BENCHMARKING CONTRACT RESEARCH ORGANIZATIONS

A comparative analysis of:

CSIRO, Australia
DPI, The Netherlands
Fraunhofer Gesellschaft Germany
IMEC, Belgium
Joanneum Research, Austria
SINTEF, Norway
TNO, The Netherlands
VTT, Finland

Report Prepared for:
DGIST Korea

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Table of contents

I. Introduction .................................................................................................................................. 3

II: Comparative analysis ............................................................................................................... 5
   1. General information about the organizations.......................................................................... 5
   2. Governance ............................................................................................................................... 5
   3. Research policies and strategies............................................................................................... 7
   4. Organization and structure........................................................................................................ 9
   5. Research funding and financial management .......................................................................... 10
   6. Human resources......................................................................................................................... 12
   7. Management of organizational assets...................................................................................... 13
   8. Management of programs and projects.................................................................................... 15
   9. Partnerships and networking...................................................................................................... 16
  10. Evaluation and impact assessment............................................................................................. 19
  11. Renewal and learning................................................................................................................ 20

III: RTO Case Studies .................................................................................................................... 23
   1. CSIRO - Australia...................................................................................................................... 23
   2. Dutch Polymer Institute and Leading Technological Institutes.............................................. 33
   3. Fraunhofer Gesellschaft - Germany.......................................................................................... 41
   4. IMEC-Belgium ......................................................................................................................... 50
   5. Joanneum Research: Austria..................................................................................................... 58
   6. SINTEF- Norway....................................................................................................................... 64
   7. TNO – The Netherlands............................................................................................................. 69
   8. VTT - Finland............................................................................................................................. 76
I. Introduction

TNO is undertaking a benchmark study of Research and Technology Organizations with the objective to derive best practice lessons for DGIST. The assessment is based on performance indicators and best practice information from a number of leading science and technology institutes worldwide. The framework presented below is a checklist based on key organizational performance indicators proposed by several authors (Schumann, Szakony, Norton and Kaplan, RECORD, Peterson).

1. General information about the organization

2. Institute governance (H)
   - Mission/Mandate
   - Autonomy
   - Steering by parent organization

3. Research policies and strategies (H)
   - Policy orientation: public, private, bridging
   - Science-based or demand-oriented?
   - Responsiveness to client needs
   - Research vs. consultancy services
   - Client and stakeholder involvement in agenda setting
   - Large or small clients

4. Organization and structure
   - Congruence or “fit” between mission and structure
   - Flexibility of O&S in relation to changes in external environment
   - Decision making processes (hierarchical, top-down, or flexible)

5. Research funding and financial management (H)
   - Diversity of funding sources
   - Separation of funding and implementation
   - Subsidies vs. output or program related funding
   - Levels of funding (changes)

6. Human resources
   - Recruitment policies
   - Staff development
   - Staff performance assessment
   - Compensation policies
   - Sanctions and termination

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1 H indicates those areas considered to be of highest importance in benchmarking exercise
• Flexibility in policies
• Researcher mobility

7. Management of organizational assets (H)
• Facilities and infrastructure (adequacy, recent investments)
• Intellectual property management
• Reputation management
• Communication

8. Management of programs and projects
• Selection of programs and projects
• Monitoring for timeliness
• Cost control
• Quality control mechanisms

9. Partnerships and networking (H)
• Technology acquisition
• Technology dissemination
• Network participation
• No. and diversity of network partners (universities, funding, policy)
• Mechanisms and instruments

10. Evaluation and impact assessment
• Client satisfaction
• Performance measurement
• Monitoring achievement of strategic objectives
• Internal evaluation mechanisms
• External evaluation mechanisms

11. Renewal and learning (H)
• Staff training and upgrading
• Technological leadership,
• New products and services
• Time lags to develop new products

Institutes included in the analysis are: CSIRO, Australia, DPI, the Netherlands, Fraunhofer Gesellschaft Germany, IMEC, Belgium, Joanneum Research, Austria, SINTEF, Norway, TNO, The Netherlands, and VTT, Finland
II: Comparative analysis

1. General information about the organizations

There is considerable variation between the eight institutes reviewed with regard to size, budget, orientation, governance, management, organization, resources and partnerships. In size the institutes range from over 12,000 staff at FhG to 360 at JR and 160 at DPI, which is by nature a virtual organization with a small core of staff. All institutes are contract research organizations, which sit somewhere on the continuum between public and private. Most institutes are autonomous in their management, but there is considerable difference in their (in)dependence from Government. Some organizations like CSIRO have a strong public orientation; others like SINTEF are more closely linked to private industry. Consequently, funding differs considerably by source as well with some institutes relying much more on Government funding than others. Even within organizations there is often considerable difference between institutes or divisions as to the extent that they depend on public or private funding. Institutes that have a large portfolio in agriculture, natural resources, environment, and policy research are more strongly oriented on the public sector than, for example, institutes that produce industrial technologies.

The following sections provide a comparison of the eight organizations along the lines of the analytical framework used for the benchmarking exercise.

2. Governance

Governance addresses the issue of how organizations are steered and directed. Most of the eight organizations have been established by law. All eight are autonomous organizations directed by Executive Boards that have the usual responsibilities of determining policies, overseeing management, and representing the organization to the outside world.

Organizations differ in the way their Boards are appointed and supervised. Sometimes Executive Boards are appointed by Supervisory Boards or Councils that represent a variety of stakeholder organizations (FhG, TNO, and SINTEF). These stakeholders usually include the relevant government ministry, private industry, and academia; in some situations staff are represented though trade unions. In other organizations Boards are appointed by the Government (CSIRO). JR is a government owned company which has two managing directors who are supervised by a board. VTT and IMEC have a single Board, consisting of stakeholder representatives and executive team headed by a Director General.

In addition to direct supervision by Boards, most RTO’s have a number of a specialized committees or councils. FhG as the largest and perhaps most decentralized organization,
has the most elaborate set of advisory and coordination bodies at central level. These include:

- The Senate: responsible for decisions concerning basic science and research policy and for appointing members of the Exec Board
- The Policy Committee is composed of representatives of the German federal government and the Länder governments, together with the Executive Board.
- The Scientific and Technical Council is the organization’s internal advisory body. It consists of the directors and senior management of the institutes and an elected representative of the scientific and technical staff of each institute.
- The General Assembly is made up of the members of the FhG. Official membership is open to the Senate, the Executive Board, institute directors and senior management and the governing boards. Ordinary membership is open to natural persons and legal entities.

Most organizations have a less heavy institutional governance system. In fact some of the reorganizations that have taken place recently at some RTO’s (e.g. at TNO) have had as a specific objective to reduce the administrative and institutional overhead of the organization. DPI has been set up as a public-private partnership to promote advanced polymer research. Because of its narrow focus compared to the other RTOs it can do with a light governance structure consisting of small executive and supervisory boards.

### Governance

The selection of an appropriate governance structure is a key issue for DGIST to decide. One option is to set up DGIST as a traditional self-contained institute public sector research institute. Other options are to establish DGIST as a Public-Private Partnership (PPP) or as a more virtual organization – these latter governance structures would be more in line with the concept of “open innovation systems”. A PPP would allow bringing in the private sector, not just as a client, but as a partner which is a joint “owner” of DGIST. The concept of a PPP may be extended further in the direction of a virtual or network organization, with a relatively small core organization and where most of the substantive R&D activities take place in the network. One of the advantages of a virtual network organization is that it combines low overheads with flexibility. Problems in networks are related to the management of cooperation and competition and in general networks are more difficult to manage (also because the concept is rather new) than traditional self-contained organizations.

Key decisions that have to be taken into account at the level of organizational governance relate to strategic direction of DGIST, internal and external supervision, establishing organizational boundaries, establishing internal and external coordination mechanisms.

Though all organizations are autonomous, the degree of autonomy they have (for example to hire staff) differs. Also, some organizations maintain close contact with the key ministry or ministries (CSIRO, TNO), while others are more at a distance (e.g. SINTEF) It also makes a difference which ministries are involved: TNO for example
reports firstly to the Ministry of Education, Culture and Science, while VTT reports to the Ministry of Trade and Industry and has a number of companies (e.g. Nokia) on its Board.

3. Research policies and strategies

Research policies may be public or private oriented, or the organizations may aim to cover both by bridging the gap. CSIRO is strongly oriented towards producing public goods for Australia. SINTEF and to a lesser extent VTT are aimed more directly at the needs of private sector. TNO and FhG have deliberately focus on public and on private clients. IMEC has the mission to carry out long-term fundamental scientific research and in the same time increase the strength of the Flemish industry.

A main difference in policy orientation can be seen between institutes with regard to their geographic coverage. One institute, JR has been specially created to do research of regional benefit. Most organizations are national, but they differ in their international orientation. CSIRO has a strong national orientation, but like all organizations aims to increase its international presence. For the European RTO’s (TNO, FhG, VTT and IMEC) the emergence of the EU as a major source of funding for regional projects, has played an important role. An example of a set of policies is presented byCSIRO:

- greater focus on major scientific challenges and opportunities for Australia
- a strong outward-looking emphasis
- stronger partnerships with universities, other science agencies and industry
- a ‘service from science’ culture
- united “One-CSIRO”, making full use of our collective strengths
- growing our impact and relevance in service to the nation – bring benefits to Australia

A key element of the policies of most RTO’s is related to the idea of bridging the gap between academic research and industry application, as exemplified by the graph from FhG.

The bridging concept has however been challenged. In 2004 an external evaluation of TNO and other technology institutes in the Netherlands concluded that the traditional intermediary role of TNO (between universities doing fundamental research and the
market of public and private clients) was no longer relevant in today’s highly dynamic and increasingly fragmented innovation system. Universities, companies and others are all involved in doing research, are undertaking research commercialization and valorization of research and are in the process of commercializing their knowledge and intellectual property and as well as doing projects and consultancies for clients.

New forms of collaboration and competition emerge between a variety of organizations. Direct linkages to the key actors in the innovation system are what really counts. The role of government in steering and funding is also changing towards market type relations based on performance-related contracts. Given these dynamics the external evaluation concluded that the old “bridging metaphor”, based on the concept of a linear transfer of technology, had become outdated. Also it was felt that, in an increasingly competitive environment, TNO should become more sharply focused on those areas where it can assume a position of leadership.

The policy recommendations, which TNO has accepted and started to implement from 2005, emphasize that TNO should:

- Become more demand-driven in its funding and operations
- Establish direct linkages with key actors in the innovation system, especially the private sector.
- Play its intermediary role in dynamic networks of knowledge organizations
- Increase its impact in society
- Increase its support to SME’s

Research Policies and Strategies

A key policy issue for DGIST to address is where to position itself in the Korea innovation system, especially in relation to the demands from the market, the public interest, and the dynamics of the S&T system. Will DGIST become market or public interest driven, or will it be first and foremost a scientific institute? Or will it carefully balance different demands? Will DGIST primarily be a research institute or will it support companies and other clients through provision of services? See Figure 1.

Other important policy decisions are which clients to target as beneficiaries. Who will DGIST be working for? (National or regional, large or small, private or public clients?), To what extent will clients will be involved in influencing the DGIST research agenda (passive consultation or more active ownership of the institute?). Finally, the selection of broad research directions and technologies is an important policy decision.
4. Organization and structure

Almost all RTO’s reviewed are large and complex organizations. All are struggling to coordinate the activities of their basic units (which often have a disciplinary basis) in order to address multi-disciplinary, real world problems.

CSIRO research, for example, is performed by 21 Research Divisions, which are clustered into four output groups: Agribusiness and Health; Environment and Natural Resources; IT, Manufacturing and Services; Sustainable Minerals and Energy. In addition, CSIRO leads the following six National Research Flagship projects: Preventative Health, Light Metals, Food Futures, Energy Transformed, Water for a Healthy Country, Wealth from Oceans. And there are five Emerging Science Areas: Biotechnology, Complex Systems, Science, Information and Communication Technology, Nanotechnology, Social and Economic Integration.

FhG is organized as a decentralized operation. It includes 57 institutes in all parts of Germany. Such a large organization needs elaborate coordination between institutes. The key mechanism used at FhG is that institutes are grouped in a number of working alliances devoted to specific broad research areas. Their purpose is to coordinate work on related fields of research within the FhG, to pool essential resources in core disciplines, and to present a unified image in the marketplace.

Starting 2005 TNO has abolished its 15 institutes and consolidated them into four Core Areas:
- TNO Quality of Life
- TNO Defence, Security and Safety
- TNO Science and Industry
- TNO Environment and Geosciences
- TNO Information and Communication Technology

The main purpose of consolidation is to do away with compartments between institutes, enhance the possibilities of doing interdisciplinary research and increase TNO, improve
the critical mass in key areas, reduce overhead and management costs and, in general, become more competitive. The former TNO Business Centers (the “windows on the market”) will become “portals” through which TNO offers its services to clients.

Similarly, SINTEF has undergone a radical process of reorganisation as it noted that client companies are increasingly concerned with solving large problem complexes. SINTEF strengthened its position in the market by reorganising its activities from a large number of small scientific departments into 12 large market-oriented research institutes.

IMEC, in Belgium, has formulated its research along 4 themes: CMOS-based technology development; Nanotechnology; Technologies for the smart environment; and Photovoltaics and power devices. IMEC’s research for technologies in the smart environment for example is organized in the strategic programs M4 and Human ++. In these programs the following research projects are formulated: wireless research, multimedia, reconfigurable systems, design technology, packaging and health.

DPI has been established as a virtual, flexible research network with a small core organization, and broad participation from the polymer industry (producers and users) and knowledge organizations (Technical Universities and TNO) with significant financial support from the Netherlands’ Ministry of Economic Affairs.

