IPR regime had been increasingly recognised in India, not only because of the impetus provided by GATT but also because of:

(a) growing realization that economic growth and state of IPR were interrelated;
(b) need to protect Indian R&D, as their contributions had now reached a level that called for protection; difficulties in copying/replicating developments which were no longer simple technologies; and to attract international R&D on a collaborative basis, not just bringing in what had been termed as `screw driver technology' and create sweat shops of manufactures. He concluded by pointing out that establishment of closer links between various components of macro and microeconomic policies was necessary to sustain a sound industrial property system.
INTRODUCTION

Dr. Raghuraman at the outset briefly gave a background to the Associated Chambers of Commerce and Industry (ASSOCHAM). He said that ASSOCHAM was established in 1920 and was the oldest central level organisation of chambers of commerce in India. The organisation had undergone a major transformation in 1987, and today it represented diverse interests, manufacturing sectors, professional, trade and service sectors and the foreign trade sector. Thus, ASSOCHAM represented the views of the widest cross section of industry and trade, he said. ASSOCHAM mobilised the views of business community through the system of 'expert committees' on different topics and subjects. The committees had organised various workshops and meetings to encourage informal debates on issues affecting industry and society in general and had got conducted several surveys as well. He said that ASSOCHAM was consulted from time to time by the government through formal and informal mechanisms prior to formulating major policy decisions.

ECONOMIC ENVIRONMENT

Dr. Raghuraman then touched upon the world economic environment which he said was beset with structural changes like diminishing role of GATT, capital shortage, growing protectionism in the West and formation of trading blocks and disintegration of the erstwhile Soviet Union and decline of communism. Many of these developments had made it imperative for India to internationalise its economy.

The world was moving towards a new technological revolution wherein the accent was on, technological innovation and internationalisation of business to save the world markets. Dr. Raghuraman explained that India as its strategy was endeavouring to target a few selective high growth markets. The need was to effect selectivity in exports based on comparative advantage, he said and some examples of such products groups were gems and jewellery, leather goods, textiles, computer software and agro-based products. But now there was an equally compelling need to transform India into a world class manufacturer and exporter of technology intensive products he said. For this it was necessary to evolve a policy package which ensured full commitment to export led growth. He was critical of the announcement of policies in bits and pieces
which gave rise to further expectations about new measures as a result of which investment decisions were kept in abeyance. He dwelt on some length of the counterproductive effect of such piecemeal policy pronouncement e.g. partial convertibility of rupee. He pointed out that to sustain export effort over some period of time it was essential to ensure cost competitiveness of exports, which required interalia internationally competitive interest rates, infrastructural facilities and assured energy supplies.

Concluding, he was hopeful that India would be able to emerge as a major economic player and international cooperation, despite competition in technology development and transfer would gain in strength.
MECHANISMS AND INSTRUMENTS OF TECHNOLOGY TRANSFER

H.R. Bhojwani,
Science Secretary, CSIR, India

Dr. Bhojwani pointed out that as technology was central to economic and industrial development of a nation; technology development, transfer and its management assumed great significance. Dr. Bhojwani dilated on the diverse formal mechanisms of transfer of technology such as:

(a) arms length technology transfer which involved licensing of technology, supply of documentation/designs, experts, capital goods etc.;
(b) through equity participation;
(c) build-operate-transfer, that is turnkey execution & operation of facilities etc.;
and (d) forming of strategic alliances etc.

At any particular time a mix of technology transfer (TT) mechanisms operating in a country depended upon numerous factors, external as well as internal. The external factors included economic & political environment, global integration access to diverse technology sources.

The internal factors according to Dr. Bhojwani were:

(a) National technology policy with respect to technology acquisition/absorption/transfer & regulations;
(b) National technology climate that is, technological level & composition of indigenous industry, intellectual property regime, S&T informational strengths, venture capital support systems etc. At the micro, or firm TT level depended on factors such as nature of the company, the source of technology, type of industry, competition etc. Thus in the case of India, the tiny sector, which contributed 10% of the country's industrial production, the technology was self acquired. In the case of small scale sector contributing around 35% of industrial production, the technology in majority of cases, almost 80%, was from internal sources that is self acquired/developed; external sources accounted for merely 20% of the technologies. Dr. Bhojwani stated that the technology transfer in small scale was predominantly equipment and manpower embodied rather than through formal technology licensing. Thus according to him the break up of technology sources for SSI was; equipment embodied 10% (7.5% from indigenous sources and 2.5% from foreign sources) consultancy/design routes - 1.5%; and manpower embodied - 8%; formal technology licensing 0.5% and that too predominantly from the indigenous sources. However in medium scale to some extent, and in large scale and public sector enterprises to a greater extent, formal licensing accounted for large number of technology transfers, from indigenous as well as external sources. He felt that with economic liberalisation the demand for foreign technology and capital had increased as was evident from the number of formal foreign collaboration approvals which
had increased from 700 in 1990 to 1650 in 1994, of which, 56% were through equity investment worth Rs. 120 billion compared to a figure of merely Rs. 1.5 billion of equity investment approved in 1990. Thus the indigenous technology development and transfer efforts were likely to face increasing competition from the foreign technology.

Next Dr. Bhojwani dwelt on the domestic technology development efforts; he said the domestic efforts were insignificant as compared to industrialised countries on the basis of R&D expenditures. R&D expenditure in India was around Rs. 5600 crore, a mere 0.83% of GNP and of this 80% was by and through the government, the industry itself spent only 20%, and the R&D expenditure of the Indian companies were very small when compared to companies abroad. The annual R&D expenditure of M/s Siemens was Rs. 170 billion which was around 11% of their sales and of M/s General Electric Rs. 135 billion i.e. around 9% of their sales, on the other hand the leading Indian companies like Bharat Heavy Electrical Ltd. (BHEL) and Steel Authority of India Ltd. (SAIL) were spending less than Rs. 0.5 billion annually on R&D which formed less than 1% of their annual sales. This according to Dr. Bhojwani affected indigenous development of industrial technology and its utilisation compared to the technology from industrialised countries which had higher level of development because of the adequate resources inputs.

Dr. Bhojwani then proceeded to compare the attributes of foreign and indigenous technologies. The foreign technology had the advantages of availability of a process technology package in commercial (volume) production, brandname/licensor goodwill, low technological risks, continued technology support/upgradation of the technology by the licensor and the Indian financial institutions favoured projects based on these technologies. On the other hand an indigenous technology was generally from a laboratory, it was a process knowhow/product design only, with engineering components either inadequate or totally absent thus involving high technological and commercial risks, with training and back up technological support lacking and the financial institutions reluctant to extend support to such ventures.

Dr. Bhojwani elaborated at length the emerging trends in technology transfer and stated that though in large sector foreign technology was increasingly licensed/transferred with equity investments, the licensor retained control of his technology in the case of SMEs, however the preferred mechanism still continued to be arms length transfer approach. Often the latest emerging technologies were not available/transferred and it was generally the technologies on the phase out which were transferred. Also arising from rapidly decreasing product life cycle times, instead of developing a technology and implementing it, firms were now seeking strategic alliances/barter tie-ups in technology development, precompetitive/precommercial R&D etc. with other organisations to gain technological competitive advantage.

Dr. Bhojwani stated that another emerging trend related to decentralisation of R&D by Transnational Companies (TNCs) to their subsidiaries in other countries, especially in developing countries to take advantages of lower cost of
R&D in these countries. Dr. Bhojwani stated that the economy of scale of operation in many cases especially for new technologies such as biotechnologies, advanced materials etc. was no longer important. The small technology firms were equally competitive and this offered significant opportunities for first generation entrepreneurs and thus increased demand for new technologies. Also the small and medium scale units, especially those technologically oriented and operating in special industries, lacked access to information on potential markets and resources to market their technologies/products globally. It was this gap which the technology transfer agencies could gainfully fill up. Dr. Bhojwani also proposed networking or forming of alliances between technology transfer agencies of different countries; a beginning he suggested could be made with forming alliances between the TT agencies of Germany and India.

Dr. Bhojwani explained that CSIR was one of the major source for new technologies in the country. CSIR provided technology for industrial development, societal welfare, resource survey & mapping and improving the quality of environment. CSIR was transferring technology to industry through licensing of IPR (200/Yr); collaborative R&D (100 in hand); sponsored R&D (1000 in hand); consultancy (700/yr) specialist S&T services (1000/yr) and training of personnel (2000 personnel/yr). Dr. Bhojwani dwelt on the change in CSIR's work culture and said that from an inward looking organisation it had become an outgoing organisation trying to harness synergy of all systems. It had reoriented its R&D programmes to suit market/users requirements with strict adherence to maintain quality and timely delivery of outputs. The other notable feature of the new work culture in CSIR was that greater emphasis was now being laid on external earnings, the target for external earning had been fixed at 50% of R&D expenditure by the year 2000; which was presently 30%.

Concluding Dr. Bhojwani stated that significant changes were taking place in CSIR as well in the Indian R&D. The Indian R&D thus no longer considered 'Research' as an end in itself but used it for the betterment of the Society.
PRESENTATION BY

DR. H. R. BHOJWANI
SCIENCE SECRETARY, CSIR

IN THE INDO-GERMAN WORKSHOP
ON
TECHNOLOGY DEVELOPMENT & TRANSFER

8 TH FEBRUARY; 1995
NEW DELHI
FORMAL MECHANISMS OF TECHNOLOGY TRANSFER

a) ARMS LENGTH
- DEVELOPMENT OF TECHNOLOGY
- SUPPLY OF DOCUMENTATION/DESIGNS; EXPERTS, CAPITAL, GOODS, CKD/SKD
- PROVISION OF TRAINING LICENSING OF TECHNOLOGY/IPRs

b) EQUITY PARTICIPATION
- FINANCIAL STAKE + PART/FULL OF (a)

c) BUILD - OPERATE - TRANSFER
- TURNKEY EXECUTION & OPERATION

d) STRATEGIC ALLIANCE
- BARTER OF (ELEMENTS) TECHNOLOGY/IPRs

e) MERCHANT
- TECHNOLOGY ASSISTANCE / INFORMATION
- CONSULTANCY
TECHNOLOGY ACQUISITION BY SSIs

EXTERNAL (20 %)

SELF ACQUIRED / DEVELOPED (80%)

EQUIPMENT EMBODIED (10%)

CONSULTANCY / DESIGN (1.5%)

MANPOWER EMBODIED (8%)

TECH. LICENSE (0.5%)

INDIGENOUS (7.5%)

FOREIGN (2.5%)

INDIGENOUS (0.4%)

FOREIGN (0.1%)
FACTORS AFFECTING TRANSFER MECHANISMS

♦ EXTERNAL

ECONOMIC & POLITICAL STANDING
GLOBAL INTEGRATION
MULTIPLICITY OF SOURCES

♦ INTERNAL

NATIONAL TECHNOLOGY POLICY

– TECHNOLOGY ACQUISITION / ABSORPTION / TRANSFER POLICIES, REGULATIONS, INCENTIVES, BENEFITS

NATIONAL TECHNOLOGY CLIMATE

– LEVEL & COMPOSITION OF INDUSTRY
– LEVEL OF TECHNOLOGY IN USE
– INTELLECTUAL PROPERTY REGIME
– S & T / INFORMATIONAL STRENGTHS
– NEGOTIATING SKILLS
– S & T VALUE SYSTEM
– EXTENT OF COMPETITION
– NATIONAL PRIDE
### FORMAL FOREIGN COLLABORATION APPROVALS

<table>
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<tbody>
<tr>
<td>TOTAL FCAs</td>
<td>640</td>
<td>700</td>
<td>950</td>
<td>1520</td>
<td>1480</td>
<td>1660</td>
</tr>
<tr>
<td>FCAs with EQUITY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EQUITY INVEST (Bill. Rs.)</td>
<td>2.9</td>
<td>1.5</td>
<td>5.3</td>
<td>39</td>
<td>89</td>
<td>120</td>
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### R & D EXPENDITURE OF SELECTED FIRMS

<table>
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<tr>
<th>R&amp;D AS % OF SALES</th>
<th>R &amp; D EXP (Rs. BLN)</th>
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<tbody>
<tr>
<td>10.7</td>
<td>SIEMENS</td>
</tr>
<tr>
<td>7.7</td>
<td>IBM</td>
</tr>
<tr>
<td>9.4</td>
<td>GE</td>
</tr>
<tr>
<td>6.7</td>
<td>HITACHI</td>
</tr>
<tr>
<td>7.1</td>
<td>BAYER</td>
</tr>
<tr>
<td>10.4</td>
<td>CIBA</td>
</tr>
<tr>
<td>9.8</td>
<td>SANDOZ</td>
</tr>
<tr>
<td>1.5</td>
<td>BHEL</td>
</tr>
<tr>
<td>0.41</td>
<td>SAIL</td>
</tr>
<tr>
<td></td>
<td>CSIR</td>
</tr>
</tbody>
</table>
FOREIGN (COMMERCIAL) TECHNOLOGY

- COMPLETE TECHNOLOGY PACKAGE AVAILABLE
- PROVEN COMMERCIAL (VOLUME) PRODUCTION
- BRANDNAME / LICENSOR GOODWILL
- LOW TECHNOLOGICAL RISKS
- FINANCIAL INSTITUTIONS FAVOUR
- CONTINUED TECHNOLOGY SUPPORT / UPGRADATION

INDIGENOUS (LAB) TECHNOLOGY

- PROCESS KNOW-HOW / PRODUCT DESIGN ONLY
- ENGINEERING INADEQUATE / ABSENT
- CLIENT TO ASSEMBLE TOGETHER ELEMENTS OF TECHNOLOGY PACKAGE
- NOT COMMERCIALY PROVEN: TRAINING / TROUBLE SHOOTING DIFFICULT
- LICENSOR BRAND NAME / GOODWILL ABSENT
- HIGH TECHNOLOGY RISKS
- FINANCIAL INSTITUTIONS, DISFAVOUR
- CONTINUED TECHNOLOGICAL SUPPORT NOT AVAILABLE
OPPORTUNITIES

* ECONOMY OF SCALE NO LONGER IMPORTANT; SMALL TECHNOLOGY FIRMS EQUALLY COMPETITIVE

* SMEs LACK INFORMATION / RESOURCES TO MARKET TECHNOLOGY GLOBALLY

* NETWORKING / ALLIANCES OF TECHNOLOGY TRANSFER AGENCIES

EMERGING TRENDS

* INCREASED DIRECT FOREIGN INVESTMENT
* INCREASE IN TECHNOLOGY PAYMENTS
* ARMS LENGTH TRANSFER FROM SMEs
* LITTLE TRANSFER IN NEWER TECHNOLOGIES
* SHORT TERM PRODUCT LIFE CYCLE: TECHNOLOGY OWNING FIRMS SEEK BARTER / ALLIANCES
* DECENTRALISATION OF R & D BY TNCs TO SUBSIDIARIES
* COOPERATION IN PRECOMPETITIVE / PRECOMMERCIAL R & D
## ABOUT CSIR

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>LABORATORIES</td>
<td>40</td>
</tr>
<tr>
<td>SCIENTIFIC STAFF</td>
<td>6000</td>
</tr>
<tr>
<td>TOTAL STAFF</td>
<td>25,000</td>
</tr>
<tr>
<td>TOTAL EXPENDITURE (Rs MLN)</td>
<td>3,900</td>
</tr>
<tr>
<td>DIRECT GOVT GRANT (Rs MLN)</td>
<td>2,900</td>
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<tr>
<td>PAPERS CONTRIBUTED / YR</td>
<td>2,600</td>
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<tr>
<td>PATENTS FILED (INDIA/ABROAD)/YR</td>
<td>250/15</td>
</tr>
<tr>
<td>NEW KNOWHOW LICENSED / YR</td>
<td>50</td>
</tr>
<tr>
<td>LICENCE AGREEMENTS SIGNED / YR</td>
<td>200</td>
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<tr>
<td>CONTRACTS IN HAND (Rs MLN)</td>
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<tr>
<td>- SPONSORED/GRANT-IN-AID R&amp;D</td>
<td>1,800</td>
</tr>
<tr>
<td>- CONSULTANCY</td>
<td>200</td>
</tr>
<tr>
<td>INDUSTRIAL PRODUCTION (Rs MLN)</td>
<td>19,000</td>
</tr>
<tr>
<td>PRODUCTIVITY IMPROVEMENTS (Rs MLN)</td>
<td>2,000</td>
</tr>
</tbody>
</table>
CSIR

PROVIDES TECHNOLOGY FOR

- INDUSTRIAL DEVELOPMENT
- SOCIETAL WELFARE
- IMPROVING THE QUALITY OF ENVIRONMENT
- RESOURCE SURVEY & MAPPING

TECHNOLOGY TRANSFER TO INDUSTRY THRU

- LICENSING OF IPR (200/YR)
- COLLABORATION R & D (100 IN HAND)
- SPONSORED R & D (1000 IN HAND)
- CONSULTANCA (700/YR)
- SPECIALIST S & T SERVICES (1000/YR)
- HRD (2000/YR)
# CSIR CULTURAL CHANGES