<table>
<thead>
<tr>
<th>Organization and structure</th>
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<tbody>
<tr>
<td>The way DGIST is structured and organized should reflect its policies and mission. A traditional institute is often structured along vertical lines, based on departments or similar units. With the general trend towards more open innovation systems it is important to create mechanisms for horizontal interaction between organizational units, for example through the use of flexible teams that are project or program related and that integrate staff with different disciplinary and skill backgrounds. If DGIST chooses to establish itself as a network type of organization this will have important consequences for its internal organization and structure.</td>
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5. Research funding and financial management

All RTO’s receive a mix of funding from public and private sources. In most cases straight government subsidies have been replaced by a combination of basic funding (over which the institute has full control), earmarked or targeted funding (aimed at e.g. doing work on ICT) and public service contracts. Mixed funding helps to spread the risk. SINTEF, which depends heavily on private sector funding, had to restructure and cut staff in an economic downturn in 2002.

Without exception all organizations have an internationalization strategy. This reflects the increased internationalization of R&D related development. Being an international player is not only seen as a sign of professional credibility, it is also aimed at attracting
different sources of funding, e.g. from the EU or from development assistance. The larger RTO such as FhG and TNO play an important role in European R&D field, but also a small organization as JR aims to increase its international presence. The degree to which organizations are internationalized depends on the nature of the institute and the size of its home market. While FhG has a (rapidly increasing) international budget of M€80 on a total research budget of M€900, corresponding TNO figures are M€100 and M€472, respectively. This reflects the size of the German home market for Fraunhofer, compared to the small Netherlands market for TNO as well as the earlier adoption of an internationalization strategy by the latter.

DPI uses an innovative ticket system to make research demand driven. Tickets are bought by companies at €50,000 each per year for a minimum of four years. A ticket corresponds to one vote in the program committee of one of the technology areas (e.g. rubber technology) Firms can buy more than one ticket per technology area in order to have more influence. Contributions from companies are matched by the knowledge institutions (i.e. universities and TNO) mostly through in-kind contributions (research work), but also equipment. The combined industry-knowledge institution investment is doubled again by the Ministry of Economic Affairs. The research agenda is set by the companies and €1 of their contribution results in €4 worth of research work.

Most organizations are aiming to receive a large share of their resources from private sector sources. TNO, for example strives to increase its presence in the commercial market and to increase its work for SME’s. Interestingly, CSIRO’s strategy does not push for a greater contribution of the private sector in the overall financing of its activities. Rather it sets out to secure greater support from the government. The government still provides most of its funding in a block grant and has tied its financing relatively loosely to specific research outputs.

<table>
<thead>
<tr>
<th>RTO funding types (%)</th>
<th>Core / grant funding</th>
<th>Contract research</th>
</tr>
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<tbody>
<tr>
<td>CSIRO</td>
<td>66</td>
<td>34</td>
</tr>
<tr>
<td>Fraunhofer</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>Joanneum Research</td>
<td>25</td>
<td>75</td>
</tr>
<tr>
<td>SINTEF</td>
<td>7</td>
<td>93</td>
</tr>
<tr>
<td>TNO</td>
<td>34</td>
<td>66</td>
</tr>
<tr>
<td>VTT</td>
<td>30</td>
<td>70</td>
</tr>
<tr>
<td>IMEC</td>
<td>24</td>
<td>76</td>
</tr>
<tr>
<td>DPI</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

On the whole there are remarkable differences between RTO’s with regard to the percentages of funding derived from contract research and from grants. The numbers

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2 Categories used in the table do not fit very well the funding mechanism for DPI with 25% from industry and knowledge organizations and 50% from Government
presented in the table below do have to be considered with some caution though. Apparently most organizations are under pressure to present themselves as contract research organizations as much as possible and they often show all government contributions that are not straight subsidies (e.g. earmarked contributions, restricted core, task related funding) as contract research.

<table>
<thead>
<tr>
<th>Research funding and financial management</th>
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<tr>
<td>Most RTO’s aim to obtain funding from different sources as this broadens the support and resource base and provides flexibility. DGIST will start as an institute that is mainly publicly funded. Important strategic decisions for DGIST to make are whether the institute should remain largely funded by the public sector (national and regional), or whether to move quickly to a mixed funding model. In order to increase private sector funding two main strategies may be followed. One strategy employed by many RTOs is to obtain private sector funding through contract research. Another funding strategy followed in a PPP model is to involve public and private members and charge a membership contribution. A combination is different funding strategies is also possible.</td>
</tr>
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</table>

6. Human resources

All RTO’s aim to attract high quality personnel to achieve their mission. Frequently they are rated as a preferred employer by young graduates. To maintain their position most organizations conduct some sort of staff satisfaction surveys. All have staff development as an objective, but the priority that this is given differs between institutes. Most of the RTO’s have introduced some form of performance related pay system.

Despite being attractive employers, some RTO’s have a relatively high staff turnover. At SINTEF for example staff turnover is relatively high at 10-15% of all staff leaving the organization every year, for JR the figures were 15 and 19 % in recent years. Probably the more market-driven RTO’s, such as SINTEF and Joanneum, experience large staff turnover as they need to restructure in response to market fluctuations. Following its reorganization TNO has set itself the ambition to increase efficiency and achieve the same turnover with 350 fewer staff.

Most RTOs are in the process of moving from more traditional, public service based human resource polices towards more flexible, performance based policies.
Human resources

In the context of open innovation systems a key issue in DGIST human resource policies and strategies is flexibility in recruitment, compensation, promotion, staff development and termination policies. Such flexible policies are needed to respond effectively to the different and changing demands of different clients and stakeholders. The extent to which flexible policies are possible depends on the independence of DGIST as an institute. The ability to recruit new staff as the needs change is especially important.

Supporting innovation processes requires teamwork which involves staff members with different backgrounds. Staff policies will need to encourage team formation, team work and rewards based on team performance.

In many RTOs staff are a key instrument to link different organizations in the innovation system. To increase its effectiveness and the scope of its activities, DGIST will have to develop mechanisms that allow the involvement of staff from different organizations in a more or less flexible manner e.g. joint professorships.

7. Management of organizational assets

Organizational assets include physical (or tangible) assets like buildings, infrastructure and equipment and intangible assets such as an organization’s intellectual property and even the reputation and trust that it enjoys with its clients, financiers and the general public.

With regard to infrastructure and equipment the RTOs reviewed have state-of-the-art facilities and equipment. An important issue to consider is that organizations aim to have a number of unique facilities that form the basis of research programs and which may attract top researchers. These may include supercomputing facilities for advanced modeling, magnet facilities for nanotech research or crash test infrastructure for automotive research work.

Most institutes have a very clear policy and strategy concerning the management of their intellectual property. Patenting is the main form of IPR that institutes use to protect their inventions and research results and for transfer of technologies.

VTT’s policy in this is to patent core technologies while avoiding unnecessary fragmentation. These core technologies are further developed by VTT or transferred as a whole in joint projects to corporate partners who possess business know-how and market knowledge. For commercialization VTT established Licentia Oy, a company that focuses on the licensing and commercialization of scientific results. TNO also exploits its patents.
through out-licensing or full transfer and a special unit Patents & Licensing TNO is responsible for the management of this active out-licensing program. Partnerships range from royalty-payment schemes to joint-ventures in start-up companies. Many research projects are carried out for partners to further develop inventions originating from TNO.

One of the strategies actively pursued by CSIRO to generate more revenue from the intellectual property of the organization is the hiring of experienced managers to extract the value residing in CSIRO’s patent and equity portfolios in a systematic manner. The main purpose for CSIRO is to realize gains for CSIRO.

All institutes emphasize the importance of their reputation as an impartial advisor to clients and customers. Fraunhofer, VTT and perhaps others use codes of conduct to ensure transparency and quality. A Code of Conduct is important when working for two competing rivals in the same market at the same time (FhG), or to be able to follow basic principles or standards like impartiality, reliability, integrity and responsibility (VTT).

There are several ways of monitoring and controlling quality. VTT, TNO and Joanneum Research are using ‘Scientific Advisory Boards’, who monitor the selection and implementation of (self-financed i.e., non-contract) projects. Once a project has been approved, the researchers submit the results of defined parts of the project to the Scientific Advisory Board at regular intervals for appraisal, and explain any further progress in their research. These presentations take place at least once a year.

Most institutes are ISO certified, which is another instrument to enhance reputation. CSIRO uses a brand preference scoring system and a customer value scoring system. Effective communication at political, policy and scientific levels is a very important component of reputation management. One instrument mentioned by FhG is frequent participation in trade fairs en industry events. Finally, publications both scientific and for a more general public are key instruments in reputation management.

### Management of organizational assets

Research facilities and infrastructure are key organizational assets for every RTO. DGIST will start as a new institute and will have state of the art facilities. An important issue in relation to facilities is that a unique infrastructure asset may attract researchers who need the equipment. Building a set of unique facilities is important for DGIST.

A key organizational asset for any knowledge organization relates to its intellectual property, especially what is in the public domain and what will be restricted. Another intangible asset for a knowledge organization is its reputation with its financiers, clients and stakeholders which requires effective communication of its performance. As a new organization DGIST will need to build up a solid reputation.
8. Management of programs and projects

Selection of programs and projects is a key instrument to achieve organizational objectives. Most organizations have a variety of program and project categories that reflect different funding sources and targets. CSIRO, for example, has four groups of projects:

- Individual Flagships
- Emerging Science Initiatives
- Priority-driven Research (Divisional Plans), and
- CSIRO-wide Support (Corporate Group Plans)

IMEC has a rather specific way to manage and choose programs and projects. The strength of all the disciplines and groups in IMEC are gathered and steered by a number of strategic drivers, fuelling a wider range of technology programs. IMEC uses two types of strategic drivers. First, those that are technology roadmap-driven, for example work on CMOS/Nanoelectronics. However, not only roadmaps can steer the drivers, also scenario methods are used to formulate programs. The scenario-driven M4 program, for example drives the technology programs on software defined radio, flexible air interface, and multiple antenna research. Beyond this program driven research, IMEC also fosters exploratory, fundamental long-term research in different fields of nanotechnology, constituting pathfinder avenues for new technology programs and strategic drivers, often in collaboration with industry to assure that new research is compatible with industry needs.

At DPI, the research agenda is driven by the polymer industry. This means that program priorities are determined by the participating companies, while research work is done by the knowledge institutes and funding is shared between industry, knowledge institutes and government through the formula discussed above.

One of the objectives of the current strategy of many research organizations is cost control through reduced overheads and purchasing costs. In order to achieve this goal, CSIRO has initiated a series of rolling reviews of the organisation’s research support and overhead cost structures. By procuring more goods and services on a CSIRO-wide basis, CSIRO expects to make substantial savings by exploiting the leverage of its combined purchasing power. As an adjunct to its reorganization, TNO is conducting a so-called ‘overhead-value-scan’ in order to identify overhead costs and value.

Next to this, quality assurance in the R&D environment is a major requirement within the context of wide-ranging industrial cooperation. At several institutes (like IMEC and TNO and others) a formal quality system based on the ISO standard has been established in the area of training, consulting, design, research, development, and/or integration.
Management of programs and projects

Like all RTOs DGIST will need effective procedures for selecting its research priorities and translate these priorities into adequate programs and projects. Most RTOs have a variety of different programs and projects which reflects the fact that most of them are serving multiple clients and multiple objectives. Disciplinary programs may be combined with national priority programs and special programs dedicated to, for example, SMEs.

A program structure needs to be designed that responds to the long-term organizational objectives of the DGIST organization. Long term program objectives can be stated in terms of future products and services that DGIST wants to offer to its clients. Projects have to be carefully designed to ensure that they contribute to the long-term program objectives. Monitoring projects for quality, relevance to program objectives, timeliness and expenditure requires effective management information and control mechanisms.

9. Partnerships and networking

All reviewed institutes think partnerships and networking are very important factors in the institute’s strategy and development and to assure the exchange of ideas necessary to maintain competitiveness and penetrate new markets. Several of the RTO’s play a key role in coordinating the activities of regional, national or international networks. Joanneum Research, for example serves as the engine of the regional “Styrian Innovation System”. One of the most important tasks of JR is to act as a “system builder” to increase network integration at different levels. A large number of mechanisms and instruments are used for two important network functions: technology development and technology dissemination.

Technology development needs the joint efforts of different partners in the innovation system. There are several mechanisms known to establish, improve or maintain networks and partnerships between research institutes, governments and industry on global, national and regional levels. Fraunhofer for instance maintains its links with universities through a variety of mechanisms such as co-location, professorships, joint projects and involvement of students and post-docs on a (paid basis). This tight integration model may be difficult to replicate in other countries as it depends strongly on national institutional infrastructure.

TNO uses as mechanism knowledge centres, which are a co-operation between university and TNO. These are not market-oriented ventures, but have technology development as their motivation. Through partnerships TNO can access specialized knowledge, while working together with university staff to develop this knowledge further. The outcome is a joint research programme, with the majority of work being done at the university - in reality an outsourcing of research with agreements on patents and knowledge rights. These knowledge centre prevent an environment of competition between TNO and the
universities for funding and contract research, while helping the universities to become active in the applied sector. Overall they strengthen the level of knowledge at TNO.

For VTT, established forms of co-operation with universities include jointly funded research projects and programmes, joint professorships, joint units, teaching by VTT staff, post-graduate academic advising, the shared use of equipment, and sub-contracting. For instance, the Maritime Institute of Finland is a joint venture sponsored by VTT and the Helsinki University of Technology. Some VTT units are located on the campuses of technical universities or other local universities.

Mechanisms for relationships with industry are harder to define. For TNO, one successful approach has been to undertake large joint strategic R&D projects together with R&D-intensive companies and develop special projects geared towards the SME sector. To anticipate the need to structure extensive, long-term research programs for innovative knowledge development, agreements are being made with the Dutch government for this purpose. TNO is developing various commercial and market-geared activities through TNO Management B.V., a subsidiary.

CSIRO has developed the concept of Cooperative Research Centers (CRC’s). CRC’s support collaboration between industry, government agencies, universities, and other research providers, including CSIRO. In 2003-2004, CSIRO participated in 50 of the 71 existing CRCs.