<table>
<thead>
<tr>
<th>Earlier</th>
<th>Now</th>
</tr>
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<tbody>
<tr>
<td><strong>Perception of R &amp; D Tasks</strong></td>
<td></td>
</tr>
<tr>
<td>Research as an end in itself; 'D'incidental</td>
<td>Research meaningful only if output inducted into socio-economic system</td>
</tr>
<tr>
<td>Scientist's area is laboratory</td>
<td>Scientist's responsibility extends to induction of research output into socio-economic system</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>R &amp; D Programmes</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Showed little concern for</td>
<td>Market orientation industry needs major concerns</td>
</tr>
<tr>
<td>- End use (Industry / Market / Society)</td>
<td>Time frame sacrosanct</td>
</tr>
<tr>
<td>- Timely completion</td>
<td>Long term ProJs (&gt;3 yrs)</td>
</tr>
<tr>
<td></td>
<td>Projects well targeted well defined</td>
</tr>
<tr>
<td>MONITORING PERFUNCTORY</td>
<td>MONITORING MORE PURPOSIVE</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>EFC NOT OBLIGATORY</td>
<td>OBLIGATORY TO EARN ECF</td>
</tr>
<tr>
<td></td>
<td>(50% BY 2000, PRESENTLY</td>
</tr>
<tr>
<td></td>
<td>≈ 30%)</td>
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</tbody>
</table>

**TRANSFORMATION OF WORK CULTURE**

<table>
<thead>
<tr>
<th>INWARD LOOKING</th>
<th>OUTGOING, TRYING TO HARNESS SYNERGY OF ALL SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• NO COMPULSION TO REACH OUT TO INDUSTRY/ENDUSERS OR FORGE LINKS WITH OTHER TD AGENCIES (INDUSTRY, Fis, CONSULTANTS, ACADEMIA ETC.)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GREATER EMPHASIS ON</th>
<th>GREATER EMPHASIS ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>• SCIENTIFIC EXCELLENCE (PRESTIGIOUS PUBLICATIONS)</td>
<td>• TECHNOLOGY DEVELOPMENT</td>
</tr>
<tr>
<td>• INDIVIDUAL EXCELLENCE</td>
<td>• TEAM OUTPUT</td>
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SESSION III

PHILOSOPHY, STRATEGY AND EXPERIENCE OF TECHNOLOGY TRANSFER: THE VENDORS' VIEWPOINT

part I

Prof. Theenhaus  KFA Jülich
Dr. Beyer  ILT Aachen
Mr. Wolfmeyer  ZENIT Mühleim
Mr. Nowitzki  VDI Düsseldorf
Dr. Döhl-Oelze  W-TEC Wuppertal
Dr. Morell  VDI Düsseldorf
1. **Introduction**

The world is currently experiencing a phase of intensive upheaval and dynamic development: economic areas are being shifted and reformed, as for example in Europe, in America under the slogan of "NAFTA", the Pacific region is becoming more close-knit increasing its economic power. After the breakdown of communism in Eastern Europe and thus the collapse of the Soviet Union, the world is searching for new equilibriums. One consequence is that we Germans have the task of integrating and restructuring a whole country, namely the former German Democratic Republic; $100 billion are being transferred annually from west to east Germany.

2. **World Population and Exponential Growth**

These global shifts of emphasis are closely interwoven with the exponential growth in many fields, both in a positive and also a negative sense.

First of all I would like to make clear once again to all of us here how dramatic the growth in world population is: for millennia the population of the earth amounted to a few hundred million people. From the end of the Second World War (about 1950) until today it has grown from 2 to 5.5 billion people and in a further 30 to 40 years there will be considerably more than 10 billion people on this planet. The world population is increasing by about 100 million every year. This population growth, together with the pent-up demand in many threshold countries and poorer regions of this world, leads to an exponential increase in the consumption of energy and many raw materials. Closely coupled to this there is an exponential growth of what is left behind after consumption and use: namely of refuse, which in this sense also includes CO₂.

In a nutshell: the world population, energy and material flows are increasing dramatically. Naturally, this exponential growth must at some time or another end in saturation. The question is when, under what conditions, how can this be controlled, is this an equilibrium process or is the world heading towards a catastrophe?
3. Why Research and Development?

The analysis of these problems, the answers to the related questions lead us directly to the field of research, development and science. Without intensive research and science, without the analysis of complex systems, without a higher degree of innovative power, and thus the definition and realization of new paths, mankind will be lost. Lost in the sense that catastrophes and famine will increase, that the pent-up demand of poorer nations and the corresponding standard of living cannot be realized. Furthermore, in the more prosperous regions of this world, the industrialized countries, this would lead to social friction and unrest.

In the industrialized countries, about 2 - 3% of the gross national product is spent on research and development. In response to the question of how much new knowledge per year results from this investment, one can only attempt to make an estimate and thus give a rough answer. If we take the number of publications in learned journals as a basis then it can be said that our knowledge doubles about every 15 years. Let us take chemistry as an example: in 1900 there were about 5000 specialized publications per year, in 1980 there were 500,000 corresponding to a doubling in a period of roughly 10 years.

4. Transfer of Knowledge and Technology

When we talk about the transfer of knowledge and technology today then we mean the conversion of knowledge into know-how and deriving benefits from this know-how, for industry, for a nation, for people in general, for mankind.

In many fields, progress is moving enormously fast - for many people alarmingly fast. Let me give a few key words or examples:

- The storage density in chips doubles approximately every two years.
- In agronomy, substances are active in the gram per hectare range.
- The simulation of experiments on large computers (computational science) is opening up completely new possibilities, so that in addition to theory and experiment a third category is being established.
- The combination of medicine and technology introduces a new quality into medicine, thus for example in brain research.

Many more examples could be added.

The question thus also immediately arises of whether each company, each land, each economic area has to be involved in all important fields of research or whether it is not more effective that an agreed division of labour should also be established in research and science. However, it must be remembered that even in research competition is necessary as a driving force. Ladies and
Gentlemen, there are already many good examples of cooperations on a world scale which function well, for example in the field of environmental research, medical research and fusion research, to name but three examples.

5. Time is Money

Today, major emphasis is given everywhere, also and indeed particularly in Western Europe and Germany, to the question of how the process of converting knowledge into know-how and ultimately into concrete benefits can be accelerated. Although this question is not new it has increased in significance and importance. Nevertheless, Ladies and Gentlemen, there is no simple remedy.

In the second part of my paper I would like to illustrate, with the example of the Research Centre Jülich, which is my own affiliation, the approaches and methods we are using in the national laboratories in Germany in our attempt to set this topic in motion. Let me first make two general comments:

a) Progress in science and technology is generally only brought about marginally, i.e. in small steps. As a rule, great leaps forward in development only result when a large diversity and number of detailed insights and skill can be integrated. Furthermore, this progress must be in tune with the times, the time must be ripe. Revolutionary new basic innovations, such as the transistor and also the laser, and cases where science, at least apparently, seems to progress in the form of quantum leaps, remain an exception. In general it may be said: a surge of innovations primarily occurs when they fit into the system context.

b) Technology and knowledge transfer are complex and continuous processes which usually cover considerable periods of time. The necessary prerequisites are a technology-friendly and innovation-oriented climate, and close cooperation between politics, government, economy and science.

6. The Situation in Germany

In 1984, Germany spent about DM 80 billion on research and development, about two thirds of this in industry. In its annual reports, Siemens alone specifies expenditures of more than DM 7 billion for research and development, of which about 10 % is for research and 90 % for development.

Let me now give you four answers to the question of why we undertake research and development:

1. Basis of education
2. Extension of knowledge
3. Preservation of national welfare
4. Provision for a sustainable world.

In addition to the universities, on the one hand, and industry, on the other hand, there are above all four large so-called nonuniversity blocks characterizing the research scene in Germany:

- The Max-Planck Society with a broad spectrum of basic research (funded 50/50 by the Federal Government and local state governments, budget approx. DM 1.5 billion, approx. 14,000 staff)
- The Fraunhofer Society with a major focus on handling contracts for industry (budget almost DM 1 billion)
- The so-called Blue List Institutes (a collection of various smaller institutes with different areas of interest, budget approx. DM 1 billion)
- The sixteen national research centres (total budget of DM 2.7 billion, 21,000 staff, 90 % of funds provided by the Federal Government and 10 % by the local state governments)

The tasks of these national laboratories can be broken down into four categories:

1. Basic research with large experimental facilities
2. Long-term programmes (e.g. space research, fusion, polar research)
3. Key technologies (biology, informatics, energy, materials)

The next transparency gives a brief overview of the structure of the KFA with 38 institutes. The five major research fields at the KFA are energy, environment, information technology, matter and materials research, medicine and biology.

The next transparency schematically shows the organizational structure of the KFA. It becomes clear that on all levels, i.e. especially, for example, on the level of the Board of Directors as well as on the institute level, there are advisory councils with the substantial participation of industry accompanying the research and development work and making critical comments and recommendations for the future. This is an essential element, on the one hand,
of the interaction between KFA and the universities, and, on the other hand, between KFA and industry. In the same way, leading representatives of industry also sit on the Supervisory Board.

To an increasing extent, interdisciplinarity, i.e. cooperation over and above subject boundaries, and also cooperation with external partners determines R&D work at the KFA. In the case of more extensive interdisciplinary topics, a project leader coordinates work within the KFA and builds bridges to external partners, particularly industrial partners. A good and particularly topical example is work on the solid-oxide fuel cell (SOFC), involving cooperation within the KFA between the various institutes for energy process engineering, materials research and development, solid-state research, surface physics, mathematics and data processing (modelling) as well as systems analysis. At the same time, there are contracts with German companies which both define in detail development work in the sense of service to be performed by KFA as well as a superordinate strategic cooperation. This topic is furthermore a good example of the new understanding of industrial cooperation ranging from basic research up to concrete developments, and also including financial support by the European Community for harmonized programmes throughout Europe in the field of basic research. This SOFC project is fairly new and I assume, on the basis of concrete evidence, that it will be very successful. There is a new expression for this type of project: leading projects.

In addition to these rather superordinate and strategic cooperations in leading projects, there are a wide range and large number of other close cooperations with industry shown in the next transparency.

A Technology Transfer Office undertakes superordinate coordinating functions, particularly in the marketing field, as well as in handling and controlling the projects. However, this type of cooperation, and also technology transfer up to and including spin-off exploitation, does not basically function in a centralized manner but only if the scientists involved are themselves interested. This can be achieved by ensuring that part of the earnings from such projects flow back to the scientists for their work. In addition to their scientific work, they must also have a feeling for the necessities of the market, which is not always the case. As a rule, large-scale research does not operate close to the market. The task of large-scale research cannot therefore consist of developing marketable products but rather of exploring and providing the basic principles of new technologies, which can then be further developed into successful products by industry in closely interconnected joint project structures.

The next transparencies show a few of the successful spin-offs mentioned above, which were centrally promoted by the scientists concerned with the support of the central Technology Transfer Office.
7. Summary

In a world of dynamic upheaval and exponential growth in various fields, research and development, as well as science, acquires particular significance. With the doubling of knowledge approximately every 15 years, the question automatically arises of how knowledge can be transformed into know-how, and how results can be transferred from science and research into industry, and thus into products and processes. Major emphasis must be given worldwide to this question, also due to stiffening competition worldwide.

The Federal Republic of Germany is pursuing the path of more closely interlinking science, politics and industry. Advisory councils on all levels are one good instrument. Apart from the transfer of spin-offs and the marketing of services, larger strategic cooperations within the framework of so-called leading projects are increasingly playing a major role in Germany.
Technology transfer by Fraunhofer

Dr. R. E. Beyer
Fraunhofer-Institut für Lasertechnik, Aachen

- Who is Fraunhofer?
  - organisational structure

- How does Fraunhofer work?
  - Interface between industry and university

- Who are the customers?

- How does technology transfer work?
  - Measures of TT
  - Aspects on SME

- How does technology exchange with other institutes work?
1. The Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft is Germany's leading organization of institutes of applied research. It undertakes contract research on behalf of industry, the service sector, and government.

Customers are provided with rapid, economical and immediately applicable solutions to technical and organizational problems.

Commissioned and funded by the Federal and State governments, the Fraunhofer-Gesellschaft undertakes strategic research projects which contribute to the development of innovations in key technologies and spheres of major public concern, such as energy, transport and the environment.

In 1994 the Fraunhofer-Gesellschaft maintained 46 research establishments at 31 locations, and employs a staff of 8100. The total volume of research undertaken amounted to approximately 800 USD. Work focuses on specific tasks across a wide spectrum of research fields. Where systematic solutions are required, several institutes collaborate on an interdisciplinary basis.

The Fraunhofer-Gesellschaft was founded in 1949 and is a recognised public welfare institution. Amongst its members are well-known companies and private patrons who contribute to the promotion of its application-oriented policy.

The organization takes its name from Joseph von Fraunhofer (1787-1826), the successful Munich researcher, inventor and entrepreneur.

The Fraunhofer model is based on a combined system of financing, whereby the different sources of funding relate to different research and development goals. Institutional funding is directed towards strategic Fraunhofer research, public funding of specific projects is devoted to the development of new technologies and the demonstration of their practical use - often in collaboration with industry - and funding from private enterprise is acquired in connection with contract research. As it has grown, the Fraunhofer-Gesellschaft has continued to confirm its status as a major institution of German industrial research - as a link between academic research and the concrete application of ideas and new findings in the form of marketable products.
The Fraunhofer Institutes can be regarded as "fractals" of the organization as a whole - each one similar in structure, yet independent in its respective activities and tasks, each one capable of dynamic response, but with a uniform policy of co-operative responsibility.

Each Fraunhofer Institute is linked to an University Institute. The head of the institute has always been appointed to a professorship to carry out fundamental basic research at the university. The development and technology deployment will be done at the Fraunhofer Institute.

Both activities give each of the Fraunhofer Institutes a wealth of independent technical expertise, which is recognised throughout the scientific community. Co-operation with industry in R&D is complemented by the conduct of examinations, consultancy and other services. Since each Fraunhofer Institute is managed as an economically independent "profit centre", executives and managers need to be first-class businessmen. Their competence ranges from in-depth knowledge of the R&D market to the ability to attune research efforts to market requirements, as well as in the marketing of the services they offer. The ultimate proof of such competence is market success - which, to a considerable extent, can be gauged by the revenue derived by Fraunhofer Institutes.
2. Summary of the principles of the Fraunhofer-Gesellschaft

1. The Fraunhofer-Gesellschaft with its numerous institutes is the leading establishment of applied research in Germany.

2. The Fraunhofer-Gesellschaft conducts research according to the needs of the market in the domestic and international R&D marketplace.

3. The research itself is carried out at the individual Fraunhofer Institutes; their activities in the R&D marketplace are guided by entrepreneurial considerations.

4. The Fraunhofer-Gesellschaft aims to provide a concrete, practical service to the economy, the state, and society as a whole.

5. The work of the Fraunhofer-Gesellschaft is customer-oriented.

6. The Fraunhofer-Gesellschaft exploits the range of its collective expertise across disciplinary boundaries, and opportunities of collaboration with other research institutions towards the solution of complex problems.

7. The Fraunhofer-Gesellschaft is independent of any vested interests of a political, economic or social nature.

8. Minimal hierarchies, decentralized structures and widely shared responsibilities and tasks serve to enhance motivation and broaden the scope for entrepreneurial achievement.

9. The Fraunhofer-Gesellschaft relies essentially on the qualities of its staff. The scientific, entrepreneurial and social skills of its employees are crucial determinants of product quality and of the overall capabilities of the Fraunhofer-Gesellschaft in competitive innovation.

10. The Fraunhofer-Gesellschaft plays a vital and active role in determining the structure of German industrial research.

11. The multi-source method of financing employed by the Fraunhofer-Gesellschaft, with funds derived from government both for institutional support and for project subsidy, as well as from private enterprise, represents the ideal basis for its application-oriented research activities. Joint funding by the Federal and State governments is an investment in the market-related research infrastructure.
3. The work of Fraunhofer Institutes

One of the Fraunhofer-Gesellschaft's basic principles is that its institutes must function on the R&D market in the same way as commercial enterprises. This entrepreneurial approach is characterised by

- Activities attuned to the prospective short- to medium-term demands of society and the economy,
- Active marketing for products and services, and
- Professional project management and control.

Close co-operation with industry leads to the objective to carry out not only R&D but to find solutions for industrial problems. Among others the following services are offered:

- Advice
- Expert reports
- Carrying out of feasibility studies
- Contract research and development
- Development and installation of pilot plants
- Acceptance and testing of systems
- Implementation of pre-production
- Training of staff.

All investigations and projects can be carried out in strict confidence. To minimize the risk, big projects are subdivided into different phases with milestones. After each milestone it will be decided whether to continue or not or to change direction. There are different possibilities of co-operation between Fraunhofer Institutes and industry.