IMEC further employs interaction programs that allow companies and institutes to have direct access to IMEC’s core competences. These are long-term research contracts, (bilateral) collaboration contracts, technology transfers and license agreements to industrial affiliation programs. At the start of a collaboration project, a suitable intellectual property ruling is determined by the different parties. In 1991, IMEC created a new cooperation scheme called ‘IMEC industrial affiliation programs’ or IIAPs for joint R&D that is based on a sharing of cost, risk, talent and IP. An IIAP is a tight R&D partnership which allows industrial researchers to integrate into IMEC’s research teams via well-defined programs. For each industrial partner and within each program there is room for more customized R&D. As part of this collaboration, the technology owned by IMEC can be transferred to the industrial partner. The more generic or methodological type of results can be shared amongst the partners in the program. Company-specific data or confidential information remains under the exclusive ownership of the industrial partner. Next to this, IMEC takes a leaf from top universities in the US where sponsorship programs offering early access to ongoing research are a common business model. This is beneficial because the partner can apply findings to the road mapping of its developments and IMEC benefits from very early feedback and insurance that the research is steered towards industrial needs.

Joanneum Research has strong partnerships within the Austrian science community and collaborates closely with universities in Styria and institutes of the Austrian Academy of Sciences. In addition JR hold shares in eleven other research companies. Next to its collaboration with industry, IMEC’s research is carried out in concert with research at its
associated labs at Ghent University, the University of Brussels, the higher polytechnical school of Bruges-Ostend and the University of Maastricht. IMEC also collaborates with the University of Leuven. DPI has been created as a public-private partnership that uses a network mode of operation. It has a small core and operations are undertaken in the network.

**Technology dissemination** can be achieved in a variety of manners. One method to disseminate technology is through the formation of spin-off companies. For Fraunhofer, TNO and IMEC this is a key technology transfer mechanism, which offers a direct route for know-how developed in the research laboratory to be applied in industrial practice. Other methods of technology dissemination used by most of the RTO’s are publications and patents, articles, and conferences notes. VTT uses their *National Technology Programmes* to generate new knowledge and technology that is transferred to companies even while the programmes are still in progress. The research programmes lead to the development of new expertise and increase the diverse interaction between the research units and companies.

VTT mentions explicitly its connections to the private sector which is reflected in the number of customer organizations. Participation in Tekes *technology programmes* and *technology clinics* offer connections to different companies. Also VTT’s own strategic research involves co-operation with companies. SMEs are an important customer group for VTT.

International research networks become increasingly important. CSIRO’s external partnership strategy focuses primarily on developing nations. The current strategy does not emphasize strategic partnerships and linkages with research organisations in other developed countries. CSIRO’s approach is very much in contrast to European institutes, where cross-border institutional collaboration has become quite important. Fraunhofer, TNO and VTT are major players in the European research area. The Fraunhofer Institutes for example, network with other centres of excellence, and together help to assure the competitive strength of European research. Through its office in Brussels (established 2003), the FhG significantly develops its involvement in multinational EU projects and European research networks. About 15% of SINTEF’s research contracts are international, of which half with the European Union (EU).

### Partnerships and networking

Managing external relations is probably one of the most important tasks in open innovation systems. Partnerships are needed for technology acquisition, technology development and technology transfer and dissemination. For DGIST, key partnerships include those with Government funding agencies, public and private research institutes, universities, private sector clients and non-profit organizations. The type and nature of linkages and partnerships determine how open the organization is to its external environment. Networks include a variety of actors in the innovation system with interests that may sometimes be conflicting (e.g. with universities that compete for resources). Mechanisms need to be developed to balance cooperation and competition.
10. Evaluation and impact assessment

Measuring client satisfaction is a first step to evaluate performance and is used by most RTO’s, including TNO, Joanneum Research and SINTEF. Customer relation management is closely linked to this. CSIRO for example has introduced Client Service Teams (CSTs) for its largest multi-divisional clients to serve as liaisons between them and CSIRO resources. CSTs should improve communication across the various players in those teams. Moreover, a careful customer segmentation project is underway to help determine where best to apply CST resources. It is expected that the number of CSTs will grow to approximately 50 by 2007. Joanneum Research and TNO use customer satisfaction surveys in order to evaluate the quality of the deliverables and the research process with the customers.

Most RTO’s try to go beyond customer satisfaction to assess their achievement of strategic objectives and their impacts. Joanneum Research formulates its strategic objectives in terms of company turnover, self-financing ratio, and average project size, rather than in terms of economic well-being and improved quality of life. In this respect, CSIRO uses specific instruments and measures of success. Annual targets are incorporated in the Operational Plan. However, to enable summary reporting of progress, a headline performance indicator has been developed for each of the major strategic goals. These measures, together with measures of staff satisfaction and customer satisfaction, will form the highest level of regular strategic progress reports to the CSIRO Board. The headline performance indicators of CSIRO include:

- **Flagship Implementation**: Percentage of Flagship annual performance goals achieved (target: 70%)
- **Science Excellence**: ISI citation rates and patent impact index (target: rate of citation increase exceeds ISI & CHI benchmarks)
- **CSIRO Brand Preference**: Importance of CSIRO Brand name in Customer Value Survey score (target: improve over 2002–03 baseline - 129)
- **Industry Engagement**: Number of significant commercial relationships with industry leaders, i.e. RDCs & States ($10m threshold), Large Corporations ($2m threshold) and SME growth stars (threshold to be defined) (target: increase over 2002–03 baselines)
- **One-CSIRO Participation**: Aggregate insight score for working relationships and work organisation and efficiency (target: improve over 2002–03 baseline - 127)
- **Financial Capacity**: Achieve targeted financial results and, relative to 2002–03, achieve an: (i) aggregate increase in appropriation income (target: $174m); (ii) aggregate increase in IP revenue (target: $114m); and (iii) aggregate decrease in overhead & support costs (target: $73m)

Most conventional models to evaluate and monitor impact are based on the requirements of business enterprises and are therefore of only limited value for the wide range of functions of non-university research institutions. For this reason, Joanneum Research has developed a tailor-made management instrument for non-university research on the basis of established standards; the JR Explorer, which is designed to collect and evaluate...
information about the financial, structural and staff-related resources of the enterprise in order to be able to make best possible use of them for the economy and society as a whole.

*The JR Explorer 2002* evaluates the status of Joanneum Research on the basis of three orientations, namely: (i) resources (financial, structural, and human); (ii) results (economic, scientific, and social); and (iii) future (analysis, strategy, and positioning). Staff knowledge and motivation, the relationships with partners and customers and innovation capacity are of more importance for business success than the financial capital on the balance sheet – and this is particularly true for research institutions. It is because of this that *intellectual capital reports* (in the case of Joanneum the JR Explorer) are used worldwide in order to improve the recording of these intangible resources and to take them into account in strategic planning. *Intellectual capital reports* cover not only the financial figures but also intangible values such as staff knowledge and cooperation networks.

<table>
<thead>
<tr>
<th>Evaluation and impact assessment</th>
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<td>RTOs are increasingly challenged to demonstrate their results and their impact in society. They need to be accountable to their parent organization, members, government and the general public. DGIST will need to establish internal and external evaluation systems that provide information on outputs and impacts. A variety of instruments may be used: customer satisfaction surveys, monitoring performance indicators, peer reviews and special impact studies.</td>
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11. Renewal and learning

A knowledge organization that does not learn and does not renew itself looses its relevance in the long run. Staff training and upgrading are important instruments to achieve organizational learning. Most of the RTO’s maintain close links with universities as key strategy to ensure renewal. They do this through the involvement of professors, students and Post Docs in projects.

Most institutes work with relatively autonomous research groups and teams which ensures high intrinsic motivation, minimal managerial infrastructure and low overheads. According to TNO, staff capacity and motivation are key organizational assets for a knowledge organization and need to be maintained at the highest level. However, there are some differences in the training of staff: SINTEF places great emphasis on being a good school for careers in research, industry and the public sector and operates its own internal training program, which accounts for TNO as well. In VTT on the other hand, staff development is seen more as an individual responsibility. Work is considered to be the constant learning of novel things, so learning on the job is important. IMEC at last, invests in e-learning by using streaming video to train staff, students and industry partners.
Both TNO and VTT do guarantee training facilities for top performances. IMEC has its own ‘Microelectronics Training Center’ that offers courses for a varied public. All institutes have the ambition to provide technological leadership, a position that requires constant renewal and continuous learning. CSIRO as an example invests quite heavily in its six National Research Flagship projects and its five Emerging Science Areas. TNO also mentions that leadership can only be achieved by strengthening the organization’s partnerships with universities, innovative companies, and government organizations. Special attention needs to be given to international and regional partnership because innovation systems become increasingly regional and global.

DPI uses a broad stakeholder consultation process (through a survey and a workshop) to obtain feedback from its users, financiers and others on organizational relevance and performance and the needs for adjustment to changing dynamics in the environment.

### Renewal and learning

The key to long-term growth and relevance for any organization is related to the extent to which it is able to learn new skills and renew itself in the face changing circumstances. This may not seem to be an urgent question for a new organization such as DGIST, but it is important to think at an early stage on how renewal and organizational learning will be addressed to achieve and retain technological leadership and to ensure organizational impact.
III: RTO Case Studies

1. CSIRO - Australia

1. General information

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is Australia’s lead scientific research organisation. With some 6500 staff, CSIRO is large and very diverse scientific research organisations in the world. Its overall goal is to improve through R&D the quality of life of the Australian population, as well as the economic and social performance of the following industry sectors:

- Agribusiness
- Energy and Transport
- Environment and Natural Resources
- Health
- Information, Communication and Services
- Manufacturing
- Mineral Resources

CSIRO’s customers are:

- Australian businesses and industries
- Commonwealth and State governments and their agencies
- The Australian community
- The International community including developing nations

2. Institute governance

CSIRO is an independent statutory authority constituted and operating under the provisions of the Science and Industry Research Act 1949. This Act lays out the functions, powers and structure of governance of the organisation.

A Board, consisting of the Chief Executive and from seven to nine members appointed by the Governor-General, is charged with ensuring the proper and efficient performance of the functions of the Organisation and with determining the policy of the Organisation with respect to any matter. The Board is responsible to the government for the overall strategy, governance, and performance of CSIRO. This role includes:

- Providing strategic direction to CSIRO
- Ensuring best practice corporate governance is being implemented in CSIRO, including legal compliance and risk management
Approving strategic and operational plans and monitoring CSIRO’s operating performance
Ensuring the Minister is kept properly informed, including all matters requiring Ministerial approval.

CSIRO’s primary functions are:

- to carry out scientific research for the purpose of assisting Australian industry, furthering the interests of the Australian community, contributing to the achievement of national objectives or the performance of national and international responsibilities
- to encourage or facilitate the application or utilisation of the results of CSIRO’s scientific research.

Secondary functions specified in the Act include:

- to encourage and facilitate the application or utilisation of the results of any other scientific research
- to carry out services, and make available facilities, in relation to science
- liaison with other countries in matters connected with scientific research
- training of research workers
- establishing research fellowships and studentships
- cooperation with associations of persons engaged in industry for the purpose of carrying out industrial scientific research
- establishing, developing, maintaining and promoting standards of measurement
- collection, interpretation and dissemination of information on scientific and technical matters
- publication of scientific and technical reports, periodicals and papers.

The Act also provides that CSIRO shall, as far as possible, cooperate with other organisations and authorities in the coordination of scientific research, with a view to preventing unnecessary overlap and ensuring the most effective use of available facilities and staff.

CSIRO is relatively independent when it comes to its day-to-day management, but at the same time is steered strongly by the overall S&T policies of the government. Two-thirds of CSIRO’s income is coming directly from the government in the form of an appropriation. In order to secure the continuation of this contribution, CSIRO has to show clearly how it targets and contributes to the National Research Priorities as formulated by the government as well as to the National Research Flagship Program launched by the government in 2002.

3. Research policies and strategies

CSIRO’s current strategic planning framework runs from 2000 to 2012 and is based upon six key messages that will steer CSIRO towards achieving its vision of becoming a
“Research Enterprise with Global Reach”, namely: greater focus on major scientific challenges and opportunities for Australia with a strong outward-looking emphasis, stronger partnerships with universities, other science agencies and industry with a ‘service from science’ culture, a united One-CSIRO, making full use of our collective strengths and growing our impact and relevance in service to the nation.

For the current strategic plan (2003-2007) the key change messages have been translated into the following six strategic goals, each broken down into four more concrete objectives:

1. Focusing our science investment
   (a) Play a significant role in delivering on Australia’s National Research Priorities
   (b) Build critical mass and ensure quality in our core research programs
   (c) Champion Flagships to improve the lives of Australians and advance Australia’s key industries
   (d) Increase the impact of major cross-Divisional activities through a focused strategic investment process

2. Delivering World-Class Science
   (a) Concentrate people processes on developing, attracting, exciting and retaining talent
   (b) Optimise delivery of all research activities by improving project management
   (c) Build our global recognition for science leadership in our chosen science domains
   (d) Help Australia play a leadership role in major international science facilities such as the Square Kilometre Array

3. Partnering for Community Impact
   (a) Focus and intensify collaboration with universities, cooperative research centres (CRCs) and other agencies
   (b) Service the needs of government for informed policy setting
   (c) Enhance communication to raise public and stakeholder excitement and trust in science
   (d) Partner with other agencies to advance Australia’s global development contributions

4. Serving as Catalyst for Industry Innovation
   (a) Intensify engagement with rural research and development corporations to grow regional and new industries
   (b) Structure deeper and more meaningful relationships with large corporations
   (c) Accelerate the growth of promising technology-based SMEs
   (d) Reinvent our ICT capabilities to strengthen Australia’s knowledge-based industries

5. Building One-CSIRO Capabilities and Commitment
(a) Stimulate breakthroughs by promoting cross-pollination, especially in frontier research
(b) Be among the best in governance, OHS&E and performance management processes
(c) Adopt a unified approach to improve service dramatically and grow top accounts
(d) Implement standard processes and IT systems to enhance collaboration and efficiency

6. Securing a Financial Foundation for Growth
   (a) Secure greater Federally funded support for CSIRO science investment
   (b) Proactively manage patent and equity portfolios to multiply IP-based revenue streams
   (c) Deliver customer value for money and eliminate subsidisation in consulting services
   (d) Reduce overhead and purchasing costs and manage balance sheet for reinvestment

CSIRO has a rather broad research mandate and spans the whole spectrum of public, private and bridging research and consulting services. About a third of CSIRO’s income is acquired through external financing provided by the Australian private sector, R&D Corporations, Cooperative Research Centres (CRCs), Australian government agencies, and overseas clients. The other two-thirds of CSIRO’s income are provided by the Australian government directly. Since 1988 a rule applies that CSIRO should generate at least 30% of its own income, but this rule is presently under discussion.

CSIRO considers its primary purpose is to bring benefits to Australia and not, as an end in itself, to generate revenue for CSIRO. The successful uptake of CSIRO technology, processes and advice depends on the relevance of CSIRO research which in turn depends on a close working relationship with both public and private sector customers.

In seeking to fulfil its functions and return maximum benefits to Australia, CSIRO needs to consider a range of issues including:

- the appropriate balance of strategic and applied research
- the level of public good research
- the nature and extent of international activities
- appropriate research partners and means of collaboration
- the choice of commercial partners and commercialisation vehicles, and other routes to adoption
- the reasonableness of charge-out rates for use of facilities and services.

Given CSIRO’s relative dependence on government support, it is being steered more by S&T policies and priorities formulated by the government rather than by concrete demand coming from the private sector. Nevertheless, a substantial part of its research and services targets clients directly. Unique for Australia is its Cooperative Research
Centres (CRC) Programme, which supports collaboration between industry, government agencies, universities, and other research providers, including CSIRO. In 2003-2004, CSIRO participated in 50 of the 71 existing CRCs, generating a turnover of AUS$ 114.6 million, of which AUS$ 73.2 million coming from CSIRO’s own resources. This Programme is in particular of importance to small and medium-sized companies which cannot afford to do research on their own. Another phenomenon is that of the Rural R&D Corporations. They mobilize levies within particular agricultural sub-sectors (usually a commodity) to finance research. The government more-or-less matches these levies on a one-to-one basis. The R&D Corporation contracts out the research to research providers, usually on a competitive basis. CSIRO currently has contracts with 10 of the 15 existing Rural R&D Corporations, with a total value of AUS$ 40 million in terms of revenues to CSIRO 2003-2004. In both instances the required co-financing by the industry will steer to a large extent the demand side. In addition, each of the seven industry sectors serviced by CSIRO has its own advisory council, which should ensure that the sector’s R&D program is responsive to the strategic research needs of industry and society.

4. Organization and structure

CSIRO research is performed by 21 Research Divisions, which are the business units of CSIRO. They are clustered into following four output groups:

- Agribusiness and Health (Revenue: AUS$ 253.7 million)
- Environment and Natural Resources (Revenue: AUS$ 224.5 million)
- IT, Manufacturing and Services (Revenue: AUS$ 292.5 million)
- Sustainable Minerals and Energy (Revenue: AUS$ 133.7 million)

In addition, CSIRO leads the following six National Research Flagship projects: Preventative Health, Light Metals, Food Futures, Energy Transformed, Water for a Healthy Country, Wealth from Oceans.

And the following five Emerging Science Areas: Biotechnology, Complex Systems, Science, Information and Communication Technology, Nanotechnology, Social and Economic Integration.

CSIRO has a very broad research mandate and has to service many different clients. In order to make this situation manageable, the 21 research divisions operate as business units with a substantial amount of autonomy and flexibility.

5. Research funding and financial management

As mentioned earlier, CSIRO still depends to a great extent on government funding.

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<thead>
<tr>
<th>CSIRO funding</th>
<th>2003-2004</th>
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<tbody>
<tr>
<td>Government contribution</td>
<td>AUS 568.6</td>
</tr>
<tr>
<td>Research and services revenue</td>
<td>AUS 296.1</td>
</tr>
<tr>
<td>Intellectual property</td>
<td>AUS  23.8</td>
</tr>
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</table>
Most of the government funding is provided in support of CSIRO’s overall mandate, with the exception of the National Research Flagships and the Emerging Science Areas. In order to improve its financial situation, CSIRO has set out the following strategy:

1. Secure greater Federally funded support for CSIRO
2. Proactively manage patent and equity portfolios to multiply IP-based revenue streams
3. Deliver customer value for money and eliminate subsidisation in consulting services
4. Reduce overhead and purchasing costs and manage balance sheet for reinvestment

Interestingly, CSIRO’s strategy does not push for a greater contribution of the private sector in the overall financing of its activities. Rather it sets out to secure greater support from the government. The government still provides most of its funding in a block grant and has tied its financing relatively loosely to specific research outputs. Perhaps tying is the strongest in the case of the Research Flagships and to some extent the Emerging Science Areas. Nevertheless, it is clear that CSIRO is making a major effort to align its research activities closely with the National Research Priorities as formulated by the government.

To cite CSIRO’s 2003-2007 strategy on CSIRO’s public good orientation:

“Prior to the most recent economic downturn, the nation wanted a CSIRO that was increasingly self-sufficient, relying on external earnings for a growing portion of its funding, and acting more like a commercial enterprise. However, over the last two years, the nation has come out in favour of a CSIRO working harder on the public good, putting more of an emphasis on public service at the same time as our commercial mission. The importance of CSIRO’s public service mission is even more important given Australia’s low level of corporate R&D relative to other countries. This imperative can be seen in the primacy now being placed on the Flagship programs and the nation’s most complex policy changes.”

CSIRO obtains external funding from a wide range of customers (both industry and government) and participates in many joint research efforts, such as CRCs (some 50) and Rural R&D Corporations (some 10) as well as international projects.

Separation of funding and implementation is rather incomplete and there is a mix of subsidy and output-related funding.

During the past decade, CSIRO’s budget has been more-or-less stagnant in real terms.

6. Human resources
Delivering world-class science requires that CSIRO attracts and retains world-class talent and provide them an environment that allows them to be the best they can be. To this end CSIRO operates a whole set of measures, including a People Development strategy concentrating on: change management, performance culture, talent management, occupational health and safety management, and learning and development. In order to monitor progress on this front, CSIRO conducts every year a staff satisfaction survey. In recent years, CSIRO has scored slightly better than the global norm for R&D organisation.

Being the largest research organisation in Australia, CSIRO also actively participates in the training of young scientists. In 2003-2004, it supervised some 464 PhD students. In addition, CSIRO operates a Post-doctoral Fellowship Program, employing some 259 post-doctoral fellows in 2004.

7. Management of organizational assets

One of the strategies actively pursued by CSIRO is to generate more revenue from the intellectual property of the organization. For that reason it has hired experienced managers to manage the value residing in CSIRO’s patent and equity portfolios in a more systematic manner to realise gains for CSIRO.

Another strategy pursued by CSIRO is to make more efficient use of its extensive infrastructure and sell off buildings and installations that are underutilized. It is expected that this could generate a substantial cost saving.

Reputation management: CSIRO brand preference score. Customer Value Score

8. Management of programs and projects

CSIRO’s annual operational plan consists of four groups of plans:

- Individual Flagships
- Emerging Science Initiatives
- Priority-driven Research (Divisional Plans), and
- CSIRO-wide Support (Corporate Group Plans)

Each of these operational plans only focuses on the strategic objectives that are relevant for that group for a given year. It is proposed that next level operational plans will progressively move to follow the same generic structure as that established for Flagship Programs. That is, they will reflect a similar ‘theme-stream’ structure with clear strategic alignment, timing, annual performance goals and performance reporting.

One of the objectives of the current strategy is to reduce overhead and purchasing costs. In order to achieve this goal CSIRO has initiated a series of rolling reviews of the organisation’s research support and overhead cost structures. By procuring more goods
and services on a CSIRO-wide basis, CSIRO expects to make substantial savings by exploiting the leverage of its combined purchasing power.

CSIRO has various instruments in place to monitor the implementation of its activities as well as to measure customer and staff satisfaction.

In addition, CSIRO has started to think more strategically about its most important clients. A lack of a one-CSIRO approach to account planning and coordination with its principal and largest clients has led to inconsistent and ad hoc interactions, together with little customer relationship management. Many of those large clients are calling out for assistance in accessing capabilities from across CSIRO.

CSIRO has introduced Client Service Teams (CSTs) for its largest multi-divisional clients to serve as liaisons between them and CSIRO resources. CSTs should improve communication across the various players in those teams. This will help CSIRO to increase revenues and reinforce client relationships through multiple linkages that will raise the stakes in the relationship.

A careful customer segmentation project is underway to help determine where best to Apply CST resources. It is expected that the number of CSTs will grow to approximately 50 by 2007, of which 25 will focus on large Australian and multinational corporations, 10 on Rural R&D Corporations, three on State agencies and five on Federal agencies, among others.

9. Partnerships and networking

Partnership is one of the six key change messages underpinning CSIRO’s overall strategic framework. For the current strategy this has translated into the following strategic goals:

- Focus and intensify collaboration with universities, CRCs and other agencies.
- Service the needs of government for informed policy setting.
- Enhance communication to raise public and stakeholder excitement and trust in science.
- Partner with other agencies to advance Australia’s global development contributions.

Regarding the latter goal, CSIRO brings multidisciplinary expertise to bear on problems of international humanitarian concern. In recent years, CSIRO has delivered more than 250 Global Aid projects in over 60 countries around the world, with collaborations involving 40 research institutions, foundations and aid agencies. CSIRO will continue to focus on the pursuit of large-scale humanitarian projects and ongoing funding for aid projects through global agencies and foundations. These projects will be performed on full cost recovery contracts and will generally be in collaboration with groups such as the Global Research Alliance (GRA), in which CSIRO is a founding member, and AusAid,
with an emphasis on transferring knowledge back into CSIRO. Aid agency objectives will be matched with CSIRO capabilities and philanthropic funding sources.

CSIRO is currently working with the GRA to set up international workshops which will culminate in multi-institution, multi-donor initiatives in the fields of water, health, energy, transportation and the digital divide. The first initiatives are likely to focus on the project areas of water and energy, taking the United Nations’ Millennium Goals as guidance. There is significant staff excitement around these pursuits.

Australia also has much to offer for many developing sovereign nations. CSIRO has been involved in activities in more than 80 countries. In 2001–02 alone, CSIRO exported $32 million of ‘knowledge’ services. CSIRO is positioned to assist in the developing nations’ complex infrastructure and nascent industry requirements. CSIRO is focused on aid, trade and science related projects that span a sovereign nation’s emerging needs.

Interestingly, CSIRO’s external partnership strategy focuses primarily on developing nations. The current strategy does not emphasize strategic partnerships and linkages with research organisations in other developed countries. This is very much in contrast to Europe, where cross-border institutional collaboration has become quite important.

10. Evaluation and impact assessment

Specific measures of success have been noted and are being further developed for each of the 24 strategic objectives contained in the current strategic plan. Further details, including annual targets, are incorporated into the Operational Plan. However, to enable summary reporting of progress, a headline performance indicator has been developed for each of the six major strategic goals. These six measures, together with measures of staff satisfaction and customer satisfaction, will form the highest level of regular strategic progress reports to the CSIRO Board. These headline performance indicators are meant to give CSIRO a clear and concise view into its progress toward the six major goals.

The headline performance indicators include:

- **Flagship Implementation**: Percentage of Flagship annual performance goals achieved (target: 70%)
- **Science Excellence**: ISI citation rates and patent impact index (target: rate of citation increase exceeds ISI & CHI benchmarks)
- **CSIRO Brand Preference**: Importance of CSIRO Brand name in Customer Value Survey score (target: improve over 2002–03 baseline - 129)
- **Industry Engagement**: Number of significant commercial relationships with industry leaders, i.e. RDCs & States ($10m threshold), Large Corporations ($2m threshold) and SME growth stars (threshold to be defined) (target: increase over 2002–03 baselines)
- **One-CSIRO Participation**: Aggregate insight score for working relationships and work organisation and efficiency (target: improve over 2002–03 baseline - 127)
- **Financial Capacity**: Achieve targeted financial results and, relative to 2002–03, achieve an: (i) aggregate increase in appropriation income (target: $174m); (ii) aggregate increase in IP revenue (target: $114m); and (iii) aggregate decrease in overhead & support costs (target: $73m)

### 11. Renewal and learning

CSIRO wants to operate at the scientific frontier and provide technological leadership. For this reason it invests quite heavily in six National Research Flagship projects (Preventative Health, Light Metals, Food Futures, Energy Transformed, Water for a Healthy Country, and Wealth from Oceans) and five Emerging Science Areas (Biotechnology, Complex Systems Science, Information and Communication Technology, Nanotechnology, and Social and Economic Integration).

### References

CSIRO Website: [www.csiro.au](http://www.csiro.au)


2. Dutch Polymer Institute and Leading Technological Institutes

1. General information about the organization

In the early nineties, the Dutch government launched the idea of so-called ‘Leading Technological Institutes’ (LTI’s) in key areas of the Dutch industry. Reports, showing that R&D activities in The Netherlands showed a relative decline in comparison with other OECD countries, induced plans to establish ‘Leading Technological Institutes’ as joint ventures between industry and academia (public-private-partnership).