- Participation of companies in public funded joint projects.
- Carrying out of bilateral, company-specific R&D-projects with and without public support.
- Carrying out of tests, pilot and prototype productions by Fraunhofer Institutes to check the reliability of the process and to minimize the risk of first-time production difficulties.
- Establishment of "research units" from industry at Fraunhofer Institutes (e.g. Fraunhofer-Institut für Lasertechnik, ILT).
In addition, companies have the possibility to use the equipment of the different Fraunhofer Institutes (e. g. ILT):

- Companies can use the equipment of the institute (ILT) to carry out their own research work.
  - The institute offers its service staff
  - Service and support by scientists of the institute
  - Implementation of investigations by staff of the institute supported by staff of the companies.

4. The customers of Fraunhofer Institutes

In fig. 2 a comparison of the total R&D expenditure of enterprises with the Fraunhofer proceeds from industry is given. On one axis the different branches of industry are listed and on the other axis the percentage of the Fraunhofer proceeds. The diagram is based on figures from 1992. The Fraunhofer Institutes obtain 25% of its industrial yield from the electrical industry. The electrical industry nearly spends the same amount of money for research in its own labs. In the transportation industry the situation is different. The Fraunhofer Institutes obtain 30% of its financial volume from industrial projects by contracts with the transportation industry. But the transportation industry spends the double amount of money for R&D in their own labs. The opposite case applies to the metal-working and the mechanical industry, as Fraunhofer Institutes get more funds from them than they spend for their own research and development.

**Branches of Industry**

- Power, water and mining industry
- Chemical industry
- Plastics and rubber goods industry
- Metal-working industry
- Mechanical industry
- Transportation industry
- Electrical industry
- Precision mechanics, optical industry
- Wood, paper and printing industry
- Leather, textile and clothing industry

*Fig. 2: FhG Proceeds from Industry and Total R&D Expenditure of Enterprises*
Fig. 3 shows the share of Fraunhofer proceeds from industry and the total R&D expenditure of enterprises subdivided into the different company sizes. 36% of the industrial project revenue of Fraunhofer is obtained from companies with more than 10000 employees. Such big companies normally have their own big research departments in which they invest more money for R&D than transferred to the Fraunhofer Institutes as can be seen in fig. 3. But from companies with less than 2000 employees the Fraunhofer institutes get more funds by R&D-projects than they spend themself. This is caused by the fact that smaller companies seldom have their own big R&D departments. This means that the Fraunhofer-Gesellschaft is a very important organization for small and medium enterprises (SME). To provide technology transfer to SMEs, the Fraunhofer Institutes have to consider some important points:

- First, SMEs cannot fund basic research. They are very seldom interested in basic research due to lack of financial basis. Thus, they clearly have to calculate their risk.
- By this, SMEs needs a short return of invest.

This leads to the fact that Fraunhofer Institutes have to carry out research in advance, paid by themselves and/or by governmental support. If a Fraunhofer Institute wants to transfer a new technology to a SME, the SME normally wants to see or to touch the result or the possible result before work can be started. It is seldom that they are interested in paper work. But they are always interested in developments which they can immediately use in their production. To get a better financial basis, Fraunhofer Institutes are concerned about working in so-called joint projects together with bigger and smaller companies. Often SMEs act as suppliers for bigger companies.
5. Technology transfer and deployment by Fraunhofer Institutes

Technology transfer and technology deployment by Fraunhofer is carried out in different fields, above all in industrial R&D-projects with or without governmental support. The procedure has been described before.

Another kind of technology transfer is given by offering seminars and workshops. They are carried out at the institutes or in the companies, i.e. three or four experts from a Fraunhofer Institute give a seminar of half, one or two days on a special topic, e.g. on laser welding, in the company. Depending on the specific needs of the company, the seminar could cover the whole field
or some special topics according to the different target groups from managers to machine tool experts.

In addition, Fraunhofer Institutes offer practical training seminars with the equipment of the different institutes.

Finally, Fraunhofer Institutes offer students to make their diploma and Phd. thesis at the institute during the work in an industrial project. By this, the students come into contact with the requirements from industry, which is a totally different way of thinking. Thus this can be regarded as a special part of education.

Fig. 4: Model of Technology Transfer by ILT
6. Fraunhofer-Institut für Lasertechnik, ILT

The Fraunhofer-Institut für Lasertechnik, ILT, as one of the 46 Fraunhofer Institutes is located in Aachen.

- Being a typical Fraunhofer Institute, ILT has had a budget of approximately 16 Mio USD including investments in 1994.
- The total number of staff has been about 230 including assistants and scientists.
- The total space of the ILT building is about 100000 square feet.
- The ILT is divided into the following main fields of work with different departments.

![Diagram of ILT's organizational structure]

*Fig. 5: Allocation of Responsibilities at ILT*
• The ILT equipment will continuously be adapted to market requirements and to the latest state of the art. At the moment the following tools are installed:
  - CO2-laser up to 25 kW
  - Nd:YAG-laser up to 3 kW
  - excimer laser
  - five-axis gantry systems
  - three-axis processing stations
  - beam guiding systems
  - robot systems
  - multi-station simulator
  - direct-writing- and laser-PVD-stations
  - equipment for machining and process diagnostics as well as for high speed process analysis
  - equipment for holographic vibration analysis and Speckle-interferometry
  - laser triangulation sensors to measure contours
  - Computer network.

With the help of this equipment, the size of the building and staff, ILT can work out industrial solutions in all fields of laser technology.

7. References

1. Annual Report Fraunhofer 1993
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ZENIT - Centre for Innovation and Technology was founded as a limited company in 1984 in North Rhine-Westphalia in Germany to promote innovation and to perform technology transfer, in particular in small and medium-sized companies of the manufacturing industry.

The model chosen was public private partnership combining the interests of three shareholders:

- industry via a support association with about 100 SMEs distributed all over the country
- main interest: practical relevance of the transfer services
- State of North Rhine-Westphalia via the Ministry of economics, industry and technology
- main interest: integration of the transfer process into the technology and infra-structure of the federal state
- the financial sector via the state bank WestLB
- main interest: integration of technology-oriented transfer know-how into the assessment of projects to be financed within the Federal State subsidy programmes.

The main objective of ZENIT is the promotion of innovation and technology:

- as competent partner of industrial firms
- as link between industry and industry and between university institutes and medium-sized industry
- as think tank to improve transfer processes and structural changes in industry in North-Rhine Westphalia.

North-Rhine Westphalia - the industrial heart of Germany
NRW is Germany's most densely populated federal state and its strongest in economic terms.
NRW is thus not only the centre of the energy sector and the chemical industry - as representative examples, it is also a region characterized by its dynamic small and medium-sized companies, by high-quality capital goods and new technologies. Environmental technology is one example. In this sector NRW is well on the way to become the technological centre of Europe.

NRW is strong in terms of

| Population | 17 million inhabitants |
| Economy    | 25% of the gross national product |
| Exports    | 25% export trade |
| Investment | 25% of all foreign investments are made in NRW |
| Innovation | 50 technology centres, 26 technology agencies, 30 R&D centres |
| Education  | 50 universities and higher education institutions |

The state development is supported and encouraged by the government's regional structural policy and its policy on technological development. One result is the comprehensive technology and infrastructure network which forms an efficient link between the scientific and business communities.

The ideas, experiences and recommendations presented here must be seen in relation to the economic system of the Federal Republic of Germany and those areas of the international market in which competition is the main stimulating force continuously checking and to improving the position and opportunities of an industrial firm in the international market.

Coal mining, steel production and processing have in the past been dominant industrial sectors in this region which have, however, seen dramatic reductions in production and employment due to world market impacts. A structural change was therefore necessary based on industry's own initiative and supported by an adequate economic policy.
TECHNOLOGY POLICY CONCEPTS

The main objective of technology policy is to maintain and strengthen the competitive position of about 12,000 industrial companies, in particular of small and medium-sized firms, which in North Rhine-Westphalia represent about 95 percent of the industrial firms and more than 60 percent of all employees in this sector of the regional economy.

The main aims are:
- to progress and advance through innovative technology
- to advance through safe and reliable technology
- to progress and advance through acceptable and accepted technology, in particular in environmental aspects.

The main target groups of technology policy are:
- universities and research institutes
- transfer agencies and institutions of different types and sectors
- companies and institutions in production and service.

The main instruments of technology policy are:
- financing and promotion of research, in particular cooperation between university institutes and companies
- assistance and financing of transfer processes
- stimulation of innovation processes.

ZENIT-ROLE AS REGIONAL TECHNOLOGY TRANSFER CENTRE

Technology transfer must not only be directed to technology alone, but must be integrated into a company's visions, strategies and different activities and functions. Therefore all questions of management, financing, qualification and cooperation and in particular also market research and technology marketing must be included. The international aspects are of growing importance, in particular the growing chances in the European community, the new challenges given in Central and Eastern Europe and, of course, the competition in the Far East and in America.

ZENIT is an active partner in the transfer network of North Rhine-Westphalia with different forms of activities with regard to the different partners as follows:
Transfer network in NRW:
ZENIT provides advisory and consultancy services mainly to industrial enterprises. The aim is to show companies how they can use technical innovation in future-oriented fields of technology. The technical and economic problems involved which are often closely related are solved by a team of experts competent in fields ranging from micro-electronics to biotechnology, from computer-integrated manufacturing (CIM) to environmental technology, from industrial robots and automatic material-handling machines to expert systems. ZENIT experts help their customers to solve their technical and economic problems and to make the right investment decisions.

The main fields of activities are

- Market research and technology marketing
  - market and sector analyses
  - company and marketing strategies
  - technology and structural consultancy of public bodies.

- Quality and environmental management
  - quality assurance and management
  - environmentally oriented management
  - new environmental technology products
  - waste management, biotechnology and sensoric
  - data bank environmental technology
Technology trends, innovation expert reports, forum
- micro technology
- micro electronics
- sensoric
- medical technology
- laser technology
- new materials
- computer simulation

Information and communication technology
- Information and communication technology trends
- production technology
- organisation / computer technologies
- qualification
- telecommunication
- multimedia
- services

Information and consultancy in European matters
- Europeanwide data research
- transnational cooperations
- financial consultancy (EU technology programmes)
- mediation of research results

Technological and structural projects
- Value Relay Centre (VRC)
- Euro Info Centre (EIC)
- transfer programme for qualified graduates into SMEs.

ZENIT is also operating in technology and transfer projects of the State of North Rhine-Westphalia.

Examples are:
- environmental technology
- micro electronics
- expert systems and neuronal networks
- biotechnology
- industrial cooperation
- transfer of qualified graduates into SMEs.

Of particular importance are the European questions, the growing European Union as well as the developments in Central and Eastern Europe. Since 1987 ZENIT is an Euro Info Centre for business (EIC) and since the beginning of 1993 one of the 27 European Value Relay Centres (VRC). The EIC has built up a complete service package targeted towards the development of strategic concepts for individual industries and companies. This package comprises:

- strategic seminars
- individual consultancy
- information and advice on public tenders in other EU countries.

ZENIT is fully integrated in a number of European networks, data banks and mailbox systems etc. in order to speed up information and to support cross-border cooperation partnerships.

EIC offers practical assistance to small and medium-sized enterprises who wish to take advantage of the wide range of European programmes, e.g. ESPRIT, RACE, BRITE. Direct contacts to the Commission in Brussels and Luxembourg as well as a direct link to the other EICs in all the other member countries are an essential support to service the SMEs in Germany. This support comprises detailed advice in

- outlining the project
- estimating an application's chances for success
- seeking the cooperation partners which are usually stipulated
- formulating and translating the application
- contract negotiations
- compulsory reporting back
- project accounting.
HOW TO BRING A TECHNOLOGY TO THE MARKET?
LASER TECHNOLOGY
STRATEGY OF THE VDI TECHNOLOGY CENTRE (VDI-TZ) IN ORGANIZING
THE TECHNOLOGY TRANSFER

Dipl.-Soz. K.-D. Nowitzki
VDI-Technologiezentrum, Düsseldorf

Support of the diffusion process - from the laboratory into the market

- distribution of R&D-results
  - Information Transfer
    - Presentation
    - Documentation
    - Consultancy

- Analyzing the obstacles of the technological development
  - Coordination of technology assessment processes
    - side effects
      - Safety

- Evaluation of the efficiency of state-supported R&D
- Training and Education
- Standardisation

- Assessment of the industrial use of R&D results
  - Analysis of the technological development
    - Trend-Analysis
• Initiating international cooperations
  • EUREKA
  • GUS
  • Canada
  • China
  • India
Business innovation centres are an effective instrument of promoting new, technologically oriented businesses and help to create qualified, innovative jobs. The impact of incubators on entrepreneurship and economic growth as well as on technology transfer and the spread of technological cooperation has made them a recognized tool of innovative regional economic development policy.

As different centres are due to their regional tasks, as common are their following goals:

- Start-up advisory services and development consulting
- A range of technical, organisational and informative services
- Technology and innovation oriented services, technology transfer, training and continuing education courses
- Availability of office, laboratory and manufacturing space

Innovation centres serve as knots in regional technology transfer networks, build up by universities, research institutes, enterprises, Chamber of Commerce and other public authorities. Usually innovation centres act as crystallization points for technologically oriented business in their neighbourhood forming technoparks.

To achieve structural changes in regional economy is a sensitive process, depending on steady cooperation of all partners. The integration of local technology transfer activities into a country wide network guaranties long lasting success.
INTRODUCTION

Business incubation centers in Germany - Which one is the right model?

- Incubators
- Technology centers
- Technology cells
- Innovation centers
- Commercial centers
- Science parks.

- Regional needs and potentials

GOALS AND TASKS

- Start-up advisory services and development consulting
- A range of technical, organisational and informative services
- Technology and innovation oriented services, technology transfer, training and continuing education courses
- Availability of office, laboratory and manufacturing space.

INCREASING THE REGIONAL EFFECTIVENESS

Joint responsibility with business, science organisations, government and organisations for industrial and technological strategy:

- Setting technological development goals
- Sponsoring joint technological projects
- Devising promotion schemes and
- Qualifying schemes with a technological orientation
- Developing a regional marketing strategy with an innovative, technological bent
- Providing guidance to technological initiatives
Developing information systems and networks for innovation
Developing technology parks
Supporting public-private partnership initiatives and
Developing technology assessment and early-warning systems.

TECHNOLOGIEZENTRUM WUPPERTAL W-TEC GmbH

The Technologiezentrum Wuppertal W-tec GmbH is working since 1992 with a mixed concept

- Technology oriented business incubator
- Research and science center
- Center for development projects.

The referring subjects are

- Data processing (software, hardware, consulting)
- Industrial and graphic design, marketing
- Economical/ecological planning
- Material Science
- Plasma and surface technology.

Synergy Effects.
FROM "TECHNOLOGY HOTEL" ..... 

- limited tenancy agreement -

joint use of:

- secretary, reception, mail service
- telephone central, Fax, copy machine etc.
- meeting rooms, kitchen
- seminars / workshops
- consulting

advantages by:

- reduction of expenses
- contact /cooperation with neighbour companies
- contact to external R&D, companies
- public relations
- ...
- ...

.....TO "TECHNOLOGY PARK"
NEW WAYS TO BENEFIT FROM THE FUTURE

Innovation or technology centres in Germany have a very short history - only at the beginning of the 80's did the first centres begin their work. The present technology centres, of which there are more than 50 alone in North Rhine Westphalia, came into being without exception due to joint initiatives between the business community and local authorities, who also support them financially. On the basis of the American experience, the planners, soon realized that "Silicon Valley" could not simply be transplanted onto the German technology-transfer policy, the founding of the centres instigated and supported the structural change in the areas. In the long term, only those industrial jobs will survive in satisfactory numbers in Germany which fulfill high technological or innovative demands.

THE KNOT IN THE TECHNOLOGY NETWORK

Also in the Bergish Land region in North Rhine Westphalia (Cities of Wuppertal, Solingen, Remscheid) the economic development over the two previous decades has been characterized by a strong and continuous decline in traditional, industrial jobs. Consequently, it is necessary to increase efforts to transform the available research and development activities of the universities and research institutions into actual products. This is where the technology centres as organized knots in the technology network are making a decisive contribution. In Wuppertal active steps are being made in this direction.

The basic idea of our technology centres is to concentrate innovative activities, thus creating synergy effects which radiate into the whole business community. An increased technology transfer from universities and research to industry is practised to make the latent scientific potential useful for the economy. Technology transfer should by no means be a one-way street. The business community should for their part exploit their opportunities - not least through the mediation and support of the technology centres - to present their research and development needs to the scientific community in order to be able to develop specific new products or services.

COOPERATION

The promotion of cooperations is the declared aim and daily practice of the technology centres. They have profound knowledge of the technology landscape. Especially the small and medium-sized companies should take advantage of this potential. Technology centres are the operational bases for small and medium-sized companies: technology consultancy, questions on financial support from the European Union e.g. or a wide range of advisory
services from questions about business start-ups to patent law are all part or the services offered by technology centres. They are always available to give support or to moderate on problem-solving in technological and financial issues.