In 1997, the Dutch Ministry of Economic Affairs, the Ministry of Education, Culture and Science and the Ministry of Agriculture, Environment and Fishery granted four proposals/business plans out of a total of 18 proposals, leading to four LTIs:

- Dutch Polymer Institute (DPI)
- Netherlands Institute for Metals Research (NIMR)
- Wageningen Centre for Food Science (WCFS)
- Institute for Telematics (IT)

The mission of DPI is to establish a leading technology institute in Europe in the area of polymer science and engineering that is characterised by a strong, multidisciplinary, ‘chain-of-knowledge’ approach. The institute is rooted in the Dutch public knowledge infrastructure and focuses on issues relevant for the polymer industry. The successful design of novel and/or improved polymeric materials and products requires an integrated, multidisciplinary approach and a profound understanding of the various disciplines. For DPI the following outputs or deliverables have been identified:

- fundamental knowledge base for the industry;
- new concepts and new leads for industrial development;
- well educated scientists and engineers;
- patent applications;
- publications, including theses;
- active polymer network of researchers in both academia and industry.

2. Institute governance

The Dutch government was very active in the initiation of LTIs, but left each of them free to decide on their organisational set-up. The government imposed only minimum requirements: scientific excellence and industrial appropriateness. The organisational form of each LTI is specific. DPI and WCFS are purely virtual organisations, with a lean organisation at the core and research being done at the participating research institutes, whereas NIMR and TI do much research at their core and thus have a mixed form between the virtual and the central organisation. Each organisational mode has advantages and disadvantages. While a central institute can easily integrate and motivate researchers, it runs the risk of not being supported by existing institutes because it takes
promising researchers and funds away from them. The virtual institute can mobilise manpower and equipment while they stay at their own institutes, but may encounter weaker loyalty by the research partners because they have their own, separate missions to fulfil. In practice, LTIs have chosen organisational modes that seem quite well adapted to the characteristics of the science base and industry in their respective technological fields, and that exploit well the possibilities provided by the advanced development of ICTs in the Netherlands.

DPI operates as a public-private-partnership between the main polymer producing and processing industries in the Netherlands and knowledge institutes (universities and TNO) that have a track record in the research of polymers and polymer processing. DPI focuses academic research on issues that are relevant to polymer industries. The research is characterised by a strong multi-disciplinary "chain-of-knowledge" approach.

3. Research policies and strategies

Based on the outcome of the stakeholders survey (see below) and the portfolio analysis, the DPI taskforce came up with a number of recommendations, which should form the basis of DPI’s business plan for the next five years.

Within two to three years at least 80% of DPI’s programme should score “strong” or “clear leader”. To enable this target to be achieved, the task force recommended reinforcement of DPI’s programme management and the installation of a Science & Technology Reference Board. Although the majority of the programme will continue to focus on the need of the current industrial partners, DPI should enable incorporation of projects which potentially could create new economic activity, and adapt its mission for this purpose. Key elements of the strategy will be:

1) The modus operandi will remain unchanged
   - Double the budget in the next five years to EUR 30 million

2) Implement extended mission
   - Broaden the basis of participating knowledge institutes
   - More emphasis on incubation of new economic activities via core programme

3) Implement programme portfolio upgrade
   - 80% In target area
   - New projects acquisition by tendering

4) Reinforce programme management
   - Full-time programme management
   - Install team of scientific area consultants
   - Install Science & Technology reference board
4. Organization and structure

DPI has been established as a virtual, flexible research network with a small core organization, and broad participation from the polymer industry (producers and users) and knowledge organizations.

The polymer producers in DPI are key players in the world of plastics and, moreover, strong competitors in the market. The challenge is that these companies have decided to establish a joint institute for generic, long term research in their key areas of interest, synthetic polymers, and are jointly owner (a requirement imposed by the Ministry of Economic Affairs) of the research results produced.

The entire Dutch polymer producing and converting industry is involved in DPI and international participation in DPI is increasing rapidly. Participating industries include major producers and users of polymers. The participating industries of DPI are Accelrys, Agro Technology & Food Innovations, AKZO Nobel, Analytik Jena AG, Avantium, Avery Denison, Basell, Bayer, Borealis, Chemspeed, Degussa, DOW, DSM, ECN, FGK, General Electric Plastics, Hysitron, Kraton, Merck, Microdrop, NPC Iran, NTI Europe, Océ, OTB, Philips, Sabic, SEP, Shell, Teijin Twaron, Ticona, TNO, Waters Technologies.

The main participating knowledge institutes are the Universities of Delft, Eindhoven, Groningen, Twente and TNO. Over the last years DPI has become increasingly active outside the Netherlands. Universities in Germany, Greece, Italy, U.K. and South Africa have already joined DPI. It is anticipated that the number of non-Dutch research groups involved in the DPI programme will grow the coming years. TNO is not only a member of the industrial consortium, but can also execute research within DPI – though its position in DPI will change in the new business plan, presently under elaboration.

The organizational structure of the DPI is presented below:
5. Research funding and financial management

From the beginning, the Dutch government imposed strict rules regarding cost-sharing arrangements among the participants in a LTI. The government share in total funding is limited to 50%, but cannot exceed two times the lowest contribution of either knowledge institutes or industry. Public research organisations and business enterprises each have to contribute at least 20%. The size and modalities of industry contribution differ substantially across LTIs.

DPI uses a ticket system. Each ticket costs €50,000 a year and corresponds to one vote in the programme committee and the possibility to appoint a number of contact persons for the area involved. Firms can buy more than one ticket per technology area in order to have more influence. This system contributes to making the project portfolio adaptive to industry needs. WCFS, the Wageningen based LTI, has a four-year rolling contribution system (every year, the firms agree to pay for another four years) which secures a stable financial base for long term research.

At DPI, a tickets buy a seat at the table for a specific technology area (e.g. rubber technology). Founders bought four tickets (@50,000 Euro each, for four years.) Contributions from companies are doubled by the knowledge institutions (i.e. universities and TNO) mostly through in-kind contributions (research work), but also equipment. The combined industry-knowledge institution investment is doubled again by the Ministry of Economic Affairs. But the schema has been so successful in attracting new industrial
partners that the Ministry was forced to set a ceiling on its contribution, so that its contribution is now a little under 50%.

DPI has been more successful in attracting industrial partners than other LTI’s largely due to the ticket system, which is not used in this way by other LTI’s. The ticket system is a very flexible arrangement and it is being revised at the moment as a result of its own success. Under a new arrangement there will no longer be a difference between founding members and those who joined at a later date.

DPI expenditure in 2003 amounted to some EUR 15.3 million, involving more than 220 researchers in primarily Dutch academia and Public Research Organisations (PROs), and equivalent to 140 full-time employees per year. On the industrial side the science-based network was linked to an industrial consortium of 21 international companies by means of six programme committees and numerous industrial contacts.

The following figure presents growth of DPI financial resources overall, and by program area.

The LTIs have a relatively low level of costs, making them very efficient. They have barely any overhead and almost the entire budget (>90%) is allocated primarily to the research. Compared to other instruments, the four LTIs receive modest support from public resources: some EUR 40 million each year.

6. Human resources

Staffing of LTI’s reflects the virtual nature of the organisation. Researchers working for the institute are joined in an LTI by researchers from businesses and knowledge institutions. They work closely together for various lengths of time on programmes and projects. Once their work is complete, the external researchers return to the company or institution from which they came or they may be hired by an LTI. This gives the LTIs a degree of flexibility and enables them to adapt their research programmes to match
developments in the market, society and science. This structure also facilitates the linking of knowledge demand with supply.

Numbers: for DPI

7. Management of organizational assets

None of the four LTIs has an explicit agreement about IPR allocation among partners, but patents are generally filed by LTIs and IPR practices are decided on ad hoc basis in consultation with relevant partners. LTIs give priority to partners for licensing. If no industrial partner shows interest in the patent, the patent is open to other companies outside the partnerships. It is compulsory to make research outputs available either through patenting or by publishing.

8. Management of programs and projects

The research programmes and the LTIs themselves are in principle finite and must continually demonstrate their quality and relevance. The partners (the institute, companies, knowledge institutions and government) commit for a fixed period.

LTIs are organizations that are driven by industry. This means that program priorities are set by the industry, while research work is done by the knowledge institutes and funding is shared between industry, knowledge institutes and government through a simple formula discussed above.

LTIs focus on pre-competitive research programmes exclusively. Together and with their knowledge partners, companies in the LTI carry out multidisciplinary research in the initial phase of innovation. Research is organised in a programme, focuses on the mid and long term. That is also of interest to knowledge institutions; the research that companies generally outsource to them tends to be developmental. An LTI orchestrates research and innovation in a particular key area.

At the end of phase I (1997-2001), DPI made strategic adjustments in the organisation for phase II (2002-2008). This led to the establishment of a science Core Programme. The DPI Core Programme was initiated as an enabling science activity supporting and integrating research in the various TAs. The objectives are twofold:
1) fostering advanced characterisation techniques and modelling activities to support research programmes in the various Technology Areas, and
2) incubating new research activities, which are fostered for some time within the DPI Core but may in due course develop into a new Technology Area with new and/or existing industrial partners.

The existing “Mesoscopic Chemistry/Physics” subcluster and four new activities were formulated for the future Core Programme: polymer characterisation, high-throughput experimentation/combinatorial chemistry, bio-related polymers and polymers in medicine and structure vs. performance & solidfluid mechanics of polymers.
9. Partnerships and networking

Extensive partnerships and networking are a key characteristic of the LTI’s and of DPI. Companies work with universities and public research organisations in the leading institutes to create and implement programmes of research and innovation. This enables the combination of market-led demand with the scientific knowledge supply in a continuous iterative process, a process that determines the direction research should be taking. The partners also contribute financially. Companies and knowledge institutions provide the leading institute with support, either in kind or in terms of finance, and the government then matches the participants’ contributions.

A unique characteristic is that participants from the entire industry chain (suppliers, competitors and buyers) meet one another in the LTIs, as a platform. As well as industry participants, the network also includes knowledge institutions and the government. The LTIs aim to initiate the exchange and transfer of knowledge between the partners, preferably in the form of applications and tangible innovations.

10. Evaluation and impact assessment

DPI was initially established for a four year period. An international committee evaluated DPI positively in 2001 and consequently the Dutch Government (the Ministry of Economic Affairs) will supply funds for a second period of six years (instead of the initially intended four years) up to 2008. The extra prolongation will enable DPI to expand in Europe, which is one of the original objectives. A second evaluation is planned for 2005. Also the LTI instrument has been reviewed by the OECD in 2003.

A set of performance indicators for DPI is presented in the following table:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market orientation and (inter)national relevance to industry</td>
<td># of industrial partners; % contribution of industry to total budget; # of established or transferred patents; # of licenses sold to 3rd parties; # of spin-off companies; # of institute researchers finding employment elsewhere in the field;</td>
</tr>
<tr>
<td>International position</td>
<td># of EU-projects with participation of the LTI; % EU-funds of total budget; % contribution of international partners to total budget.</td>
</tr>
<tr>
<td>Scientific/academic position</td>
<td># of TTI-papers in internationally refereed journals.</td>
</tr>
<tr>
<td>Education</td>
<td># of completed PhDs.</td>
</tr>
<tr>
<td>Governance, organisation, finance and efficiency</td>
<td>Ratio indirect costs/total costs; expenditures for knowledge transfer.</td>
</tr>
</tbody>
</table>

DPI has held a stakeholder survey and conference in 2003 to determine amongst other client satisfaction and to obtain feedback from users and other stakeholders.
11. Renewal and learning

In order to make a blueprint for the future, DPI conducted a stakeholders survey and installed a task force to study the key strategic issues for the future. The stakeholders survey revealed that DPI is on the right track to becoming a real Leading Technology Institute. However, it also showed that we have to improve our organisation and operating procedures in order to be able to demonstrate real “excellence” with our academic partners and to demonstrate real “impact” to our industrial partners.

The DPI Stakeholders Survey indicated that DPI as LTI is on the right track, but there is a need:
• for clear strategic choices in the programme
• to improve project selection
• to involve more knowledge institutes, especially foreign ones
• to improve programme management
• to improve industry participation
• to improve communications to partners
• to demonstrate excellence and impact

To assess the current status quo and to outline a future blueprint for DPI, the task force initiated a DPI portfolio analysis, to visualise the strengths, weaknesses and prospects of the DPI projects portfolio. The outcome of this exercise showed that, among other things, only half of DPI’s current projects can be seen as “strong” or “clear leader” within the academic world.

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3. Fraunhofer Gesellschaft - Germany

1. Introduction

The Fraunhofer-Gesellschaft (FhG) was established in 1949 as a non-profit organization to undertake “applied research of direct utility to private and public enterprise and of wide benefit to society.” In the early years of its existence, the main function of the FhG was to raise and distribute funds for industrial research. Its first own research institute was founded in 1954. The Fraunhofer funding model came into force in 1971. From then onward, the organization’s research capacity was continually increased through the creation of new institutes, the incorporation of other research establishments and the expansion of existing institutes.

In 2003 FhG had around 80 research units, including 58 Fraunhofer Institutes, at 40 different locations in Germany. The staff amounted to 12,700, predominantly scientists and engineers. The FhG annual budget is over one billion euros in 2003.

FhG has affiliated research centers and representative offices in Europe, the USA and Asia.

2. Governance

2.1 The FhG corporate level

The FhG has a specific place in the German research environment. Research of practical utility is the focal objective of all activities, whether these involve contract research, pre-competitive research, consulting services or studies. The majority of the Fraunhofer-Gesellschaft’s activities therefore take place in the middle ground between public sponsorship and free enterprise.

This specific orientation obliges the organization to develop the appropriate strategic objectives and organizational structures. The Guiding Principles document describes the fundamental features of the Fraunhofer-Gesellschaft’s corporate identity, and incorporates the Mission Statement which summarizes its objectives. The Statute provides a detailed definition of the tasks incumbent on the various organizational units and administrative bodies.

FhG is an autonomous organization. It is governed by an Executive Board which consists of the President and three other full-time members (Senior Vice Presidents). The Executive Board is responsible for managing the business activities of the FhG and represents the organization both internally and externally. It elaborates the basic premises of the organization’s science and research policy and draws up business-development and financial plans. The Executive Board also negotiates to obtain institutional funding for
the FhG and defines how it is to be distributed among the institutes. A further duty of the Executive Board is to appoint the directors of the institutes.