SERVICES

The technology center provides the local economy with a competent partner. Bureaucratism and the ivory tower of science are foreign to us. We do not only demand innovation but we also practise it ourselves. Thus, technology centres are also to be regarded as innovation catalysts for new and valuable local jobs. Our tools in this business are making suitable sites and services available as preconditions for the execution of projects covering business starts, development and science. Newly-established business as well as young technology business in the manufacturing and service sectors receive continuous support. In the centres, innovative new business concentrate their efforts onto the process of innovation. The centre supports and advises the new companies on all business issues, offers as communal facilities a shared infra-structure (from secretarial jobs to photocopying) which a new business cannot afford to pay for itself. It only fosters the businesses until they can stand on their own two feet and can establish themselves outside the technology centre. Our service does not end when the tenancy agreement expires. In cooperation with the economic aid institutions we help in the search for new premises. So, the technology park just being established in the close neighbourhood of the technology center gives room for the "grown up"-companies. One advantage by moving to the technology park is that still the ways to their business partners in the center is short. On the other hand the innovative image of the cooperating technology center and park attracts additional technologically oriented companies from outsight. The number of new jobs created is the most visible and most easily perceived success of technology centres. But they cause even more to happen: they contribute substantially to the enhancement of the structure and the image of the location and to the strengthening of the businesses' technological competitiveness.

INNOVATION BY COOPERATION

Innovation requires information, contacts and joint efforts. What more suitable location than a technology centre can be envisaged for this purpose, where under one roof firms work together next to and with each other door-to-door, where the journey to the advisory research institute is only a few metres, and where seminars and workshops bring the latest technology and contacts onto the premises? But the job of promoting innovation and cooperation has not
been undertaken merely within the walls of the technology centre alone. In their role as knots in the technology network initiated by the North Rhine Westphalian Ministry for Economics, Small and Medium sized Companies, Technology and Traffic (1), the technology centres also offer support in accessing partners and consultancy services. The Bergish Land Region is characterized by mainly medium-sized companies. The surrounding structures are subject to permanent change, which the companies must take into account if they want to be successful. Mounting pressure from competition, falling sales prices, rising raw material costs or changes in exchange rates are just a few of the indicators. Faced with increasingly shorter product life-cycles, often without direct access to technological innovations and in many cases confronted with substantial financial expenditure, more and more companies are reaching the limits of their possibilities. The classic answers provided by economics - rationalisation, redundancies - no longer seem satisfactory. New models of behaviour are needed. Cooperation through the use of joint possibilities is indispensable here. Development and research activities can in many cases be carried out on a joint basis especially by small and medium-sized enterprises. Significant economies in costs, gaining the partners' know-how potential, or even winning new market potential or sales markets are just a few advantages worth mentioning.

The cooperation of the centres themselves is also an expression of our experience that in joint project work the respective resources are employed more effectively. For example, the expertise profile in the area of modern plasma surface technology attracts interested visitors from the whole of Germany into the valley of the river Wupper (Wuppertal). With the headquarters of the Plasma Technology Initiative of North Rhine Westphalia (PlatIn), the organisational lead function in this area of technology is housed in our Technology Centre W-tec. The expert knowledge links to the Solingen centre - represented by the newly-founded Institute for Galvanising and Surface Technology Solingen GmbH (IGOS) - are plain to see. In this way, the traditional galvanisation coating techniques are combined with the latest possibilities made available by plasma processes.

**THE BERGISCH PRIZE FOR INNOVATION**

The Bergish prize for innovation is a further example of the cooperation between the centres. The prize is meant to supply a further incentive to establish the potential of new technologies, to develop innovative products, processes and services in tune with market demand, and to achieve competitive edge by means of cooperation with companies and institutions. The concept was successful: more than 40 contributions to the competition proved the high innovation potential of the Bergish Land. The idea of cooperation was also addressed, as in fact more than 90 companies and research and development institutions participated in the competition. Cooperation between
different areas of business enabled the prize-winner to develop a completely new product and gain new market segments.

TO REGARD RISK AS AN OPPORTUNITY

The good contacts amongst the firms based in the centres, the links to the local economy, to regional and supra-regional institutions and not least to the Bergish University in Wuppertal, together supply the synergy effects. Thus the centres are increasingly becoming crystallisation points for the creation of stable structures between the scientific community, innovative business, newly-founded businesses and economic-political movers. Attractive sites for new technology-orientated business arrivals are being formed. A new study carried out by the Ministry of Economics (2), for example, predicts that the number of jobs in the direct periphery of technology centres in North Rhine Westphalia will increase by 145 % from 1993 to 1997. This prediction presupposes not least that the present strength of innovation will remain and that companies continue to be willing to further develop their products with available know-how and new technologies. It is without doubt necessary to take care of the existing product range - but the realisation of today's knowledge combined with new technologies is indispensable in winning new product and market areas. The assessment of the contribution to the Bergish Land - the problem is often to be found in the area of support. Alone the exploitation of all possibilities, and here of course the structural help offered by the technology centres plays a part, leads to rapid success. The centres will continue to develop. Supra-regional specialist expertise will be driven onwards: lead functions will be taken over more and more in technology initiatives. Technology consulting and marketing will play increasingly central roles in the work of the Technology Centre Wuppertal W-tec and the neighboured centres. The technology profile of the region will be improved markedly. The climate of innovation already created symbolizes a get-up-and-go mood in business.

ACKNOWLEDGEMENTS

We thank for the support given by the Ministry for Economics, Small and Medium-sized Companies, Technology and Traffic of North Rhine Westphalia.

REFERENCES

1. Technology Handbook North Rhine Westphalia; published by Ministry of Economy, Mittelstand and Technology NRW; March 1993
2. Ten Years of Technology Centres in North Rhine Westphalia, publisher as above; November 1993
The German Association of Engineers (Verein Deutscher Ingenieure - VDI) has been founded in 1856. Since its foundation this learned society works as an independent technological-scientific organisation with nowadays more than 120,000 individual members. The aim of the work of VDI is technological know-how and experience transfer, given as service to all members, natural scientists, industrial companies, public organisations and the general public.

The most useful and effective instrument for this aim are VDI-Guidelines. In 1917 VDI initiated the foundation of DIN (German Institute for Standardisation).

The procedures for the elaboration of technical rules (VDI-Guidelines and DIN-Standards are described), which are necessary that they can fulfil their aims. It will be given hints for the proper use of the framework of national and international technical rules:

- the necessity of participation in the elaboration of national and international technical rules
- the proper use of international guidelines and standards
- instruments to support the broad use of technical rules
- technical rules as an instrument for gaining national and international markets.
PRINCIPLES FOR THE ELABORATION OF TECHNOLOGICAL RATES

- Anyone can apply for a VDI-Guideline to be created.
- VDI-Guidelines are drawn up in technical committees. The experts in these committees must represent all interests involved, that means representatives of science, producer, user, supervisor and the public authorities are personnel members in the committees.
- The draft of every VDI-Guideline must be submitted to public objection.
- Every objection received in connection with a given draft must be cleared with the party objecting.
- (only DIN-standards)
  The Standards Editing Office must check DIN Standards prior to their final editing that the new DIN-Standard does not conflict with any other existing standard.
- VDI-Guidelines must be examined every five years to check whether they still correspond the actual technological know-how and practice.
COOPERATION
VDI - IMEE (Institution of Mechanical Engineers of Egypt)

- The organisational structure of cooperation
- Example VDI 2055
  - translation
  - visit to study practical use
  - workshop in Egypt
  - cooperation of companies
  - Egyptian products in the German and European market
SESSION III

(continued)

part II

Mr. H. J. Back  IES, Germany
Dr. K. V. Raghavan  Director, CLRI, Madras
Dr. M. H. Dhananjaya  Director Techn. JSS Mahavidyapeetha, Mysore
Prof. A. K. Sengupta  Managing Director, FITT, New Delhi
Mr. N. K. Sharma  MD, NRDC, New Delhi
Mr. S. Sreenivasa Rao  MD, APITCO, Hyderabad
Dr. H. Razdan  Technology Transfer Group, BARC, Bombay
INTRODUCTION

Dr. Raghavan said that leather sector was a traditional sector but it had great potential for countries of the region. The leather manufacture had remained as an art for a long time. But this art had now undergone rapid strides and science and technology had come to play a greater role in leather making. He said that leather making was a complicated process and one could not embark upon it successfully without the required knowledge and skillbase. Dr. Raghavan explained that till 1960s India was a major exporter of hides and skins to the advanced countries. The Govt. of India then realised the potential of leather industry for socio-economic upliftment and exports and followed the policy for value addition to the strong raw material base. The Govt. policies also placed emphasis on employment promotion and protection of interest of small scale units. As a result the sector grew tremendously and established an impressive record on the export front also. Indian leather exports were now of the order of Rs. 4,200 crores in 1993-94.

TECHNOLOGY TRANSFER

Dr. Raghavan pointed out that technology transfer in leather sector was achieved through multiple modes viz. onsite and offsite process demonstrations, job oriented training, packaging of knowhow and design engineering or their combinations. The leather process technology was generally transferred through onsite process demonstrations by the national and overseas consultants, chemical and equipment manufacturers and research institutions. The leather chemical sector, on the other hand, derived its new technologies through product development and offsite process demonstration on pilot scale followed by the packaging of knowhow and design engineering information.

Dr. Raghavan said in a totally different style, the leather product sector obtained its new technologies mainly through general and specialized training in design and construction of products. He felt that appropriate strategies, had to be evolved by the leather research institutions to attain proficiency in these modes of technology transfer.
Dr. Raghavan then dwelt upon certain "Innovative Strategies" which could be effectively utilised for technology transfer in traditional sectors like leather, they were:

- Reaching users directly;
- Sensitizing industry through group interactions;
- Full scale technology transfer;
- Packaging of knowhow & engineering;
- Training & services;
- Technology upgradation through time specific retainership schemes.

THE ROLE OF CLRI

Dr. Raghavan explained that the Central Leather Research Institute (CLRI) since its inception had been working very closely with the leather industry and had made significant contributions to its growth over the last 40 years. CLRI had assisted the industry in steadily transforming its traditional leather processing techniques into environmentally compatible and technoeconomically attractive manufacturing technology by providing HRD inputs and by offering range of specialized services at affordable costs. He said CLRI had established a computer aided design centre for footwear and products designs. The centre had been assisting over 50 different footwear units engaged in the export of either shoe uppers or shoes. The nature of services rendered included, creative styling of shoes, generation of new patterns, pattern grading, pattern assessment for area consumption and optimum layout for economic cutting etc. Besides the institute had established a pilot facility for footwear production with a view to assist the small scale and tiny units. Dr. Raghavan said a full fledged footwear testing and certification centre was also established in association with SATRA, a UK based organization to provide assistance to the Indian industry. A similar centre for leather garments had also been established with the assistance from UNDP. He added that these facilities were widely being used by industry.

CONCLUSION

Dr. Raghavan concluded his presentation by pointing out that a determined government, a highly motivated industry and a dedicated support from research and academic institutions were three major factors which had helped strengthen a traditional industry sector in India so much so that it was today a major foreign exchange earner. He said that a similar approaches of technology transfer could be applied to other traditional industrial sectors like sugar, textiles, jute etc.
EXPERIENCES OF SJCE-STEP's S&T ENTREPRENEURS PARK

M. H. Dhananjaya

Directorate of Technical Education,
JSS Mahavidyapeetha,
Mysore, India

INTRODUCTION

Dr. Dhananjaya talked about the Science & Technology Entrepreneurs Park (SJCE-STEP) at Sri Jayachamarajendra College of Engineering. He said it was setup with the objectives of: innovation in technology; transfer of technology; promotion of entrepreneurship; serving industry and service sector. He said that the precursor to STEP was the Product Development Centre (P.D.C.) conceived more than 12 years ago with the objective of 'Technology Transfer' from the engineering college to industries. Later the Govt. of India had extended support for the concept of Technology Transfer and Entrepreneurship Promotion by assisting in setting up STEP. The State government and the financial institutions had then supported the project.

Dr. Dhananjaya pointed out that there were parallel efforts in Technology Transfer in the country through State Councils of Science & Technology and Technology Consultancy set ups, NRDC etc. He said that STEP had promoted entrepreneurship by facilitating subsidy to entrepreneurs through Small Industries Development Boards, Small Industry Service Institutes, Department of Industries.

ACTIVITIES OF S&T ENTREPRENEUR's PARK

Dr. Dhananjaya explained that support for technology transfer meant a concentrated effort from both the contracting parties. The SJCE-STEP had accordingly taken up a comprehensive activity of training, facilitation, and support for SSI including problem solving, and quality management, he elaborated.

The diverse activities SJCE-STEP thus included:

- Entrepreneurship development
- Skill development
- Continuing education
- Consultancy services
- Prototype & product development and marketing
- Quality assurance
- Database & information
ENTREPRENEURSHIP DEVELOPMENT PROGRAMME

He explained that the Entrepreneurship Development Programme (EDP) had three major sub programmes aimed at:

a) Fresh Graduates;
b) Working Professionals;
c) Women (S&T personnel).

He explained that through the EDP 234 candidates were trained; 54 units were established and employment was generated for 300 people.

The range of products that were being manufactured by entrepreneurs trained under EDP was quite wide ranging from Battery Eliminators, Glow-lamp, Moulded Microcellular rubber products, Thermocole Packaging, Pulse Transformer, CRT Terminals, Special foam pads, Vacuum pumps, Invertors & Convertors, Metal engraving, Narrow tapes, Fibre glass tape, CNC retrofit lathe, Expandable foam products, Cotton rag pulp, PVC weld articles, Electronics products, Briquettes, Telex cord, Computer products, Pump controller, Electro mechanical products, Software development, Electronic ballast, Computerised telephone charge, Automatic flasher, Thermographic & direct copy paper etc.

SKILL DEVELOPMENT

He explained that the Park had a programme for skill development of entrepreneurs in need based areas such as basic electronics, advanced testing and trouble shooting, personal computer servicing etc.

He elaborated that employment opportunities generated by need based training in different districts were for Hand Pump Mechanics; Master Designers for Garment Making; Engine Mechanics; Motor Rewinding; Computer Mechanics; Masonry; Pottery; Refrigeration & Air Conditioning; Welding; Electronics; Submersible Pump Mechanics; Multipurpose Mechanics etc. He said that more than 1000 candidates had been trained with a clear emphasis on employment generation under this programme.
CONTINUING EDUCATION

Dr. Dhananjaya pointed out that programmes were organised from time to time to facilitate continuous learning process among entrepreneurs. They had been:

IN-HOUSE: According to the specific requirements of industries, courses were organised in-house exclusively for the Technical Professionals of the Industry.

RESIDENTIAL: The need based programmes, as per schedules periodically announced, were organised in the campus of Science and Technology Entrepreneurs Park.

He said that SJCE-STEP had organised so far:

- 50 Residential Programmes
- 15 In-house Programmes
- 1000 Engineer/Managers trained

The clientele included both private & public sector companies like, Hindustan Machine Tools Ltd., Pune; Bharath Earth Movers Ltd., Bangalore & Mysore; Modi Xerox, New Delhi; Larsen & Toubro Ltd., Mysore; Vikrant Tyres, Mysore; Indian Aluminium Ltd., Nanjangud; Rare Materials Project, Mysore; Kirloskar Electric Co., Mysore; Automotive Axles Ltd., Mysore; Backau Wolf Ltd., Pune etc.

He said that the Park had also started assisting small scale industries for acquiring ISO 9000 and M/s B.T. Solders, Mysore; M/s Brooke Bond India (Pvt.) Ltd., Mysore and M/s Dunford Fabrics, Nanjangud could acquire the ISO 9000 accreditation due to centre's assistance.

QUALITY ASSURANCE

Dr. Dhananjaya said that the Park had assisted entrepreneurs in providing calibration facilities for DMM's, PI Meters, Photometric Control Panels, Pressure Gauge, Calibrating, Dial Gauge, Calipers, Micrometer, Slip Gauge, Calibrations camp in collaboration with ETDC, Bangalore had also been organised time to time.
INFORMATION CENTRE

He said that the Park had an information centre where entrepreneurs could get diverse information on:

- Products & Suppliers;
- Project Profiles;
- Journals on Business & Management;
- Data pertaining to Natural Resource available in Mysore District;
- Standards Specification published by Bureau of Indian Standards (Accredited as an Extension Centre of BIS);
- All BIS Standards.

CONSULTANCY / SERVICES

He explained that the STEP also provided diverse consultancy and other services namely:

I. PC Service Centre
   A. Servicing of all PC computers

II. Product Design Centre
   A. Design of EPABX system
   B. Design of Electronic Energy meter
   C. Packaging Design for Small Scale Electronic Industries

III. Business Facilitation Centre
   A. Office Space
   B. Secretarial Service
   C. Fax & Telephone
   D. Xerox Facilities
   E. Seminar Hall Facilities
   F. Reference Facilities
INTRODUCTION

Dr. Sengupta pointed out that in the context of globalized economic environment, technology in the totality of the term had come to occupy the centre stage of industrial management. Every industry, whether it dealt with manufacturing or it provided services, must ensure that it became and remained competitive in order to even survive, and it was primarily through the right choice of technology, its optimum utilisation and continuous forward development that competitiveness could be sustained.

He said the technical universities and academic institutes were prime sources of technological expertise and new developments; and all over the world there was strong emphasis on close linkage between the industry on one hand and academia on the other. The Indian Institute of Technology (IIT), Delhi had recently established an autonomous organisation called the Foundation for Innovation and Technology Transfer (FITT) which was the first of its kind in India dedicated totally to enhancements of interaction with industry.

OBJECTIVES, CHARACTERISTICS AND ROLES OF FITT

Dr. Sengupta said that the broad objective of FITT was to foster, promote and sustain the cultivation of science and technology and scientific research in all its aspects, and to engage in result oriented R&D both at industrial premises and at IIT, Delhi. In other words FITT was broadly to market the intellectual-ware of IIT to industry on competitive terms and inject industrial relevance in IIT's teaching and research activities. Dr. Sengupta elaborated on characteristic features of FITT and pointed out that FITT was

(a) an autonomous body promoted by MHRD and IIT, Delhi;
(b) its primary knowledge resource was IIT, Delhi but its resources could be supplemented by other generator or constituents of the innovation chain including other IITs; engineering colleges and polytechnics;
(c) it would seek to operate on a commercial basis.

He said that accordingly the roles taken on by FITT were to:
(a) provide information on knowledgebase resources of IIT Delhi on transferable technologies, expertise available, extramural HRD programmes (past, present, designable), facilities (labs. or special infrastructures);
(b) facilitate multi-disciplinary approach to problem-solving and technology transfer by locating and tie-up resources from outside IIT and integrating these with those of iIT to offer more complete packages;
(c) identify, assess and promote technologies developed at IIT, Delhi in the market place;
(d) identify industry needs for R&D and inculcate industry relevance to IIT's R&D activities;
(e) provide a single window services to industry for its technological requirements, and
(f) act as a conduit, to facilitate flow of funds from industry to IIT, Delhi.

Dr. Sengupta then went on to classify the activities of FITT into groups as follows:

(a) transfer of (off the shelf) technology,
(b) R&D partnership,
(c) problem solving consultancy,
(d) HRD Programmes and training,
(e) information support services, and
(f) facilitating the use of infrastructural facilities of IIT Delhi.

Each of these activities generated funds for the FITT he said. Besides, the FITT offered corporate membership to organisations which afforded them some priority in and concessions in availing of FITT services.

Dr. Sengupta while summing up his presentation touched upon certain issues that needed in transfer of technology based on FITT's experience to be pondered namely:

(a) FITT had two clients : Industry & Faculty but it had no executive authority over both the resources;
(b) The only tools for catalysing business were persuasion and motivation to be put in place;
(c) Thrust needed was on Medium and Long Term Investigative problem solving & R&D partnership;
(d) Emphasis should be on using expertise available, rather than transfer of technologies already available;
(e) Change of Attitude necessary at both the constituents:
- Industry oriented work to be given equal recognition with academic achievements;
- Limits imposed on faculty earning through industry interactions should be removed, and the remuneration pattern of US Technology Institutes may be adopted for faculty at IIT;

(f) Interaction with academic institutions by Industry to be promoted through fiscal incentives;

(g) R&D functions of SMEs could be taken up by academic and R&D Institutes through motivation and support of government.
Mr. Sharma highlighted the functions of National Research Development Corporation (NRDC), which was the public sector company wholly dedicated to commercialising of new technologies. Mr. Sharma informed that hitherto NRDC earnings were from transfer of domestic technologies only however the new approach for NRDC envisaged atleast 50% of its earnings coming from transfer/sale of foreign technologies within the country. According to Mr. Sharma the myth that Indian technologies failed and thus the Indian industry failed was wrong; infact in the pre-liberalisation regulatory regime the over protected indigenous industry never felt the need to go in for new and more efficient improved technologies due to lack of competition. This scenario had however changed and the Indian industry was now awakening to the rising competition with the induction of foreign technologies and investments in the country. This had led to the realisation by the Indian industry that it needed induction of new technologies to be competitive and thus the role of NRDC as a technology transfer agency was now become even more important.

Mr. Sharma explained that the major objective of NRDC was the commercialisation of the laboratory knowhow by the industry, NRDC facilitated commercialisation of technologies through such measures as

A. providing technology development loans for setting up pilot plants,

B. participating in equity capital (to the extent of 50%) of new ventures set up to exploit indigenous technologies etc.

NRDC also carried out promotional activities such as awarding meritorious inventions, assisting inventors in patenting & commercialisation of their inventions etc. The changing economic and industrial scenario had necessitated a new approach for technology transfer activities to be evolved. NRDC in addition to strengthening its existing links with R&D institutions was enlarging its technology resource base.

Thus besides public funded R&D organisations which hitherto were its only source for technology acquisition, NRDC was now entering into alliances with industry & industrial R&D organisations, in private as well as public sector, Universities/ technical institutions etc. The other new initiatives launched by NRDC were carrying out of professional market surveys, preparing comprehensive knowhow documentation, feasibility/ project reports, technology evaluation reports and General Technological Consultancy Services to SMEs.
Significant assistance given by NRDC was for

a) arranging complementary financing;

b) advertising (a subsidy), product price support and export of technology.

Mr. Sharma explained NRDC's patent assistance to industry. It comprised carrying out international patent search, filing of international patents, watching for infringements etc.

Mr. Sharma then informed the diverse market surveys carried out including assessment of the size of market, determining specifications of final product required by the market, determining sale price of product which market could bear etc.

Mr. Sharma pointed out that over the eight year period 1985-86 to 1993-94 NRDC had licensed about 25 major technologies based on which project investment of the order of Rs. 1300 million had been made and projects valued at US $ 7 million exported and projects valued at US $ 17 million were under negotiations.

Concluding Mr. Sharma stated that NRDC aimed at becoming an International Technology Transfer organisation dealing with not only domestic technology and its transfer within the country but with foreign technology and its transfer within India and to other countries as well.
TECHNOLOGY TRANSFER - PHILOSOPHY, STRATEGY AND EXPERIENCE: APITCO's VIEWPOINT

S. Srinivasa Rao
Andhra Pradesh Industrial and Technical Consultancy Organization (APITCO)
Hyderabad, India

INTRODUCTION

Mr. Rao said that Andhra Pradesh Industrial and Technical Consultancy Organization Limited (APITCO) was a consultancy organization, in the public sector, promoted jointly by the national level financial institutions (IDBI, IFCI, ICICI), industry promotion organization in the State of Andhra Pradesh and commercial banks to extend industry related consultancy services, especially to the small and medium enterprises.

He said APITCO began its operations in 1976 with identification of viable investment opportunities, preparation of project reports and training of potential entrepreneurs in Andhra Pradesh. Over the years, APITCO had added to its services range, activities like counselling existing entrepreneurs on project expansion / diversification, modernization and rehabilitation, and more importantly arranging technology transfer. Lately, APITCO had also been active in the propagation of innovative rural technologies and extending "escort services" to micro enterprises. Initially, APITCO confined its operations to the State of Andhra Pradesh only. But gradually it extended its operational base to cater to the requirements of institutional and individual clients in other States as well.

APITCO's ROLE IN TECHNOLOGY TRANSFERS

Mr. Rao said in the context of technology transfer, it was important to note that APITCO was neither a vendor nor a vendee of technologies. Yet, APITCO had played an important role in technology transfers primarily as a facilitator between technology vendors and vendees. He said APITCO played a catalytic role in technology transfers and the views expressed by him on the subject were based essentially on APITCO's interactions with technology vendors and technology users.
PHILOSOPHY

Mr. Rao said that technology transfer could be defined as a process of planned and rational movement of technology from one firm to another. The basic philosophy underlying technology transfers thus related to the fact that technologies evolved and used in one part of the globe could be extended and used in other parts as well. He said technology gaps existing between the supplier and recipient acted as a motive of transfer.

He said that in the Indian context, technology transfer assumed greater importance today than ever before, in view of the opening up of the country's economy and the concerted efforts initiated towards globalisation. As such, the success or otherwise of an industrial unit, today would depend more on the technological superiority of its process/product and or services.

Mr. Rao said technology transfer manifested in skills, information and capital goods. Skills would include capabilities such as operation of the equipment, quality control and managerial capabilities. Information on the other hand would cover aspects relating to the drawings and designs, process knowhow, material specifications and the like. Finally, capital goods would include all facilities relating to the plant and machinery, instruments, devices etc. added Mr. Rao. He said APITCO's viewpoint and philosophy was that any technology under consideration for transfer must satisfy certain conditions. It should be:

- Superior, reliable and commercially viable;
- Amenable for modification/scaling down to suit local requirements;
- Suitable for product and productivity improvement;
- Energy saving and eco-friendly;
- Prone to least possible indirect/implicit costs.

STRATEGY

Mr. Rao said while deciding technology transfer strategy following parameters deserved serious consideration:

I. 'Sources for Technology': For any entrepreneur wishing to set up a manufacturing enterprise, it was necessary to know about the various alternative technologies available, understand processes involved and evaluate their relative strengths and weaknesses. It was also important, in this regard to physically inspect and study their performance at the ground level. He said as facilitator of technology transfer, APITCO collected information on available technologies from research organisation, international agencies engaged in technology transfer, as also equipment suppliers. This task was accomplished through scanning various national and international publications, participation in trade fairs and
exhibitions and also through personal interaction with experts in respective fields. The information thus generated was disseminated to intending entrepreneurs.

II. 'Choice of Technology': Often the technologies chosen were not appropriate, in that they neither ensured cost minimisation, nor did they fulfill number of objectives and satisfy a number of constraints. It was noticed that while choosing technologies, the entrepreneurs tended to overemphasise on the innovative nature of production process and ignore the equally crucial aspect of assessing the size of the market for the end product vis-a-vis the production capacity being contemplated. In such situations, the technology recipients had to face situations of huge production capacities, small domestic markets and absence of revealed competitive advantage in export markets. In certain cases, the technology vendors did promise to help market the products of the vendee in the third world markets, but usually this did not happen smoothly.

III. 'Training of Technical Personnel': In all aspects of manufacturing process including quality control, testing and vendor development played a crucial role in effective technology transfers.

IV. 'Customer and Service Support': Data such as spare parts lists, tools for installation, commissioning and maintenance etc, must be made known.

Commenting on technology from R&D institutions he said that R&D institutions in India, should be given adequate operational freedom to innovate. Likewise effort should be made to understand and assimilate imported technologies with the ultimate view of improving upon them to suit local requirements and to gain, over a period, technological leadership. However, only those technologies which enjoyed strong absorptive capacity should be contemplated for transfer.
APITCO's EXPERIENCES

Mr. Rao then dwelt on APITCO's experiences involving technology transfer which painted a mixed scenario of both achievements and failures, as below:

I. Smooth transfer of appropriate technologies was generally inhibited by the existence of knowledge gaps with regard to the sources and content of technology. This phenomenon resulted often in a situation where a vendee abruptly limited its search only to a few known sources.

II. Apart from process technology, organizational innovation would be quite essential to achieve international competitiveness by a firm. But there existed several knowledge gaps about the transfer of organizational and managerial technologies.

III. Technology transfer agreements generally favoured the vendor compared to the vendee. In his anxiety to acquire a new technology, a vendee usually was prepared for adjustments.

IV. Mutual trust, throughout the transfer and assimilation process, between the vendor and vendee was very crucial for an effective and efficient technology transfer. Often, the trust was not carried out throughout.

V. It was difficult to assess precisely the transfer capabilities of the vendor and absorption capabilities of the vendee in a technology transfer. Normally, the recipient tended to hold excessive expectations from the supplier vis-a-vis the final output derived from technology transfer. Likewise the transferor normally underestimated the recipients and tried to settle down for transferring redundant or obsolete technologies.

VI. Direct interaction with the technology suppliers would be quite necessary to evaluate their relative strengths and weaknesses. But such detailed interaction was inhibited by inadequate resources.

Mr. Rao said in the light of these experiences, APITCO insisted on devoting adequate time and resources for understanding various technologies and assessed the implications of their transfer.
TECHNOLOGY TRANSFER IN THE NUCLEAR SECTOR

H. Razdan

Bhabha Atomic Research Centre Bombay, India

INTRODUCTION

Dr. Razdan explained that the country is ranked among the top six countries in the world in the peaceful use of atomic energy. The activities at Bhabha Atomic Research Centre (BARC) were thus primarily to provide research and development support needed to sustain India's nuclear programme for power generation in relation to concepts, designs, materials, reliability and safety. As a result a versatile infrastructure of R&D facilities and highly trained scientific and technical manpower had been developed.

BARC's EFFORTS

He said that research reactors were powerful tools in carrying out basic and applied research and also used for producing radioisotopes for applications in industry, agriculture and medicine. Dr. Razdan explained that the experience gained in design, construction, operation and maintenance of the research had paved the way for developing competence and expertise for designing and operating commercial reactors for power generation.

More importantly in the area of radio isotopes BARC processed and supplied more than 70,000 consignments of different radioisotope products to over 3,000 users and institutions in the country and abroad. He said that the radiation medicine centre of BARC provided nuclear medicine services to a number of patients every year and was recognised as a Regional Reference Centre of the World Health Organisation.

BARC had also developed a wide range of radiography equipment for non-destructive testing of industrial components and structures and trained manpower in this field.

Dr. Razdan pointed out that spin off specialisation developed were in remotisation, radiation monitoring instrumentation, high vacuum technology, chemical processes and electronics etc. Thus, BARC was in a position to aid industry by transfer of some of these technologies which were useful industrially. In order to ensure that these spin offs of R&D work benefited the industry, a Technology Transfer Group had been set up to liaise with outside organizations on matters related to technology transfer. Successful examples of technology transfer were : High vacuum equipment, high efficiency filters,
space quality solar cells, low carbon speciality measuring surface area, automatic fraction collectors and equipment for osmotic dehydration of fruits etc. In addition, a large number of instruments and techniques were also offered to industry and included laser technology, spectrometry, optics, chemical analysis and electronics. Besides technologies related to nuclear power were transferred internally to industrial units under the Department of Atomic Energy.

Summing up his presentation Dr. Razdan emphasized that success of technology transfer endeavour was primarily determined by the quality of persons who were involved and associated with it. Keeping this in view BARC conducted regularly specialised training programmes in the various disciplines of nuclear science.
SESSION IV

INDUSTRY’S EXPERIENCE OF DEALING WITH TECHNOLOGY DEVELOPING/TRANSFER INSTITUTIONS

Prof. R. Theenhaus  KFA Jülich
Prof. G. Sepold  BIAS Bremen
Dr. J. Balbach  LaserProdukt Alfeld
Mr. V. Hepple  IHK Aachen
Mr. S. C. Rastogi  National Council for Cement & Building Materials (NCB), New Delhi, India
Mr. G. K. Sarin  Encon Thermal Engineers, New Delhi, India
Mr. Gautam Goel  Director, DSM Group, New Delhi
SOME IDEAS ON HOW TO OVERCOME THE WEAKNESS OF TECHNOLOGY TRANSFER

Prof. Dr.-Ing. G. Sepold
BIAS Bremen

INTRODUCTION

Technology transfer is some thousand years old. For example, this old Greek named Archimedes performed his own innovations some 2300 years ago, when the Roman fleet besieged his homestead Syracuse. Archimedes is said to have used a large curved bronze mirror focusing the light of the sun onto the sails of the fleet and set them on fire. More than 2300 years later BIAS started its work using special light which was produced by laser sources but not trying to set sales on fire but to peacefully use it for measuring and material processing applications. Some of the BIAS activities are given on overhead 1. One of the main aims of BIAS is to transfer innovations from the physical and the mechanical engineering fields into industries.

Technology transfer from universities or institutions like BIAS are suffering from a number of difficulties due to the fact that today's economical demands lead to discrepancies between science and industries, see overhead 2 and 3. There are not only demands from the side of industries but also from the side of science working in the field of applied research, see overhead 4. It is a necessary step to bring together both positions of industry and of research and find a synthesis, see overhead 5. Such a cooperation between industry and applied research was demonstrated by two examples where both partners had to cooperate. The first example is the introduction of a laser cutting machine into a shipyard environment and the second one is the introduction of a laser robot in a factory environment for laser welding of refrigerators. This work was done without any financial support of the government. Both examples demonstrate the benefits of a successful cooperation. From these experimental works BIAS derived after more than 15 years multifold experience and knowhow. From this experience a model was made for successful innovation and technology transfer.