The Senate of the FhG is made up of eminent figures from the world of science, business, industry, and public life, plus representatives of national and regional government, and members of the Scientific and Technical Council. The Senate has a total membership of approximately 30 persons. It meets twice a year. The Senate is responsible for decisions concerning basic science and research policy. It also formulates decisions concerning the establishment, the incorporation or devolution, the merger and dissolution of research entities belonging to the Fraunhofer-Gesellschaft. The Senate is also responsible for appointing members of the Executive Board.

The Policy Committee is composed of representatives of the German federal government and the Länder governments, together with the Executive Board of the Fraunhofer-Gesellschaft. It meets twice or three times a year. The Policy Committee issues statements of opinion concerning issues of major strategic importance, and its approval is required to authorize the annual budget. It also discusses national and regional government research and development policy insofar as it affects the Fraunhofer-Gesellschaft.

The Scientific and Technical Council is the organization’s internal advisory body. It consists of the directors and senior management of the institutes and an elected
representative of the scientific and technical staff of each institute. The Scientific and Technical Council provides advice to the Executive Board and other constituent bodies in matters of fundamental importance. It issues recommendations concerning research and human resources policy. Furthermore, the Scientific and Technical Council issues statements of opinion concerning the creation of new institutes or the closure of existing institutes, and participates in the appointment of the directors of the institutes. The official duties of the Scientific and Technical Council are exercised by a standing committee consisting of nine members.

Institutes, branches of institutes and independent departments may form specialist groups (working alliances, thematic alliances or networks). The formation of cross-institute alliances is subject to the approval of the Executive Board. Each alliance has a chairman, appointed by the Chairman of the Senate for a term of three years. The alliance chairman assists the Executive Board in the implementation of corporate policy and accepts assignments for and on behalf of the Executive Board. Alliances exist in fields such as life sciences, microelectronics, polymer surfaces etc., an number a total of 12.

The General Assembly is made up of the members of the Fraunhofer-Gesellschaft. Official membership is open to members of the Senate, the Executive Board, institute directors and senior management and the governing boards. Ordinary membership is open to natural persons and legal entities who wish to support the work of the Fraunhofer-Gesellschaft. Honorary members may be elected from among the research staff and patrons of the FhG in recognition of outstanding services to the organization. The General Assembly meets once a year. It elects the members of the Senate and discharges the Executive Board of its responsibilities. It also formulates decisions concerning amendments to the Statute.

### 2.2 Institute level governance, organization and structure

The FhG is run according to a decentralized management concept, in which the otherwise independent institutes share the same basic aims and a common organizational structure. The institutes are the entities responsible for carrying out the Fraunhofer-Gesellschaft’s research work. As a rule, each institute is managed by one or several directors. The directors of the institutes are appointed by the Executive Board.

The director draws up plans for the institute’s scientific work. He or she holds responsibility toward the FhG for the best-possible utilization of funds, and for correctly directing the institute’s activities. The directors promote the scientific quality of their institutes by ensuring that staff receive adequate training and continuing education.

An institute’s steering committee comprises the director(s) and senior management of the institute, members of staff with a broad level of responsibility, and representatives of the Scientific and Technical Council. The steering committee advises the director(s) of the institute in all major issues concerning the institute.
The institute **Governing boards** are external advisory bodies attached to the institutes, and consist of representatives of science, industry, business and public life. For each institute, approximately twelve members are appointed to the governing board by the Executive Board with the approval of the director(s) of the institute. Their annual meetings are attended by at least one member of the Executive Board. They act as advisors to the director(s) of the institute and the Executive Board on matters concerning the research orientation and any structural changes to the institute.

### 3. Research policies and strategies

FhG is an important element in German industrial infrastructure. It provides a bridge between university and industry in the field of applied research. The following illustration shows the FhG position in the German institutional landscape.

**Research orientation**

FhG acts autonomously in defining its own strategic orientation, on which it bases its planned research activities. This orientation is closely aligned to the objectives of national and European economic and research policy. FhG is an independent organization and takes a neutral position with respect to the demands of individual interest groups in the domains of politics, industry or society.

FhG carries out publicly funded pre-competitive research. This forms the basis of the contract research projects conducted for customers. Private-sector earnings enable the organization to finance a major proportion of its budget through its own means. The FhG sees itself as a service company, offering its scientific and technical expertise on the market for research and development services.

Compared to other CROs FhG is more decentralized. Linkages and partnerships are important for effective coordination of work.

Strategy development and planning uses techniques based on the evaluation of possible future scenarios. The range of methods is extremely broad: from the linear extrapolation
of an existing situation to brainstorming sessions and other exercises in lateral thinking that deliberately ignore the status quo. The FhG has introduced a selective mix of the processes best suited to its purposes, including informal meetings of experts, creative debates with junior scientists and workshops with companies. The 1999 evaluation of the

FhG recommended that a corporate level strategy be developed and FhG three-year corporate strategy documents (the most recent covering 2003-2005) that are however not widely made available.

4. Organization and Structure

FhG is organized as a decentralized operation. It includes 57 institutes in all parts of Germany. Such a large organization needs elaborate coordination mechanisms at the central level (governance, discussed above) and between institutes.

As mentioned above the Fraunhofer institutes are grouped in a number of working alliances devoted to specific broad research areas. Their purpose is to coordinate work on related fields of research within the Fraunhofer-Gesellschaft, to pool essential resources in core disciplines, and to present a unified image in the marketplace. The spokesmen of the alliances and the Executive Board together form the Presidential Council of the Fraunhofer-Gesellschaft.

In addition, the Fraunhofer networks are marketing groups whose function is to promote the expert skills and products of all Fraunhofer institutes within a specific line of business. Their activities include joint PR campaigns, promotional events, trade show appearances and a central management system for bids and inquiries.

5. Research funding and financial management

In 2003 total budget was over €1 billion. Of this total 912 Million Euros (M€) were used for research under two different funding modes. Revenue from contract research services for public and private clients amounted to M€556 and core financed research took M€356. The core budget is contributed by the German federal and Länder governments, to support FhG in pursuing more longer-term strategic research.

FhG services are solicited by customers and contractual partners in industry, the service sector and public administration. The organization also accepts commissions and funding from German federal and Länder ministries and government departments to participate in future-oriented research projects with the aim of finding innovative solutions to issues concerning the industrial economy and society in general.

FhG provides core funding to the institutes, on average 40%. But institutes differ in the extent they depend on core FhG funding in relation to contract funding from private companies.
The Fraunhofer-Gesellschaft’s foreign earnings continue to rise steeply. This confirms the increasing significance of the organization’s activities outside Germany.

6. Management of organizational assets

The statistics on patent applications demonstrate the practical utility of research carried out by the Fraunhofer Institutes: by comparison with other German research organizations, the work of the Fraunhofer Institutes generates far more patent
applications. (more than 7 per 100, which is double that of Helmholtz and Max Planck). Although the focus is on applied research FhG as a whole has a strong publications record.

A written “code of conduct” defines the rules observed by the FhG if ever it works for two competing rivals in the same market at the same time.

Marketing receives considerable attention to attract new clients. Staff participation in over 50 organizations and associations. FhG is frequently represented at trade fairs and exhibitions.

FhG is tightly integrated in the German innovation system and it has a strong record of communication at political, policy and scientific levels.

7. Partnerships and networking
- Technology acquisition
- Technology dissemination
- Network participation
- No. and diversity of network partners (universities, funding, policy)
- Mechanisms and instruments

The ability to collaborate is an essential ingredient in enabling FhG to fulfill its designated functions and mission. The organization forms internal and external cooperative alliances to assure the exchange of ideas it needs to maintain its competitiveness and penetrate new markets.

An important characteristic of FhG institutes is that they have strong links to education and industry. There is a kind of managed competition between institutes, with some overlap and useful rivalry. At the same time the complementarity between institutes forms the basis for the internal formalized alliances.

Of particular importance are FhG institute intimate ties with selected universities, which represent a key element in its integration in the scientific community as a whole.

FhG is a major player in the European research area. The Fraunhofer Institutes network with other centers of excellence, and together help to assure the competitive strength of European research. Through its office in Brussels (established 2003), the FhG significantly develops its involvement in multinational EU projects and European research networks.

The formation of spin-off companies was started systematically from 1999. It is a key technology transfer mechanism, and offers a direct route for know-how developed in the research laboratory to be applied in industrial practice. The FhG Venture Community has been created to provide these companies with information and support. Since 1999 a total of 87 spin-offs have been created and FhG is participating in 35 such companies.
FhG and its institutes have strong links to education infrastructure, and achieve a good balance between academic approaches and industry needs. Links are maintained through a variety of mechanisms such as co-location, professorships, joint projects and involvement of students and post-docs on a (paid basis). This tight integration model may be difficult to replicate in other countries as it depends on German institutional infrastructure. In other countries these models are often cosmetic (e.g. co-location in a science park, but no real collaboration). There is a need for close operational cooperation using multiple channels and mechanisms.

8. Renewal and learning
- Staff training and upgrading
- Technological leadership,
- New products and services
- Time lags to develop new products

A key strategy for many FhG institutes to ensure renewal are to maintaining close links with universities through the involvement of professors, students and postdocs in FhG projects.

Many institutes are successful in producing a wide range of new innovative products and services on a continuous basis.

Staff commitment at many institutes is high with a recognition of institute values and industrial orientation. Decentralized operations mean that work is done through a set of linked, but autonomous research groups and teams. This ensures high intrinsic motivation, minimal managerial infrastructure and low overheads.

9. Conclusions

The most important characteristics of FhG include:
- Tight integration with the German industrial infrastructure
- Focus on large companies and public sector clients
- Limited success in reaching SME’s
- Effective internationalization strategy
- Close and effective links with universities
- High technical competence, and motivation of staff.
- Effective use of inter-institute alliances to integrate a very large and diverse system
- A large number of governance bodies and consultative mechanisms to integrate the system
- Decentralization to institutes and research teams/units

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4. IMEC-Belgium

1. General information about the organization

IMEC (Interuniversity MicroElectronics Center) is Europe's leading independent research center in the field of microelectronics, nanotechnology, enabling design methods and technologies for ICT systems. IMEC focuses on the design, production and packaging of the chips of the future. IMEC was founded in 1984, has a staff of more than 1300 people (of which about 400 industrial residents and quest researchers), and has set up more than 20 spin-offs. It has an international character and houses people of more than 50 different nationalities. IMEC always tries to look for the right balance between fundamental and applied research. IMEC is headquartered in Leuven, Belgium and has representatives in the US, China and Japan.

2. Institute governance

IMEC’s mission is "To perform R&D, ahead of industrial needs by 3 to 10 years, in microelectronics, nanotechnology, design methods and technologies for ICT systems." Its strategic objectives are:

- To sustain its position as an international center of excellence
- To maintain the right balance between fundamental and applied research
- To collaborate with an international network of partners to ensure insight into industrial needs and roadmaps
- To cooperate with local universities and higher polytechnical schools
- To strengthen local industry through technological innovation and spin-off creation
- To provide industrial training in ICT

By:
- Building up of strong, strategic know-how ("background information")
- A unique business model & IPR portfolio (intellectual property)
- Formulating visionary research programs:
  - sub-45 nanometer technology and 12" Si wafers in new lab
  - multimode-multimedia (terminals for the intelligent environment)
  - human++ (wireless sensor networks for biomedical devices)
- with worldwide networking
- in multidisciplinary teams

IMEC conceives as its important mission the integration of graduate education and research in a strong collaboration with the academic community in Belgium. Study and research have held a prominent place at IMEC.
In 1982 the Flemish Government set up a comprehensive program in the field of microelectronics to strengthen the microelectronics industry in Flanders. The decision was inspired on the one hand by the strategic importance of microelectronics for industry and on the other hand by the major investments which are required to keep up with developments in this field. This program included the establishment of a laboratory for advanced research in microelectronics (IMEC), the establishment of a semiconductor foundry (former Alcatel Microelectronics, now STMicroelectronics and AMI Semiconductor) and the organization of a training program for VLSI design engineers which is now fully integrated in the IMEC activities (INVOMEC & MTC, Microelectronics Training Center). IMEC was founded in 1984 as a non-profit organization under the supervision of a Board of Directors, with delegates from industry, Flemish universities and the Flemish Government.

3. Research policies and strategies

IMEC states that its research bridges the gap between fundamental research at universities and technology development in industry. IMEC’s research encompasses the complete spectrum from design through the processing up to the packaging stage. In addition, Microsystems are also studied. This broad range of research topics results in a comprehensive and in-depth knowledge, which according to IMEC is attractive to industrial partners. Based in its business model, it is possible for industrial partners to collaborate in research teams, which target specific technological challenges. Knowledge obtained by both fundamental and applied research is subsequently transferred to industry. This can be knowledge or a specific application, but also by the transfer of people trained at IMEC who became expert in a certain field.

IMEC carries out scientific research that runs 3 to 10 years ahead of industrial needs in the areas of microelectronics (the next generation chips and systems), nanotechnology, design methods and technologies for ICT systems (enabling technologies for ambient intelligence). In addition, IMEC has a mission statement to increase the strength of the Flemish industry.

4. Organization and structure

no information has been collected

5. Research funding and financial management

IMECs total budget of 145 Million Euro consists of 111 million euros of self-generated revenue and 34 million euro subsidy from the government of Flanders. For research facilities (like the IMEC 300 mm research facility) IMEC received a government grant of 37,2 euro. In 2003 IMEC's revenues rose by 7% to 145 million euro. Today, IMEC generates 76% of its total budget, the remaining 24% being funded by the Flemish community.