In summary it has to be stated, that existing technology transfer models must be simplified as far as possible thus simplifying administration work and avoiding larger lacks of time. Governmental money should be only asked for in cases when the technological risks are too high. At the other side if new technology fields are so interesting that they lead to a technological leap for next generation machines; again monetary sustain is a must. As to smaller medium sized companies demonstration centers can take over some amount of technical risks demonstrating how a new technology could work and transferring knowhow to the newcomer. A very important point for future common activities will be to come together and try to streamline innovative ideas of scientific people as well as the desires of partners from industries and government. There are clear reasons for such "joint venture", because who has no wishes will neither raise hopes nor realize innovated projects.
Laser System Technology
Prof. Dr. Sepold

Laser Material Processing
Dipl.-Ing. Binroth

Laser Based Microtechnology
Prof. Dr. Metev

Quality Control
Prof. Dr. Jüptner

Coherent Optics
Dr. Hartmann

Optical 3D-Sensing
Dr. Osten

The Structure of BIAS
Difficulties for the Innovation of New Products
• Time to market must become shorter

• Demonstration of a technological process must be possible

• Competition becomes more severe
  (less new technology - fields are available)

• Mutual understanding must become more profound
• Mutual understanding must become more profound
• Stimulation for new products must come from industries
• Complete technology transfer into industries is not possible
• Work must be adequately paid
• Science is not a slave of industry
- Science and industries must be convinced that the quality of research is high and leads to synergetic effects

- Scientists have to be convinced that the free choice of their work is partly restricted dependent on economical demands

- Industry has to give up its belief that science can't keep the aims and schedules to fulfill the demands of the cooperation

- An innovation project should be installed in one region

- An exchange of people must work in both directions
Advanced Technologies Moving into Small and Medium Sized Companies

Dr. Joachim Balbach,
LaserProdukt GmbH, Alfeld

1. PREFACE

The author owning two enterprises with all in all about thirty employees, a software company and an enterprise working at laser material processings (fig. 1), reports on his experience of the transfer of new technologies especially in the field of manufacturing. The software companys' consultations and developments are related to production planning and controlling. In this field one emphasis is a so-called tool management system (fig. 2) to organize tools, machine tools, jigs, and fixtures by computer aid. Laser material processing comprises cutting, drilling, welding, marking, and surface treatment with Carbondioxide-, Neodymium-, and Excimer-Lasers. Further on consultations are made concerning investigations on material processing and economical efficiency. The creation of specialized CNC programming systems for machine tools provided with laser and courses of training are taken on. R&D activities concern for instance the reduction of air pollution due to laser material processing, the drilling and cutting of composite and ceramic materials, the ablation with excimer laser, and the hardening of small workpieces (fig. 3).

Experience on technology transfer was gained when founding these enterprises, keeping them at the state of the art and transferring technological innovations to business partners.

2. TECHNOLOGY TRANSFER BY SETTING UP ENTERPRISES

The setting up of enterprises - especially done by employees of technical universities or development departments of bigger companies - which is an essential means to manage the transfer of new technology into economy anyway in Germany. Therefore the setting up of a technology orientated enterprise is to be supported in various ways.
Technology Parks or Founder Center offer far reaching assistance and subsidies on all fields illustrated on fig. 4, at least concerning business premises, secretary, communication technology or the participation at exhibitions. Cities set up about 30 of these facilities in Lower Saxony (the Land of the Federal Republic of Germany the author comes from) and several hundred in Germany. In most cases they receive a basic financing from public recourses. The durance of new companies work in these rooms is often restricted, f.e. for 3 years. Besides cost reduction in those small companies working in these rooms arising from joint use of resources and other synergy effects, many of these facilities offer additional services, on one hand often neglected by engineers or physicists, but on the other hand very important for the companies' success and continued existence. That means support at authorities, f.e. tax office, trade association, factory safety and health control, as well as consulting in economical (choice of companies' legal form, structure of accounts department) and financing matters and matters of patent and arranging of trade area in case of moving out of the technology park.

The technology parks supply is completed by special institutions most of them with participation or in possession of the Federal Government or of the Land of the Federal Republic of Germany respectively sometimes of an organisation founded by bigger companies and banks. Additionally they take on business management advice, contacting, market research, support on development projects, and establishment on the market on the companies' founder behalf.

In addition to numerous "normal" financing programs for companies with innovativ product and processing developments venture capital is to be obtained to very special conditions. By this means the rate of capital resources and interests are reduced as long as returns are low. Though the investors' demands on his right to a say and perhaps on a part of the companies' profit are often not in accordance with the founder, although in the first years after foundation an external company controlling helps recognizing dangers early.

One main emphasis of the foundation of technology orientated companies is to put on so-called "spin-off" from technological universities, fig. 5: graduates and assistants found their own enterprises on the field of activity they passed their exam. Often connections with the university exist for a long time so that results of research influence economy and also universities hear about reaction in praxis. The author himself followed this way to self-employment in the year 1984. He worked at the Institute of Manufacturing Engineering at the University of Hannover on the same field the foundation took place. The head of the institute - he is descendid from a family of entrepreneurs by himself - enabled him to go on working half-time at the university in the first half year after company's foundation. The results of his work at the university, in particular the fundamentals of computer-software in the field of Computer Integrated Manufacturing as well as knowledge of machines and technology of cutting, drilling, welding and surface-hardening by means of laser radiation were the basis of the new companies.
3. TECHNOLOGY TRANSFER BY INNOVATION

Permanent innovation is prerequisite for the preservation of the competitiveness of technology orientated enterprises. Technology transfer agencies can help. Help the author received concerned to information, consultations, and cooperative projects, Fig. 6. Information activities the author took part are illustrated in Fig. 7. The author received consultations for instance on database and literature researches or while visiting other companies in related fields of work, Fig. 8. He got part on cooperative projects in the regional, national, and European scale, negotiated by technology transfer partners, Fig. 9.

Small and Medium Sceived Enterprises (SME) enjoy the advantage of „at hierarchy“ and less bureaucracy but the disadvantage of limited personnel and financial resources. In order to compensate there are measures on state national and EU level favouring SMEs. For instance graduates of universities so-called assistants of innovation could be engaged by SMEs with temporary limited public subsidizing salary. In the authors companies three employees have already been engaged by this support: a physicist, an engineer in the area of laser technology, and an engineer as a software specialist.

Another measure of technology transfer affects subsidy in salary the company get if a clerk, especially a scientist of the company works temporarily at a research facility of the Federal Government or of a Land of the Federal Republic of Germany, f.e. Lower Saxony, actually in the field in which the company is preparing product or processing innovation.

Many technical universities installed advice centres gathering universities and companies and contributing to the transfer of innovative developments. These centres as well as corresponding authorities, for instance innovation adviser at the chamber of industry and commerce, help the SMEs to gain experience from project restricted R&D programs in order to use them for support of product and process development as well as investment in needed devices and machines for example in the field of computer use in production, laser assisted material processing, or environmental technique.

Cooperation with universities and non-university research institutions and industrial companies in so-called cooperate projects is a big chance for technology transfer in SMEs. Installation, guidance, and care of these cooperative projects is assumed by competent and nationwide working centers of research or the centre of technology of the Society of German Engineers. The participation at a research program of the Ministry of Research and Technology in the field of computer aided production as well as at a program of the European Community in the field of security of laser material processing helped the authors' company to contribute to technology progress.

By the opportunity of cooperation or membership in public, non-university R&D institutions, for example "Laser Center Hanover", "CIM-Institut" or Microelectronic-Institut, an effective and favourable opportunity of participation at innovative events is offered to SMEs. These institutions often arise by first support of the Land of the Federal Republic of Germany, a small part by membership
subscription but after a certain time they finance themselves mainly by applied public research orders and development orders of economic enterprises. To give an example: early the author heard about a special software development at the CIM-Institute in Hannover and acquired the licence for sale and further development of this program.

By the membership various cooperations arised with the Laser Centre Hannover, f.e. Orders for the analysis of optical parts of laser installations, metallurgizal tests or rent of an excimer laser (new type of laser for purpose of material processing) that would not be economically sensible to be bought for only few material processing orders on hand.

4. TECHNOLOGY TRANSFER BY COOPERATION OF ENTERPRISES

Many technology orientated SMEs are transmitter of new technology by themselves. Often they are integrated as the leader in product and technology research by other companies. Examples are research orders for special sensors, interfaces or material processings - from the authors' field of work, for instance the laser marking of safety glass or the drilling of ceramic material by means of laser radiation or the creation of special interface-programs for relational databases - that could be worked on in a short period of time and at low costs at the SMEs.

To initiate business connections with potential clients for technical developments to write publications for professional magazines, not inevitable scientific magazines, and the active participation at seminars is very effective. In Germany there are about 15 private or institutional seminar organizer. They considerably contribute to technology transfer. Seminar events are increasingly specialized. As a result the exact target group of potential users for the offered technology can be addressed. The topic of specialist seminars - often organised as workshops and precisely referring to the users questions and problems - is for instance nc-programming of industrial robots, welding of small parts with neodymium lasers, quality assurance of software development,...

As in Germany industry locations complete concerning settlement and extension of eminent especially technology orientated enterprises, supportive institutions of the local government have been established, fig. 10. Initiatives coming from those institutions have an emphasis on the publication of product and progressive innovations. For example enterprises are invited to take part on competitions for innovative developments annually, submitted proposals are widely published, choose proposals are given an award.

In some regions also the author's place of business resident companies come together for cooperation of development, introduction and use of new technologies, fig.11: they inform themselves about innovative applications, put capacities at each other's disposal and plan common projects. Not only the new ideas, but also the problems to be expected for instance when introducing a computer based production planning and control system or an industrial robot, that are conveyed in
this way support transfer of new technologies effectively. Another result of this cooperation is for instance a database for technological services, e.g. electron-microscopy, hardness or crack tests, electro-erosive metalworking, measuring of parts at a coordinate measuring machine, transforming CAD data in other data formats. Another example concerns mutual support when realizing a quality management system that has become an important factor of competition for technological orientated companies. After the companies have met each other, thoughts of competition have disappeared and they trust each other, joint development projects of different companies working in related fields seem possible. In the author's region these stressed fields are for instance wood working and woodworking machines, environmental techniques, as well as laser processing and laser progressing machines.

That could be an alternative way instead of using technology transfer agencies. It's the direct approach to enterprises and entrepreneurs, who frequently do not accept authorities, never been in charge of a company, nevertheless telling them what to do to be successful. There is a danger indeed. At the author's place of residence several entrepreneurs founded their enterprises by the assistance of a technology center - which probably was interested in having rent all it's rooms - and went bankrupt a few years later.

Therefore technology transfer should no longer be a domaine of the government, of large companies and banks, it should integrate to a much higher extend the persons and companies concerned, their experience gained while founding their enterprises or while developing or importing new products or processings.
Advanced Technologies Moving into Small and Medium Sized Companies

by Dr. J. Balbach

LaserProdukt GmbH, Alfeld, Germany

Dr. Balbach – Consultants & Software, Alfeld, Germany

![Diagram showing Industrial Enterprises, Transfer, Research and Development cycles]

Fig. 1
### Laser Material Processing
- cutting
- drilling
- welding
- marking
- surface treatment

### Consultation
- Investigations
- economical efficiency
- advice on programming systems
- education

### Research & Development
- Investigations on
- air pollution due to laser processing
- drilling and cutting of new materials
- ablation with excimer-lasers
- hardening of small workpieces

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**Fig. 2**

### Table: Laser Material Processing (L1 & L2)

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**Fig. 3**

**Indo-German Workshop**
"Technology Transfer"
Feb.1995 New Delhi India

**Activities of**
LASERPRODUKT GMBH

J. Balbach

**Fig. 4**
| Find out your own reasons and risks of self-employment |
| Income?  |
| Realization of own ideas?  |
| Expenditure of energy, stress?  |
| Prepared to take risk?  |
| Restriction of private consumption?  |
| Qualify yourself |
| Specialized knowledge?  |
| Economical knowledge?  |
| Choose the right legal form of enterprise |
| Install bookkeeping |
| Carry out Correct registration at authorities |
| Prove your creditworthiness |
| Get hold of loan capital |

**Indo-German Workshop**  
"Technology Transfer"  
Feb, 1995 New Delhi India

**Fields of Foundation Aids**

**Fig. 4**

**Spin off**

**Indo-German Workshop**  
"Technology Transfer"  
Feb, 1995 New Delhi India

**Fig. 5**
Activities of Technology Transfer Agencies

- Information
- Consultation
- Cooperation Projects

Information Activities

- Catalogues and Publications
  - Research and cooperation opportunities
  - Possibilities in equipment and services
  - New developed equipment, processes and software

- Information Events
  - Different topics e.g.
    - Quality assurance
    - Food technology
    - Waste water treatment

- Institut Visits
  - Equipment
  - Laboratories
  - Cooperation/joint usage
  - Workshops of university and enterprise staff with special topics

- Fair Presentation
  - Presenting latest R&D highlights
  - Demonstrations to industry
  - Organisation of booth, publications, staff

Fig. 6

Fig. 7
consultation

- database and literature researches
  - literature and patent research

- company visits
  - individual consultations
  - help in finding cooperation partners
  - technology transfer colleagues

- advice on cooperation and founding sources
  - founding possibilities for university and enterprise staff

Indo-German Workshop "Technology Transfer"
Feb.1995 New Delhi India

Consultation Activities

J. Balbach

Fig. 8

cooperation projects

- projects with regional partners
  - e.g. publications
  - events

- national projects
  - e.g. technology transfer programs in Lower Saxony
  - R&D programs of the German government

- projects on European scale
  - e.g. SPRINT
  - FORCE
  - COMETT
  - EUREKA

Indo-German Workshop "Technology Transfer"
Feb.1995 New Delhi India

Activities on Cooperation Projects

J. Balbach
**Discussion Group “New Technologies in Alfeld”**

1. Together we take part at informative and educational events

   We keep ourselves informed about the latest product technologies

2. We inform ourselves about applied processing technologies

3. We offer each other technological services

4. We inform ourselves about R&D-activities

5. Together we obtain and carry on R&D- and product facilities

6. We set up R&D-cooperations (e.g. laser techniques, environmental techniques...)

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**Indo-German Workshop “Technology Transfer” Feb. 1995 New Delhi India**

**Fig. 10**

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**Indo-German Workshop “Technology Transfer” Feb. 1995 New Delhi India**

**Fig. 11**
What is it that makes some companies more successful than others? What exactly is it that makes the difference between the outstanding performance of one and the average of the other? Here, innovation is the answer to the question, and it is also the big challenge of the nineties. In a period with an ever-expanding technology and information supply and with enormous global and ecological demands, companies are forced to search for new products, processing technique and services, since the life span of products decreases as competitions and customers' demands increase.

The manufacturing industry, however, is not so much interested in one particular technology or invention. Attention is focussed on the market and on customers' demands and on how the products can best cover the needs of the customers. The general demand for, and interest in, innovation and research is, however, often overrated - the more so when all costs of an innovation project are taken into account -

- research and preliminary development: 5 to 10 per cent
- construction and product design: 10 to 20 per cent
- product preparation: 40 to 60 per cent
- production start: 5 to 15 per cent
- marketing: 10 to 25 per cent

Talking about technology transfer immediately calls to mind "technology" itself. One should, however, always be aware of the fact that developing and manufacturing attractive products is never just the combination of various novel and different technologies. In the end it is the market that decides about success or failure of innovation. Selection, conversion and application of new products have always been the sole responsibility of each company involved. Inside companies, all essential information on market, customer demands, and manufacturing etcetera must be linked. This, however, cannot be the task of an innovation or technology adviser. Advisers and advice bureaus can help companies by supplying extensive information on new technologies and the application thereof. Thus the aim of technology transfer activities is to assist companies in organising their own self-help programme.

Time and speed, of course, play an important role - as it is essential to introduce new ideas as quickly as possible into a company's production and then present the product to the market. Eventually, it is the customer who will decide on whether or not the technology transfer has been successful.
Fierce international competition and rapid progress in high technology fields also mean shorter life spans of goods. Continually, new products must be developed.

As managers concentrate on rationalisation and cost cutting, they tend to disregard excellent new ideas. In fact, they are often not so sure how to handle a most valuable asset - that is creativeness. Accordingly, a company's "imagination potential" often lies idle. Nowadays, innovations are indispensable for a company to successfully operate, and therefore any neglect of imagination can be lethal. Accordingly, "anonymous creativeness" of employess has to be identifies, estimated and then brought to action for the benefit of the company. Presumably, around 30 per cent of the staff are "creative" above average.

In particular, small companies have realised that the prime task of purchasing, manufacturing and selling can only be carried out via new technologies, in order to remain competitive - since the mass of technical information available must be taken into account. The production transfer of new technologies inside the company must be carried out quickly and effectively, in order to hold the advance position over competitors. However, where medium-sized industries cannot pay for their own R & D schemes, it is fairly difficult to determine any new technology with respect to the potential benefit to the company and/or its market.

It should not be ignored that German industries do not always fully use their innovation potential, for various reasons. A study has been made on possible critical points in technology transfer where innovation procedures have to be introduced. The following problems have been determined, namely -

- failure in procuring information
- problems in converting technical know-how into products ready for the market and/or processing
- no possibilities for innovation with products of a high level of technology
- companies of one particular industry (or suppliers, or customers) are unwilling to cooperate
- problems in engaging qualified staff for Research and Development.

Normally, innovations do not come out of the blue. Hard and long-term efforts are required to develop new products and procedures. Big companies can afford to employ capital and experts for that task. Accordingly, the development of the latest remote control wrist-watch by Junghans took nine months only, with twenty-one experts engaged and sufficient funds in the background for the tests required.

In this field, small and medium-sized companies are unable to compete. Where would the money come from? Any Deutschmark obtain through the proceeds is fed back to stand up to competition. Who then can do the task? Many firms have had to dismiss staff, on account of the long depression period. Will the
boss himself then work on innovation? As a manager, he is certainly aware of what is required on the market.

However, if small and medium-sized companies are to hold their position in the market tomorrow, they cannot but engage into innovation management like the big companies do.

The future of a company is depending on innovations, and in many firms, the head of the company himself is responsible for this. After all, the boss has been running the company right from the beginning, and he knows best which new products he may require. This ist the theory - but does the boss really find the time for engaging himself into developing new products? In small and medium-sized companies the boss has to look after everything in his daily routine and there is little or no time for extra efforts.

This is the reason for German medium-sized companies for often being extremely reluctant in investing into developments for new technologies. Accordingly, it is essential to introduce a systematic innovation management into those firms, for

- the procurement and assessment of innovation ideas from the staff
- the procurement of information on new developments suitable for the firm's own products
- follow-up of competitors' activities
- estimation of cost.

Following is a check-list for diversification planning projects:

1. Will the product envisaged fit into the targets of the company?
2. Will the product envisaged well fit into the company structure?
3. Are R & D expenses relatively low?
4. Are competitors not yet in possession of the relevant patent/licensee rights?
5. Will there be relatively little time required for R & D?
6. Can a company of our size manufacture the product envisaged?
7. Will the product well fit into our manufacturing scheme?
8. Will the company have to engage substantially more staff?
9. Will it be possible to manufacture the product in small series?
10. Will it be possible to purchase those products which are necessary for manufacturing the new items, but cannot be procured from inside the company or are too costly to make?
11. Will regular customers buy the new product?
12. Are those regular customers also solvent customers?
13. Is there a fairly regular demand for the new product?
14. Is the competitive situation for our company?
15. Will the new product have favourable impacts on the other articles of our range?
16. Are the essential advantages of our new product over those of our competitors?
17. Is the market for the new product expanding?
18. Will the life span (life cycle) of the new product be long?
19. Will estimated development cost be lower than 3 per cent of the turnover?
20. Will the estimated annual turnover be more than 10 million Deutschmarks (after three years)?
21. Will the annual turnover expected for the first three years regularly be double every following year?
22. Is the break-even point expected to be reached in the introductory phase?
23. Are the financial means expected to be sufficient for the new project?
24. Will advertising expenses be relatively high?

With the above arguments in mind, the company will be in a position to determine which services by external experts are to be employed without a R & D scheme of their own, for effectively participating in development progress.

The Aachen region is offering a dense network of transfer institutions, innovation advice and counselling bureaus all aimed at assisting entrepreneurs who wish to enforce innovation programmes through new technologies.

There is, for instance, the Aachen Chamber of Commerce Innovation bureau where information can be obtained, contacts for cooperation set up and possible financial aid can be discussed. Another such bureau, acting on similar lines, is the Technology Transfer Bureau run by the Technical University of Aachen, and the Transfer Office of the Technical College who, in a way, ensure the marketing of research demands in many different fields. Also, the Technology Transfer Office of the Jülich Nuclear Research Centre offers a wide range of functions, meetings, visits to particular Institutes and individual counselling.

In connection with growth and key industries, more than one department of science may have to be considered as new projects are planned. Various special fields of engineering and technology will increasingly be involved. There is a wide range of research institutes, organisations, specialised working groups focussed on one or the other particular problem, associations of prominent researchers, brains trusts and managers' associations who all cover the activities of technology transfer.

Some industries place specific orders for research on a particular project direct with Universities and research institutes. These projects are often very well paid ("third-party funds"). In particular some applied research projects at Technical Universities covering all fields of engineering and at Institutes related to these Universities are of interest to the Industry. Accordingly, the Aachen University's funds for such activities amount to more than 190 million Deutschmarks coming every year from the various industries but also from the Ministry of Research, the Association of industrial research groups, etcetera.
Since private institutions on the one hand and University institutes cooperate in many fields, all these efforts are effectively combine to assist the industrial customers. All those institutes may intervene at the university when, for instance, research staff feel unable to continue, and, on the other hand, the research and development programme should be further extended for practical application within the firm. Normally Technical Universities and Colleges do not focus their research programme on products ready for the market, even if such research programmes are initially financed by the industry. Therefore the partner outside the University will have to turn research results into such marketable products which may have to be further developed before they can actually be sold. The firm only will be in a position to ensure the right marketing of the final products and then also bear warranty and liability for these.

As some companies pass their request for a particular thesis to the University on subjects related to industrial requirements the management often make use of an interesting know-how transfer. The interest here is focussed on two different targets, depending on the size of the company involved that is -

- Small and medium-sized companies are in general interested in solving particular problems. In such cases graduates' theses are an excellent means of technology transfer.
- Larger companies, however, often place their orders for a thesis in such a way that research can be made within the company with the possibility then of recruiting potential staff. In that case, the solution of particular problems is of secondary importance.

Apart from the technological component of such transfer companies are also interested in improving the qualifications of their staff. Advanced technologies will be applicable only if all employees are still better trained and qualified. Some firms offer training and further education on their premises. However there are now schemes to provide the transfer of personnel from the University to the Industry ("Innovation Assistant") and, vice versa, from a company to a University for a limited period ("Research Cooperation").

However, the problem lies with the transfer of ideas and technologies from a particular laboratory to a pilot project and then to the firm's prototype. Critical stages are the decisions to be made when a particular product is passing from the laboratory to the pilot project, prototype, manufacturing - at this point, market assessment and market developments have to be determined.

As we have seen there are manifold possibilities of technology transfer with external experts furnishing advice and development companies designed to assist medium-sized companies. However, those companies seeking help must be prepared to accept innovation and advice from outside, permit members of their staff to develop new projects or request prototypes to be set up by suppliers coming from University institutes. It is vital to companies to apply new ideas and processes to their products with the help of experts from outside and thus obtain a high degree of competitiveness in the international and global
markets. Cooperation contacts have been made to assist managers in this respect.

There are some remarkable examples of successful technology transfer through close cooperation among University institutes and the industries around them.

- The construction of hydraulically adjustable shields for pits has been facilitated and the stability of the product increased by applying laser-welding procedures.
- A manufacturer of tablet packaging has been able to solve the problem of separating the two components - plastics and aluminium foil - with the help of the University. Now both components can be recycled separately.
- A newly-founded metrology company operating in the field of plastics (that is a non-University group) is assisting a large CD-manufacturing company in reducing waste out of a complex production process from more than 50 to under 10 per cent.
- A manufacturer of industrial weighing equipment is calling for advice from the Plastics Department of the University, on how the metal components of their equipment (originally up to 90 per cent) could be replaced by more plastic components, thus reducing the manufacturing cost. The integration of plastic materials into such high-precision items has never been attempted before.
- A company manufacturing cardboard articles complains about a machine showing problems in operation. The supplier argues that such problems are the fault of the manufacturer. With the help of the Machine Tool Institute of the University the fault can be identified and an acceptable solution proposed to both the supplier and to the customer.
- A manufacturer of inflatable lifting pads is interested in using plastic stiffening rather than steel wire. Again the Plastics Department of the University carries out studies on a possible innovative change of the product and also carries out comparison tests.

In the field of project-oriented technology transfer the "AGIT" (Aachen Company for Innovation and Technology Transfer) has played a prominent role. It links institutions of the University (the technology-supplier side) with with industries (technology-receiver side). AGIT is compiling a cooperation pool with the government of North Rhine-Westphalia providing financial support to promote advanced product and manufacturing procedures from the University to be fed into Industry. Each member company of such a pool thus pays for only part of the whole project costs but in turn is entitled to receive full how information via special training schemes. As prototypes out of such programmes coming from the University have to be turned into a product ready for manufacturing, regional partners for development and supervising are engaged, in most cases engineers.

The following example will help to illustrate this concept. The overall cost of a particular project is assessed to amount to 500,000 Deutschmarks. The Land
North Rhine-Westphalia operates a special promotion fund for technology projects and from this fund, 50 per cent of the costs are paid by the Land, that is 250,000 Deutschmarks. Member companies will have to bear the same amount. Now if ten firms participate in this project each of them will have to pay a share of only 25,000 Deutschmarks although they all benefit from this 500,000 Deutschmarks worth project. The funds go to a large extent to the technology supplier and the intermediate engineering bureau (as outlined above) and a fixed part is passed on to AGIT to pay for their services of establishing contacts and acquisition expenses. In this way a wide range of projects totalling more than 30 million Deutschmarks have been carried out.

Most of these projects have been realised following offers from the University institutes. Such solutions to particular problems are offered to companies that may be interested in using them. Often these propositions do not necessarily meet the present requirements of the industry.

It will be the aim of future initiatives to assess industrial requirements and feed those back towards the University for further research.
INTRODUCTION

Mr. Rastogi explained that in India building materials accounted for two-thirds of the construction cost of a dwelling unit and the country would need 40 million new dwelling units by 2000. There would thus be shortage of all building materials in future. He emphasised that it had become necessary to use new and local building materials to meet the expected shortages and rising demand, e.g. agrowastes, flyash, wood substitutes etc. The availability of flyash from the thermal power stations was over 25 million tonne per year and it was an environmentally hazardous material. To promote its use in building materials government had exempted the building materials with fly ash content of 25% or more from excise duty (local taxes). He thus felt that the building materials of tomorrow were mud, flyash bricks, concrete hollow blocks and corrosion resistant steel. Mr. Rastogi pointed out that there were no standards for such new building materials and there were also no testing facilities for them thus constraining their wider acceptability and use.

NBC's EFFORTS

Mr. Rastogi then dwelt upon the contributions of National Council for Cement and Building Materials (NCB), which was a cooperative effort of the cement industry and the Ministry of Industry, Government of India. NCB had over the years developed through intensive R&D effort and consultations adequate national competencies in cement, building materials such as lime and asbestos and allied industries thereby providing an increasingly better technology support to these industries. It had set up a good system for disseminating the R&D output to diverse sections. NCB had over the years completed more than 900 technology oriented projects of which 700 projects were sponsored by users/industries. NCB had established alliances with a number of reputed organizations and engineering consultancy agencies to enlarge on its expertise and knowledge base for catering to a wider and newer client base.

He specially mentioned NCB’s Diagnostic Services for Concrete and Construction Industries that had been attracting innumerable clients with enquiries ranging from dams, bridges, pavements, industrial structures,
housing complexes to estimation of damages due to accidental fire and choice of suitable aggregate of cement etc. Advise and assistance rendered by NCB had not only resulted in enhancing durability and safety of the structures but also in winning the confidence and trusts of its clients. And more over the work had imparted NCB with a better understanding of troubleshooting in concrete constructions he added.

Mr. Rastogi said NCB had been also involved in non destructive evaluation of concrete structures for the assessment of quality of in-situ concrete. NCB had diagnosed for the first time in the country occurrence of alkali - silica reaction as the cause of distress in two major hydraulic structures. As a consequence of which, a number of project authorities had been particularly emphasizing the evaluation of concrete aggregates and their compatibility with the cement systems for alkali-aggregate reactivity considerations. The other services provided by NCB were in the areas of productivity enhancement, process optimization and trouble shooting, plant maintenance, energy conservation and environmental improvement.

Summing up Mr. Rastogi emphasised that close interaction and working on live problems of clients had provided them the insight and knowledge to undertake and takeup appropriate R&D programmes that were useful and acceptable. This in turn had improved their contacts and credibility with the industry leading to high success rate in transferring of knowledge/technology.
INTRODUCTION

Mr. Sarin pointed out that the commercial energy usage had been increasing rapidly in India and projected energy demand for the year 2000 was of the order of 450 million tonnes of coal, 95 million tonnes of oil and 645 billion units of electricity against the present level of 200 million tonnes of coal, 32 million tonnes of oil and 220 billion units of electricity. He said increasing demand of commercial energy had lead to wide spread energy shortage and thus hampered the industrial growth and production. Mr. Sarin explained that energy availability from commercial sources was also getting more and more expensive at the micro level and it was becoming practically non available at the micro level. In this regard the importance and need for energy conservation could not be minimised. But for industries to invest in an energy efficient or energy conserving technology the yield or benefit to them, either in the form of direct financial return or as protection against supply cut offs (fuel switching) had to be attractive and appealing.

ENERGY CONSERVATION

Mr. Sarin then went on to explain various factors that hampered the acceptance of energy conservation as a viable solution in the Indian context viz. administered pricing, subsidies, inefficient operation of plants and facilities; low electricity rates, etc. Also till recently in a supply scarce market, it was considered prudent and beneficial to invest in increasing production than to invest to conserve energy usage and; energy prices which formed one small component of the value addition to the product were simply passed on to the unsuspecting consumers and this did not augur well for energy conservation measures. But more recently energy conservation was coming in its own and a more mature view was being taken about the need to conserve scarce and expensive commercial energy due to the ever increasing cost and the scarcity looming over the horizon.

Mr. Sarin pointed out that in India about 55 percent of total commercial energy was utilised by the industrial sector and major portion of it was consumed by the energy intensive industries. He explained that conservation was a systematic, scientific analysis of existing processes and it was generally possible to save 30-50 percent of the energy in a large number of industries by putting in place proper techniques/technologies of which 10-15 percent could
be saved by employing simple housekeeping measures with very little investment and another 15 percent by application of known and accepted technologies with viable investments. He explained that some new technologies considerably reduced the energy cost, e.g., there was ample scope for conserving electrical energy by using high efficiency fans, motors, grinders, pulverisers, material handling systems, etc., and soft start motors that consumed less energy when there was no or low load.

He especially emphasized the need for energy conservation in small scale industry sector as it could contribute significantly for profitable operation through cost savings; enhanced production and; extended production in times of power scarcity. He said to initiate energy conservation process an audit of usage of energy in the unit was necessary. The unit was divided into smaller segments called islands and for each island the energy input component was worked out. The utilisation of energy and wasted energy then tabulated to account for the entire energy input. Mr. Sarin pointed out that simple measuring tools, instruments were generally sufficient for conducting such audits namely thermocouples, oxygen analyzers, electrical load managers, manometers, flow measuring pilot tubes, etc. When the results of the energy audit were available a thorough analysis should be done to reduce the cost of energy. The possible methods were finding alternate cheaper energy sources like using oil or coal instead of electricity for heating applications, using low cost biomass like rice husk, saw dust, bagasse, cashew shells, etc. instead of costly fuels like oil or coal and wastage of energy could be avoided by providing better insulation, example by covering the vessels, etc. If the wastage of energy was inevitable then the waste heat recovery systems could be thought of.

Mr. Sarin said that considerable R&D expertise in diverse areas existed in CSIR laboratories and these laboratories had also developed various techniques/technologies and devices which helped in energy conservation in industries. He pointed out that his firm had successfully commercialized the technology of 'Low Air Pressure' (LAP) film burner developed by the Indian Institute of Petroleum (IIP), a constituent laboratory of CSIR. He pointed out that LAP burners were most commonly used in small industrial furnaces in India, and such burners consumed about 30 percent of the oil used in the industries. The design of these burners was highly dependent on quantity of atomising air. The IIP burner provided fuel saving of the order of 6-30% in case of oil and 20% if the natural gas was used as fuel. It could handle preheated air up to 350°C without any problem of oil cracking and also reduced sulphur corrosion due to lesser formation of sulphur trioxide. Mr. Sarin said a number of Indian units had replaced their old burners with the energy efficient LAP burners. However, his firm had to demonstrate and convince the industry initially of the advantage of these burners.

Summing up his presentation Mr. Sarin said energy conservation was the need of the hour and industry had to opt techniques/technologies for energy conservation keeping in view their specific requirements.
INTRODUCTION

Mr. Goel introduced the DSM Group, which he said had a large sugar and chemical complex and it had diverse manufacturing facilities which are listed in table 1.

Mr. Goel said that apart from the manufacturing facilities, DSM had a good Research and Development unit well equipped with analytical facilities, a strong Design Engineering Group, a Biotechnology Research Centre, a well-equipped Fabrication shop and a Construction Task Force. DSM had been known for its innovative character and had often interacted with the laboratories under the Council of Scientific and Industrial Research and also with Consulting Engineering Firms in its search for innovations and inventions. In this process DSM had also sponsored Research Programmes at these Laboratories with both success and failure case-histories. He said that DSM had developed the technologies picked up from the laboratories and successfully productionised them and then offered the developed package with the manufacturing in-house expertise for licensing on a turnkey basis.

PROCESS OF INVENTION

Mr. Goel said that what was possibly not readily recognised was that the process of invention was only a small part of the total endeavour leading to a business or commercial success. If the total invention phase consumed one unit of effort (research, development and prototype demonstration), the phases that followed (engineering design, production technology and management, quality control, marketing, servicing etc.) would certainly consume five units and possibly as many as ten. This was a factor so often overlooked by the enthusiastic inventor, who believed that when he had successfully demonstrated his brainchild on the laboratory bench, the door to success and fortune had been opened.
He said that those who pledged their money to the exploitation of technological invention exposed themselves to a two fold risk. Not only were there the normal business hazards - the whims of the market place and the costs of borrowed money but also the technological risks such as the problems of scaling the laboratory development unto its full working size? Would materials problems emerge owing to corrosion, fatigue and creep? Would the apparent market advantage be eroded as the technological problems emerged and were mastered, and would the product be rapidly superseded by a competitive version within a short time?

Mr. Goel said that these accumulated uncertainties could frequently be daunting, particularly if there were less complex and risking options available to those who specialised in providing risk capital.