Self-generated income (108.93 milion euro):
• 54,24 % : International industry
• 25,80 % : Flemish industry
• 15,94 % : European Community
• 3,88 % : European Space Agency
• 0,15 % : Government

6. Human resources

The recruitment policies of IMEC say that PHD students in IMEC have to have a master degree. The further requirements strongly depend on the nationality and the location of the university that issued the master’s degree. For foreign students, a pre-doctoral exam is required, in order to make the foreign master’s degree equivalent to a Belgian Master’s Degree. The doctor’s degree itself requires four years beyond a Master degree in the same field and requires amongst others the completion of an acceptable thesis prepared at IMEC.

IMEC has a total personnel of 1272 (2004)

• Staff: 891 members
• Guest researchers & industrial residents: 381
• 85 % directly involved in R&D
• 32 % non-Belgian employees, 50 different nationalities
• average age = 34.4 year
• 62 % university degree
• 11 % PhD students

7. Management of organizational assets

IMEC has many other ‘advanced research facilities’ on 16,400 square meter of offices and laboratories. An educational network was set up based upon a large decentralized network of workstations and PC’s. Today, the infrastructure comprises a hundred workstations of which 60% are installed in the polytechnic schools.
IMEC recognizes the importance of awakening the general public to the importance of ICT for the society. IMEC organizes open days to make IC technology more accessible for non-specialists. In addition, the Roger van Overstraeten Foundation works to build an appreciation of science and technology amongst younger students.

Not much information has been found on organizational assets.

8. Management of programs and projects

IMEC has a rather specific way to manage and choose programs and projects. The strength of all the disciplines and groups in IMEC are gathered and steered by a number of strategic drivers, fuelling a wider range of technology programs. A first strategic driver (roadmap-driven) is CMOS/Nanoelectronics. In order to address all the technological challenges related to this driver, IMEC has built the **300 mm-compatible clean room**. The other strategic drivers all cover technologies which will be required to underpin some aspects of intelligent environment. The scenario-driven **M4 program** drives the technology programs on software defined radio, flexible air interface, multiple antenna research, etc etc. In **Human ++** the building blocks for a body-worn sensor network are being developed. Efficient power (roadmap driven) answers the need for higher power/higher efficiency demands in broadband wireless communication, et cetera. In this context, a GaN technology is being developed. Society in the future will increasingly rely on renewable energy source as solar energy. This important domain is the focus of **Solar+**. The aim of this roadmap-driven strategic driver is to improve the cost efficiency of silicon solar cells, and more.
Beyond this program driven research, IMEC also fosters exploratory research in different fields of nanotechnology, constituting pathfinder avenues for new technology programs and strategic drivers.

Quality assurance in the R&D environment of IMEC is a major requirement within the context of wide-ranging industrial cooperation. At IMEC a formal quality system based on the ISO 9001 standard has been established and this has resulted in the full NBN and ISO 9001 certification of IMEC in the area of training, consulting, design, research, development, integration and characterization of processes, systems and software in the field of microelectronics and related technologies. The purpose of the certificate is to lay foundations within IMEC to constantly improve the quality standard as well as to gain a better insight into the degree of customer satisfaction. Moreover, the certificate confers upon IMEC a greater influence in the outside world.

9. Partnerships and networking (H)

IMEC disseminates technology and science through publications, articles in national and international press, patents, posters, invited papers, conference contributions (often in collaboration with Flemish universities), class-based training. IMEC also has spun-out its low-power design tool technology to a Silicon Valley startup in a license agreement. Other spin-offs have been realized as well. During the first phase, the so-called incubation phase, spin-offs are supported through seed money and infrastructure, and these new companies can seek help from IMEC staff. In 2003, four companies were in the incubation phase. Today, about 20 spin-off companies were set up.

In 2003, more than 500 companies and institutes worldwide decided to team up with IMEC. IMEC takes part in and/or coordinates many European programs and projects (FP 5: IST; EESD; et cetera. FP 6: MEDEA +; NanoCMOS; MoreMoore; Magnet; CrystalClear; and joint research with ESA projects).

IMEC’s success in industrial collaboration relies on its combination of both fundamental and applied research, its well-established IP-policy, its state-of-the-art infrastructure and its independent base. IMEC’s research is carried out in concert with research at its associated labs at Ghent University, the University of Brussels, the higher polytechnical school of Bruges-Ostend and the University of Maastricht. IMEC also collaborates with the University of Leuven. The companies Infineon, Intel, Philips, Samsung Electronics and STMicroelectronics agreed to join IMEC’s sub-45 nm silicon research platform. IMEC also has signed a memorandum of understanding relating to a research program (germanium on insulator) with CEA-LETI, a step towards the realization of a European Research Area. IMEC, Umicore and Soitec signed a cooperation agreement and Philips and IMEC formed a strategic alliance with the aim of exploring the key processing and integration steps involved in advanced CMOS technologies.

One special partnership example of IMEC is the Arenberg research facility. 84 million was invested in it of which 37.3 million was obtained from the local government and the remaining 46.8 million as a loan from Fortis Bank, financially supported by the European
investment bank (EIB). Its activities focus on nanoelectronics and the challenges of advanced process module and device research. The interaction between process engineers, design engineers, and experts in Microsystems and packaging technologies is the cornerstone of the research facility. It is also a meeting place for experts from research institutes, semiconductor companies, material and equipment suppliers. IMEC operates with so-called ‘open research platforms’ together with industrial partners.

IMEC further employs interaction programs that allow companies and institutes to have direct access to IMEC’s core competences. These are long-term research contracts, (bilateral) collaboration contracts, technology transfers and license agreements to industrial affiliation programs. At the start of a collaboration project, a suitable intellectual property ruling is determined by the different parties. In 1991, IMEC created a new cooperation scheme called 'IMEC industrial affiliation programs' or IIAPs for joint R&D that is based on a sharing of cost, risk, talent and IP. IMEC believes that cooperative programs are critical for the development of new technologies, especially when the technological challenges are tougher than ever before.

An IIAP is a tight R&D partnership which allows industrial researchers to integrate into IMEC's research teams via well-defined programs. For each industrial partner and within each program there is room for more customized R&D. As part of this collaboration, the technology owned by IMEC can be transferred to the industrial partner. The more generic or methodological type of results can be shared amongst the partners in the program. Company-specific data or confidential information remains under the exclusive ownership of the industrial partner.

The next picture shows this business model.
In an ever more competitive market, IMEC supports its industrial partners via collaboration contracts within its various research domains. Technical specifications and duration of the project, as well as intellectual property rights are agreed in close consultation with the industrial partner. Technologies developed by IMEC are available to the industry for further development or commercialization via technology transfer or license agreements. IMEC-owned submicron process technologies or modules can be transferred to companies world-wide for further development and/or commercialization via license agreements. These can be entered either on stand-alone basis, or in combination with one or more IMEC Residency or IAP programs.

IMEC has three programs that allow partners to gain an exclusive insight into IMEC's long-term research (5 to 10 years ahead of industry) in the field of design methodologies and wireless communication systems. In this way, IMEC takes a leaf from top American universities where sponsorship programs offering early access to ongoing research are a common business model. This is beneficial to both parties since the partner can apply findings to the road mapping of its developments and IMEC benefits from very early feedback, ensuring that new research is steered accurately, towards industrial needs. The three programs, called Plato, Aristotle and Socrates, offer access to research work at different levels.

An important aspect of IMEC's mission is the reinforcement of industry in Flanders. Besides the creation of spin-offs, IMEC fulfills this goal by setting up collaborations with Flemish companies, belonging to both the ICT and non-ICT sector. Various kinds of
collaboration are possible: a joint research program, services, feasibility studies, product or process innovation, technology transfer, prospecting...

10. Evaluation and impact assessment

No information has been found

11. Renewal and learning

IMEC has a ‘Microelectronics Training Center (MTC)’ that offers courses for a varied public. These courses vary from integrated system design to process and packaging technology, but also telecommunications, introduction to ICT and training for operators and technicians. For training courses in process technology, MTC makes use of IMEC’s clean room and deep-submicron pilot line. The design courses make use of laboratories equipped with the latest design tools. The presence of and regular contact with specialists within these domains ensures the continuing high quality and currency of all these courses. Through such initiatives, teachers, post-graduates and researchers from industry can broaden and update their knowledge. Next to this, IMEC supports PhD’s from Flemish and international universities. MTC targets 3 Flemish Universities and 12 higher polytechnic schools with an electronics curriculum. Financial aid for this is arranged through IMEC and is sufficient to cover all living expenses, housing, health insurance and registration as a student. IMEC’s training center started a few years ago an initiative to reach young students between 16 and 18 in the Flemish secondary technical schools. MTC provides training to the teaching staff in the most up-to-date techniques used for the design, simulation and manufacturing of integrated circuits. Teachers of more than 55 secondary technical schools make use of this service in order to keep their knowledge and hence the content of their lessons up to date.

Next to this, MTC invested in e-learning by using streaming video. IMEC staff can make use of enormous sources of information at any time. Also training material is being disseminated. More than 300 hours of seminars and courses and 45 computer-based training courses are available online.
5. Joanneum Research: Austria

1. General information

JOANNEUM RESEARCH (JR) is one of the largest non-university research institutions in Austria, employing some 360 staff. It is organized as a private limited liability company, which is owned by the Government of Styria (90%) and TNO (10%). The corporate mission of JR is to support and strengthen Styria (a region in Austria) as an attractive location for business and science. Its core business is to conduct applied R&D for the business sector (and in particular small and medium-sized businesses) and to provide technical consultancy services to business, industry and public administration. JR covers close to three-quarters of its expenditures through research and service contracts with both the private and public sector.

JR comprises 15 research institutes located in Graz, Vienna, Leoben, Niklasdorf, Frohnleiten, Weiz and Hartberg, which are grouped into the following six research divisions:

- Division 1: Sustainability and Environment
- Division 2: Information Technology
- Division 3: Electronics and Sensor Technology
- Division 4: Materials and Processing
- Division 5: Economy and Technology
- Division 6: Medical Technology

2. Institute governance

The corporate mission of JR is to support and strengthen Styria (a region in Austria) as an attractive location for business and science. Its research and consulting services is geared to the demands of small and medium-sized businesses.

JR actively supports businesses in the innovation process and also works on developing those fundamentals upon which decision-makers in politics and administration depend in leading the region into a worthwhile future. This is done by carrying out contract research for businesses and the public sector. In addition, clients from all over the world turn to JR in their quest for solutions to problems which cannot be tackled without a broad spectrum of interdisciplinary knowledge.

JR is led by two managing directors who report to a Supervisory Board. In addition, there is Scientific Advisory Board advising on research activities undertaken by JR on its own account. This independent or pre-competitive research is seen as an investment in the further development of key research areas of the various research institutes and, through this, of the entire company. The mutual positive influence between self-financed, pre-competitive research and projects for contract research bring about spill-over effects for the clients' benefit.
The two shareholders of JR (the Styrian Government and TNO) approve the accounts.

3. Research policies and strategies

Objective: The applied R&D activities of JR are designed to provide companies with a competitive edge while ensuring a secure future and a better quality of life for society as a whole. In addition, JR aims to contribute to the further development of the province of Styria within the “EU region of the future” and enhance its competitiveness as a business location.

As a non-university research institution, JR sees its position as a bridge between the research and the business community as well as a bridge between basic and applied research. JR conducts predominantly contract research and hence has a culture of being demand-oriented and responsive to client needs. In addition, based on the grant provided by the Styrian Government and the Federal Ministry for Transport, Innovation and Technology JR conducts a substantial amount of research on its own account.

JR strives to achieve top scientific quality and economic efficiency using the means at its disposal. The research program is subjected to a continuous process of evaluation and revision. The aim is to achieve a high degree of innovation and problem-solving capacity. Special attention is placed on anticipation of future research needs and market observation in order to ensure long-term competence.

With the expansion of European Union, JR sees major opportunities in increasing its research partnerships with the new EU members. It is promoting itself as a bridge between the old and new EU members.

4. Organization and structure

JR comprises the following six research divisions, each comprising two or more research institutes:

- **Division 1: Sustainability and Environment**
  - Institute of Water Resources Management
  - Institute of Sustainable Techniques and Systems
  - Institute of Energy Research

- **Division 2: Information Technology**
  - Institute of Information Systems and Information Management
  - Institute of Hypermedia Systems

- **Division 3: Electronics and Sensor Technology**
  - Institute of Applied Systems Technology
  - Institute of Digital Image Processing
  - Institute of Chemical Process Development and Control
  - Institute of Sensor Technology
Division 4: Materials and Processing
  o Laser Center Leoben
  o Institute of Nanostructured Materials and Photonics

Division 5: Economy and Technology
  o Institute of Technology and Regional Policy
  o Institute of Applied Statistics and Systems Analysis

Division 6: Medical Technology
  o Institute of Medical Technologies and Health Management
  o Institute of Non-Invasive Diagnosis

In addition, JR participates in some eleven research companies.

Central functions of the organization are assigned to four departments: (i) Research Planning, Technology Consulting and Project Management; (ii) Finance and Controlling; (iii) Computer Centre; and (iv) Central Services and Maintenance.

The overall tendency in terms of organization is to consolidate the relatively large number of small institutes into larger entities.

5. Research funding and financial management

JR receives nearly three-quarters of its revenues on the basis of research and service contracts. The other quarter or so is provided by the Styrian Government and the Federal Ministry for Transport, Innovation and Technology in the form of a grant. A breakdown according to client groups reveals that business enterprises account for 40%, public authorities for 41%, and international organisations, such as ESA or the European Commission, for 19% of JR’s operating revenue. Overall, JR seems to work for quite a diverse group of clients.

<table>
<thead>
<tr>
<th>Funding Joanneum Research</th>
<th>2002-2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government contribution</td>
<td>EUR 7.8 million</td>
</tr>
<tr>
<td>Research contracts</td>
<td>EUR 18.3 million</td>
</tr>
<tr>
<td>Other</td>
<td>EUR 2.0 million</td>
</tr>
<tr>
<td>Total revenues</td>
<td>EUR 28.1 million</td>
</tr>
</tbody>
</table>

The grant provided by the Styrian Government and the Federal Ministry for Transport, Innovation and Technology is invested, among other things, in key research activities JR has initiated on its own. Usually additional funding is being leveraged for this type of research by submitting research proposals to competitive funding schemes, like the S&T Framework Program of the EU. The EU funding, however, does not cover more than 50% of the research costs.