**DSM's EXPERIENCE**

Mr. Goel said that in particular, among the National Laboratories, DSM had worked with the National Chemical Laboratory, Pune; the Indian Institute of Chemical Technology, Hyderabad; the Central Fuel Research Institute, Dhanbad; the Department of Atomic Energy and the Indian Institutes of Technology at Delhi and Madras.

He said that DSM were the first to seek technology developed by the National Chemical Laboratory, Pune for the continuous fermentation of molasses by the Encillium process. DSM picked up the process at the bench scale level of development; but in large-scale fermentation trials at the factory it was found that the yeast strain was temperamentally sensitive to the type and to source. Also the environment too turned out to be an extremely sensitive factor, as the yeast strain was sensitive to bacterial infection. He said that innovation at the plant level were required to overcome these problems. DSM based on its learning experience offered to other alcohol producers, turn-key plant and equipment, with process guarantees in collaboration with the National Chemical Laboratory, Pune and a Consulting Engineering Firm, Chemec, Madras.

Mr. Goel then described their association with the Department of Atomic Energy (DAE) and said that DSM had obtained a licence from BARC of DAE for a process for hydrolysing sugar to glucose and fructose through use of a specific variety of yeast. The resulting high fructose syrup had a sweetening value much higher than sugar syrup as the fructose was not crystallised readily. This could find use in food processing and pharmaceutical industries. DSM Group had scaled up this technology from BARC at bench level and brought it up to the production stage. Subsequently it was making available the proven technology to others in collaboration with NRDC.
Mr. Goel said DSM had some unsuccessful case studies as well. DSM had sponsored a project at the National Chemical Laboratory for the production of Acrolein and Acrylic acid from alcohol via acetaldehyde, using a novel molecular sieve catalyst. The technology could not be commercialised by DSM for two reasons: Firstly, the work although highly successful as regards conversion had not looked at the separation aspects, where the required product had to be separated from the unreacted components; Secondly, the rights for manufacturing the catalyst had been assigned to a third party firm which quoted very high price for it, thus virtually blocking further investment in commercialisation by the process user.

Mr. Goel said the second unsuccessful case was that of another sponsored project, the conversion of ethyl alcohol to Ethylene however DSM had to wind up the project due to the upswing in prices of molasses and thus in the production of alcohol. The price advantage which alcohol had earlier enjoyed disappeared with policy changes in the pricing of molasses, and this was an example of the facility of planning projects when they were vulnerable to state intervention and administered prices, he explained.

Mr. Goel pointed out that more recently DSM had taken up programmes for joint development of technologies with some laboratories for ultimate licensing to others for "common good". This concept of developing a "basket" of closely related technologies was a novel one in the Indian scenario. Mr. Goel said that the lessons to be learnt from the DSM experience were that it was important to sustain joint developmental programmes between the R&D Institutes and Industry to obtain marketable technology packages. DSM had thus put in place the "consortia" concept, wherein along with Consulting and Design Engineering Firms, Fabrication Industry, complete technology packages could be offered on a turn-key basis with built in performance guarantees.

DSM had also developed mechanisms for building up a "brain bank" for problem solving through continued interaction on a consultancy basis with the Indian Institutes of Technology, he explained. DSM had a record of in-house development in sugar processing, effluent treatment and especially in biotechnology leading to superior varieties of sugarcane plants. The DSM Greens was a Centre for Research and Dissemination of newer plant varieties through tissue culture. For this activity, DSM had developed strong ties with the G.B. Pant Agricultural University, where it had sponsored several research programmes. DSM had also entered the field of medicinal plants, horticulture and floriculture, and found superior methods of genetic expression and clone propagation.
CONCLUSION

Concluding his presentation, Mr. Goel said that it was clear from DSM experience that newer synergies were created when Industry and Research Institutions interacted. Industry had enough resilience to support development of technology, and sustain its accelerated growth. Mechanisms for strengthening this interaction could be based on a concept of joint-marketing rights. DSM had made proposals to CSIR in this regard, and these were now to be tried out.

Table 1: Manufacturing Facilities of DSM Group

<table>
<thead>
<tr>
<th>Unit</th>
<th>Capacity</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dhampur Sugar Mills Ltd</td>
<td>10,000 TCD</td>
<td>Sugar</td>
</tr>
<tr>
<td>Mansurpur Sugar Mills Ltd</td>
<td>4,000 TCD</td>
<td>Sugar</td>
</tr>
<tr>
<td>Vashulinga Sugar</td>
<td>1500-2000 TCD</td>
<td>Sugar</td>
</tr>
<tr>
<td>DSM Sugar (Kashipur) Ltd.</td>
<td>3,200 TCD</td>
<td>Sugar</td>
</tr>
<tr>
<td>DSM Sugar, Barabanki</td>
<td>2,500 TCD</td>
<td>Sugar</td>
</tr>
<tr>
<td>DSM Sugar, Asmoli</td>
<td>2,500 TCD</td>
<td>Sugar</td>
</tr>
<tr>
<td>DSM Chemicals</td>
<td>70 KLD</td>
<td>Alcohol</td>
</tr>
<tr>
<td></td>
<td>40 MT/D</td>
<td>Alcohol + Acetic acid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ Acetic anhydride</td>
</tr>
<tr>
<td>DSM Papers</td>
<td>30 TPD</td>
<td>Writing paper</td>
</tr>
<tr>
<td>DSM Board</td>
<td>10,200 CU.MT</td>
<td>Particle Board</td>
</tr>
<tr>
<td>U.P. Straw &amp; Agro Products Ltd</td>
<td>50 TPD</td>
<td>Kraft paper</td>
</tr>
<tr>
<td>DSM Greens</td>
<td>3 Mln.biotech plantlets</td>
<td>Tissue cultured/Plantlets</td>
</tr>
<tr>
<td>Dhampur Invertos Ltd</td>
<td>10 TPD</td>
<td>Invert Sugar</td>
</tr>
<tr>
<td>Hitech Aluminium</td>
<td>20,000 Sq.m/A.</td>
<td>Aluminium Products</td>
</tr>
</tbody>
</table>
CONCLUDING PANEL DISCUSSIONS

Friday, 10th February, 1995

TECHNOLOGY TRANSFER ALLIANCES

ROLE OF BILATERAL AND MULTILATERAL CO-OPERATION
Dr. J. Bischoff initiated the discussion and emphasized that intra-regional and inter-regional technology flows had become an important factor in the economic development of nations due to the growing interdependence of production structures and increasing openness of the economies. Complementarities resulting from the differences in the levels of technological development had provided impetus to momentum for intra and inter regional technology flows. Dr. Bischoff cited the growth in Indo-German trade as a factor that had brought the two countries closer; Germany contributed around 8% of India's imports and was India's most favoured partner.

Prof. Sepold indicated that technology transfer efforts and instruments in India appeared to be in the required format and deserved appreciation, especially the models described by Prof. Dhananjaya and Mr. Goel. He said SMEs needed quick money; mechanisms should be worked out to make available such finance to them. Prof. Sepold then emphasized that even transfer of in-house technology within the firm itself required attention and care.

Mr. Back expressed his surprise at the diverse methods and instruments of technology transfer practiced in India. He felt that both Germany and India could learn a lot from each others structures for technology transfer. The workshop had provided the requisite opportunity to share such experiences and to work out broadly the areas of cooperation.

Dr. Peters said that an interesting system of technology transfer prevailed in India which had some similarity to Germany but cautioned on the danger of
duplicating these efforts/systems in India. Germany and India differed in their economic, industrial and financial systems: Germany was a differentiated system; while India was now opening up. But the common feature in both the systems was the rising demand for new and cost effective technologies; the effort should be to see how this could be satiated.

Dr. Joshi emphasised the need of appropriate technology for SMEs. He said studies should be taken up to find out the bottlenecks in the development of SMI sector and the hurdles and problems should be overcome through proper solutions. He was quite impressed with the German Technology Innovation/Advisory Institutes which had: Regional/Local reach, variety of structures with no central umbrella institutions; small size; large numbers that were bordering on 'over-kill.' He said some key areas should be identified where technology transfer could be facilitated between the two countries. He proposed that around 30 CSIR personnel could be sent to Germany at different times and different institutions to learn from the experience of the German system.

Dr. Juneja recalled that NSIC’s first prototype development centre was setup with the assistance of Germany. He said in India impetus of modernization was building up with the opening of economy. The new trend was that young entrepreneurs were looking for new technologies and he emphasised that their demand should be met. He said NSIC had organised a series of eight workshops in association with CSIR and APCIT to assist SMEs in technology modernization and acquisition. In these workshops 3000 entrepreneurs were exposed to newer technologies. In recognition of the enthusiastic support NSIC was setting up a technology transfer centre at Delhi and sought Germany’s cooperation in establishing it.

Dr. Juneja felt that there were many opportunities in technology sharing between India and Germany and areas should be identified for it. A promising emerging trend was that people were now willing to set up joint ventures.

Mr. Advani explained the activities of ICICI which was a development bank and had association with KFW of Germany. He said that the bank had till date financed 800 Indo-German collaborative projects and had 10 programmes in hand. Mr. Advani said ICICI had a expeditious mechanism for clearing the projects rate. ICICI offered a conditional loan for developing technology; firms were required to repay the loan when they commercialised the technology; but in case the technology failed the loan was written off.

Mr. Rajan said that the workshop was timely and it had been possible to cover diverse topics of mutual interest. He pointed out that till recently there was absence of domestic and international competition but the scenario was fast
changing now. He also highlighted the local technology development trends and the close interaction and information flow between the various sides.

**Dr. Engelmann** emphasized on the many similarities and differences between Indian & German systems. He said in Germany foreign technology transfer played minor role; 2/3 of R&D expenditure was contributed by the industry and spent in the industry; Govt. contributed only for long term research which was beneficial to society. German companies depended basically on innovation which aspect he felt was lacking in India. Dr. Engelmann felt that the workshop had played a catalytic role as a clear picture had emerged of both the systems now and perhaps more closer interaction could materialise in future.

**Dr. Rama Rao** said that the workshop had lead to opening of many windows, through personal contacts, and he hoped that these would lead to valuable intangible benefits. He said it was important to differentiate between techniques and technology. When people went for import of technology they ultimately lead to import of simple techniques and he suggested that a systematic study on technology transferred through import of technology to be taken up and stressed for creation of a matrix of technology transfer models. He said that technology development was a group effort and adequate rewards should be built in for recognising the group activity. Dr. Rama Rao felt that there were many things in technology transfer that could be incorporated into the Indian system based on German experience and studies.

The panel discussion culminated in the adoption of recommendations as follows:

I. **Exchange of Information on a periodic, regular and systematic basis for:**
   A. technology, especially suited to SMEs, required and available in the two countries and
   B. technology transfer institutions including their fields and region of operation.

II. **Explore the net-working of selected TTIs in India and Germany.**

III. **Placement of personnel for extended period of time in the Technology Transfer Institutions with a view to study the TT practices, protocols and procedures.** CSIR requested for placement of around 30 interns, from its establishments, at selected TTIs in Germany for a period of around three months each.

IV. **Undertake joint studies, with appropriate support, on Technology Transfer inter alia for**
A. the factors and causes for successes/failures of Technology Transfer from German industry to Indian units and

B. bench-marking the successful technology transfer practices & mechanisms of TTIs in Germany and India.

V. Facilitate the visit and interaction of groups of entrepreneurs/industrialists in SMEs to manufacturing units/technology transfer institutions of relevance in each others countries.

VI. Foster cooperation between relevant institutions in the two countries for promoting environment friendly and internationally acceptable technologies and products and for undertaking hazards & risk analysis arising from industrial activities.

VII. Identify collaborating institutions and follow-up for funding on the joint project already initiated on `Laser Assisted Surface Technologies' between BIAS in Germany and India.

VIII. Organize a follow-up workshop in Germany to strengthen technology transfer in general and in specific niche areas between the two countries.
PRESSEERKLÄRUNG

-ÜBERSETZUNG-

EIN MEILENSTEIN IN DER UMFASSENDEN DEUTSCH-INDISCHEN ZUSAMMENARBEIT IN WISSENSCHAFT UND TECHNOLOGIE
Presseerklärung
-Übersetzung-

Deutsch-Indischer Workshop zu Technologie-Transfer und Technologie-Entwicklung

Ein Meilenstein in der umfassenden deutsch-indischen Zusammenarbeit in Wissenschaft und Technologie

Am 10.02.1995 endete in Neu Delhi ein viertägiger deutsch-indischer Workshop zu Technologie-Transfer und Technologie-Entwicklung. Der Workshop war eröffnet worden durch Dr. S. Z. Qasim, für Fragen der Wissenschaft zuständiges Mitglied der indischen Planungskommission. Der Workshop umfaßte Vorträge von hochrangigen und sachkundigen Teilnehmern aus beiden Ländern, u. a. Ministerialdirigent Knoerich, Bundesministerium für Bildung, Wissenschaft, Forschung und Technologie (BMBF), Dr. P. Rama Rao, Leiter des indischen Department for Science and Technology und des Department for Ocean Development, Dr. S. K. Joshi, Leiter des Department of Scientific and Industrial Research und Generaldirektor des Council of Scientific and Industrial Research, Mr. Y. S. Rajan, Berater des Department for Science and Technology, Dr. P. Engelmann, Koordinator des BMBF für die deutsch-indische Zusammenarbeit, Prof. Theenhaus, KFA Jülich, Dr. J. Bischoff, Leiter des Asian-Pacific Centre for Technology Transfer, Dr. W. Badziong, Forschungsleiter von Hoechst India, und Dr. Huttel, Siemens India. Darüberhinaus haben ca. 60 weitere Delegierte aus der Regierung, der Industrie sowie aus Forschungs- und Technologietransfer-Einrichtungen teilgenommen bzw. mitgewirkt.

Der Workshop diskutierte Wirkungsweisen, Werkzeuge und organisatorische Möglichkeiten, um Innovationen in wirtschaftliche Anwendungen umzusetzen, insbesondere bei den kleinen und mittelständischen Unternehmen, die in Deutschland wie in Indien ein wichtiger Faktor technischer Erneuerung sind. Erörtert wurden die jeweiligen Verfahren und Strategien, um daraus angemessene, praktisch anwendbare Modelle abzuleiten.


Der Workshop ermöglichte gleichzeitig die Anbahnung vielversprechender bilateraler Kooperationen, z. B. eine Zusammenarbeit in der Materialbearbeitung und bei der Entwicklung technischer Richtlinien nach deutschem Vorbild.
PRESS RELEASE

AN IMPORTANT MILESTONE IN THE STRONG INDO-GERMAN COOPERATION IN SCIENCE AND TECHNOLOGY
Press-Release

INDO-GERMAN WORKSHOP
ON
TECHNOLOGY DEVELOPMENT & TRANSFER
AN IMPORTANT MILESTONE IN THE STRONG INDO-GERMAN
COOPERATION IN SCIENCE AND TECHNOLOGY

A four-day Indo-German Workshop on Technology Development and Transfer inaugurated by Dr. S.Z. Qasim, member (Science), Planning Commission, concluded here on February 10, 1995. Among the distinguished participants who addressed the Workshop included

- Mr. V. F. Knoerich, Deputy Director General, German Federal Ministry of Education, Science, Research and Technology (BMBF).
- Dr. P. Rama Rao, Secretary, Department of Science and Technology & Department of Ocean Development,
- Dr. S. K. Joshi, Secretary, Department of Scientific and Industrial Research & D. G., CSIR,
- Mr. Y. S. Rajan, Executive Director, TIFAC.
- Dr. P. Engelmann, Coordinator Indo-German Cooperation, BMBF,
- Prof. Theenhaus, Board Member, KFA Jülich,
- Dr. Jürgen Bischoff, Director Asian Pacific Centre for Technology Transfer,
- Dr. Huttel, Executive Director, Siemens A.G.,
- Dr Werner Badziong, Research Director, Hoechst,

besides 60 high level participants from Government, Industry, Research and Technology Transfer Institutions.

The Workshop discussed the mechanism, modalities, instruments and organisational set-ups for facilitating the commercialisation of innovation specially in the small and medium enterprises. The best practices and
successful organisation strategies were discussed to derive therefrom appropriate and applicable models.

The Workshop recommended that both the countries would exchange information on technology transfer institutions including their fields of operation and outstanding features; technologies available and required; and exchange of personnel for strengthening the technology transfer mechanism.

Positive factors for research and technology development by the German enterprises in India emanating out of highly qualified S & T-personnel, well developed R & D systems and tax advantages were taken note of. The question of Intellectual Property Regime, which would strengthen technology transfer and the R & D/Technology base in India were also discussed.

The Workshop also enabled the preparation of fruitful bilateral cooperations including a cooperation in Physics based Technologies and the information of technical guidelines...
Joint German-Indonesian Seminar on R&D Activities using the MPR-30  
Jakarta, August 19-21, 1985  
GERMAN-INDONESIAN COOPERATION  
ISBN 3-89336-011-5

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GERMAN-INDONESIAN COOPERATION  
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VIIth German-Yugoslav Meeting on Materials Science and Development  
Ceramics and Metals  
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GERMAN-YUGOSLAV COOPERATION  
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