Due to its high dependence on contracts, the income of JR is quite sensitive to the overall economic development of the country.
6. Human resources

For the last two years, the reported staff turnover has been in the order of 19%, which seems to be quite high.

JR offers tailored postgraduate opportunities in order to assist innovative and committed staff to develop their technical, social and entrepreneurial skills, thus preparing them for management careers in research, business and administration.

7. Management of organizational assets

Investments in fixed assets have increased in recent years.

JR recognizes the importance of public relations and manages those relations actively.

No information on IPR or reputation management.

8. Management of programs and projects

The selection and implementation of self-financed (i.e., non-contract) research is closely monitored by JR’s Scientific Advisory Board. Once a project has been approved, the researchers submit the results of defined parts of the project to the Scientific Advisory Board at regular intervals for appraisal, and explain any further progress in their research. These presentations take place at least once a year.

JR has just started customer satisfaction surveys. No results are available yet.

9. Partnerships and networking

JR closely collaborates with universities in Styria and institutes of the Austrian Academy of Sciences. Moreover, by actively holding shares in eleven other research companies, JR has developed strong partnerships within the Austrian science community. In addition, it has developed strong partnerships with research organizations throughout Europe by actively participating in EU projects.

JR serves the regional “Styrian Innovation System” as an institution whose work is targeted at the sustained strengthening and forward-looking development of this complex intertwined network. One of the most important tasks of JR, which in this context acts both as a “system builder” and as a “network node”, is to increase its integration in international, national and (supra-)regional innovation networks, an essential precondition for competitive research and business.

JR emphasizes the importance of networking at all levels:
Internationally, JR seeks out strategic partnerships in the »European Research Area«, which may range from long-term institutional collaboration in the European Networks of Excellence to reciprocal participation in non-university research facilities in other countries. (Supra-)regional cooperation focuses on collaboration with other federal provinces and with the neighbouring countries of the “South East Region of the Future”, i.e. the neighbouring EU candidate countries. At national level, JR will continue to participate actively in cooperation projects between the federal government and the provinces and in programmes co-financed by the state (e.g. competence centres). A further objective is to establish a sound forum for the development of a joint strategy by the state and the provinces, in which questions of research planning, institutional links or new locations can be discussed. At regional level, JR will attempt to extend its key role in the Styrian innovation system. This is to be achieved by intensifying relationships with the Styrian universities and universities of applied sciences, as well as with the business sector.

JR promotes communication and cooperation between scientists at all levels within the “European Research Area”.

JR sees itself as a node within an international network in the context of a future “Centre of Excellence”.

10. Evaluation and impacts assessment

In addition to its annual reports, JR also publishes on a regular basis an Intellectual Capital Report (or JR Explorer). The global economy presents companies with ever changing challenges. Staff knowledge and motivation, the relationships with partners and customers and innovation capacity are of more importance for business success than the financial capital on the balance sheet – and this is particularly true for research institutions.

It is because of this that intellectual capital reports are used worldwide in order to improve the recording of these intangible resources and to take them into account in strategic planning. Intellectual capital reports cover not only the financial figures but also intangible values such as staff knowledge and cooperation networks. The conventional models, however, are based on the requirements of business enterprises and are therefore of only limited value for the wide range of functions of non-university research institutions. For this reason, JR has developed a tailor-made management instrument for non-university research on the basis of established standards; the JR Explorer, which is designed to collect and evaluate information about the financial, structural and staff-related resources of the enterprise in order to be able to make best possible use of them for the economy and society as a whole.
The JR Explorer 2002 evaluates the status of JR on the basis of three orientations, namely: (i) resources (financial, structural, and human); (ii) results (economic, scientific, and social); and (iii) future (analysis, strategy, and positioning).

Economic results in the JR Explorer 2002 are defined mainly in terms of turnover of the institute. Client satisfaction surveys have only recently been initiated. The ultimate economic impact of the research and services provided is not being reported upon. Strategic objectives are more formulated in terms of company turnover, self-financing ratio, and average project size, than in terms of economic well-being and improved quality of life.

11. Renewal and learning

No information available.

12. Conclusions

Joanneum Research shows balance between private and public clients. JR still receives a substantial grant from the government, which allows it to initiate some of its own research. It also gives JR more lead way to leverage additional resources. Typical for JR is the recent emphasis on playing a lead role in partnering with research organizations in the new EU member states and the emergence of a new and dynamic EU region.

References

JOANNEUM RESEARCH website: www.joanneum.at


6. SINTEF- Norway

1. General information

The Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology (SINTEF) is the largest independent research organisation in Scandinavia, employing some 1700 staff. SINTEF was originally established in 1950 by the Norwegian Institute of Technology in Trondheim, which today is part of the Norwegian University of Science and Technology (NTNU). Two intentions were involved: SINTEF was to encourage technological and other types of industry-oriented research at the Institute. SINTEF was also to meet the need for R&D in the public and private sectors. The SINTEF of today includes the former Centre for Industrial Research, which was set up in Oslo in 1949. The two institutes merged in 1993.

The SINTEF Group was founded in the mid-1980's when the Ship Research Institute of Norway, the Norwegian Research Institute of Electricity Supply and the Continental Shelf Institute were drawn under the SINTEF umbrella. These institutes were transformed into research companies with SINTEF being the central shareholder. The fourth research company, SINTEF Fishery and Aquaculture, was established in 1999.

The SINTEF Group consists of nine research institutes gathered (since January 2004) under the following six research divisions:

- SINTEF Health Research
- SINTEF ICT
- SINTEF Marine
- SINTEF Materials and Chemistry
- SINTEF Oil and Energy
- SINTEF Technology and Society

Contracts for industry and the public sector generate more than 90 % of SINTEF’s income. Only a small proportion of SINTEF’s income is provided in the form of basic grants from the Norwegian Research Council. Most of SINTEF’s research staff (1350) is based in Trondheim, while the remainder (350 staff) is based in Oslo.

2. Institute governance

The SINTEF Group lives by finding intelligent, profitable solutions for its clients - solutions based on research and development in technology, the natural sciences, medicine and the social sciences. SINTEF’s vision is: Technology for a better society.

SINTEF is a private, independent foundation, managed by its own Board. The Board responds to a Council, which comprises 32 members drawn from NTNU, SINTEF, and representatives of industry. The Council meets twice a year, and ensures that the objectives of the Foundation are being pursued. The Council appoints the Board for a
two-year period, as follows: two members who hold full-time positions at NTNU, three members from the industry and public sector, and two tenured SINTEF employees. The Board has the responsibility in all matters that are not the responsibility of the Council. The Board appoints the Group’s President. The Group’s daily management is in the hands of the Group’s President and Senior Vice-President, together with the directors of the six research divisions.

Via its statutes and in other ways SINTEF has close ties to NTNU, but in financial and administrative terms it operates completely independently. Any profits made by SINTEF have to be reinvested in research projects.

About a third of the activities of the SINTEF Group are organized in form of limited companies, which SINTEF owns fully or partially. These companies are: SINTEF Energy, SINTEF Petroleum, SINTEF Fisheries and Aquaculture, MARTINEK, and Sinvent Ltd.

3. Research policies and strategies

The revenues of the SINTEF Group are predominantly coming from research contracts (93.6% in 2003) provided by both industry and the public sector. SINTEF receives only a small grant from the Norwegian Research Council for non-project related costs and some strategic research programs. In that sense, most of SINTEF’s research activities are demand-driven and hence the Group’s strategic decisions are steered largely by the expected demand in the market. Close to half of this demand is coming from industry, while the other half is coming from the public sector, including Norwegian government agencies, the Norwegian Research Council, as well as overseas government agencies (in particular the European Union).

4. Organization and structure

Since the mid-nineties the SINTEF Group has undergone a radical process of reorganisation - a process that was triggered by changes in the industrial scene. Mergers and foreign buyouts led to internal restructuring and reductions in the size of research departments in many industrial companies. This altered the character of the contract research market, and thus also the need for SINTEF’s competence. The market for top-level expertise has shrunk and companies are more concerned with solving large problem complexes. Nevertheless, SINTEF has been able to strengthen its position in the market by reorganising its activities from a large number of small scientific departments into 12 large market-oriented research institutes. Further consolidation took place in January 2004, when SINTEF created the following six research divisions:

- **SINTEF Health Research** (revenue: NOK 126 million)
- **SINTEF ICT** (revenue: NOK 252 million)
SINTEF Marine: comprising SINTEF Fisheries and Aquaculture and the Norwegian Marine Technology Research Institute (MARTINEK) (combined revenue: NOK 184 million)

SINTEF Materials and Chemistry: comprising the former SINTEF Materials Technology and SINTEF Applied Chemistry (combined revenue: NOK 376 million)

SINTEF Oil and Energy: comprising SINTEF Energy and SINTEF Petroleum (combined revenue: NOK 308 million)

SINTEF Technology and Society: comprising SINTEF Civil and Environmental Engineering and SINTEF Industrial Management (combined revenue: NOK 183 million)

In addition, the SINTEF Group also acts as an incubator for new industrial companies. For this purpose it has created Sinvent Ltd, which generated revenues in the order of NOK 87 million in 2003.

SINTEF’s six new research divisions have been defined in terms of value chains and industrial market clusters, creating a close match with the market.

5. Research funding and financial management

SINTEF works for a large number of both public and private clients. Most of its funding is obtained in the form of (research) contracts and only a small proportion of its income comes as a grant (less than 7%). Hence the separation of funding and implementation is almost complete.

<table>
<thead>
<tr>
<th>SINTEF funding</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research contracts</td>
<td>NOK 1,213 million</td>
</tr>
<tr>
<td>Research Council projects</td>
<td>NOK 371 million</td>
</tr>
<tr>
<td>Research Council grant</td>
<td>NOK 49 million</td>
</tr>
<tr>
<td>Other</td>
<td>NOK 57 million</td>
</tr>
<tr>
<td>Total revenues</td>
<td>NOK 1,690 million</td>
</tr>
</tbody>
</table>

SINTEF relies strongly on the market for its income and hence is vulnerable to fluctuations in demand for research due to economic recession. In 2002, for example, SINTEF had to cut its staff and operating costs substantially in order to avoid further losses. Further consolidation of the Group’s activities was deemed necessary.

In 2003, SINTEF launched a number of measures aimed at increasing turnover and raising customer satisfaction. SINTEF has set itself the goal of developing a robust strategy for internationalisation which, in addition to a range of market-oriented measures, will focus on the organisation’s international capacity. Another improvement project will focus on SINTEF’s market processes, including its ability to understand its clients’ value chains and build networks with customers on a more strategic level.
6. Human resources

Staff turnover is relatively high at 10-15% of all staff leaving the organization every year. It suggests that SINTEF has quite a bit of flexibility to adjust its staff depending on demand in the market.

SINTEF aims to be an attractive place to work, in which the company culture will be rooted in basic values such as honesty, generosity, courage and solidarity. The business culture of the organisation will be strengthened.

SINTEF ranked third among Norwegian companies as a preferred employer by young graduates.

<table>
<thead>
<tr>
<th>SINTEF staffing</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total staff SINTEF Foundation</td>
<td>1,118</td>
</tr>
<tr>
<td>Total staff SINTEF Companies</td>
<td>640</td>
</tr>
<tr>
<td>Total staff SINTEF Group</td>
<td>1,758</td>
</tr>
<tr>
<td>Of which researchers (estimated)</td>
<td>1,270</td>
</tr>
</tbody>
</table>

7. Management of organizational assets

No concrete information available.

8. Management of programs and projects

No concrete information available.

9. Partnerships and networking

Historically, SINTEF has very close ties with the Norwegian University of Science and Technology (NTNU). Collaboration between the two institutes involves, among other things, exchange of staff and joint use of laboratories and equipment. At present, SINTEF is in the process of setting up similar close collaboration with the Faculty of Mathematics and Natural Sciences in the University of Oslo.

About 15% of SINTEF’s research contracts are international, of which half with the European Union (EU). Most international contracts are in partnership with overseas research organizations.

10. Evaluation and impacts assessment

No concrete information available. Impact is mainly formulated in terms of turnover. The slogan “Technology for a better society” only operates in the background. No concrete measurable targets are being applied.
11. Renewal and learning

SINTEF’s close ties with two universities give it access to the academic community, including PhD students. SINTEF places great emphasis on being a good school for careers in research, industry and the public sector and operates its own internal training program.

SINTEF is keen to produce the best technological solutions for its clients. Hence it closely monitors client satisfaction and has taken steps to better understand client needs.

The SINTEF Group operates a business incubator in order to launch new products and services in the market.

12. Conclusions

SINTEF is strongly demand-driven and works primarily for the private sector and to a lesser extent for the public sector. SINTEF’s strong involvement in the private sector is also reflected by the fact that SINTEF operates a business incubator (Sinvent Ltd).

References

SINTEF website: www.sintef.no


7. **TNO – The Netherlands**

1. **General information about the organization**

TNO is the Netherlands Organisation for Applied Scientific Research. In 1930 the Dutch Parliament passed the ‘TNO Act’, an act that regulates applied scientific research in The Netherlands. Two years later TNO was legally established. A revised and updated TNO Act became operative in May 1986. The current TNO mission statement summarizes what the organization is about:

“To apply scientific knowledge with the aim of strengthening the innovative power of industry and government”.

In 2003 TNO and other Technology Institutes in the Netherlands were externally reviewed. Following the evaluation TNO has taken the initiative to restructure its operations.

2. **Institute governance**

TNO is an independent organization defining and implementing its own policy with respect to finance, personnel, commercial affairs, R&D programming, and so on. TNO is not, and has never been part of the national government. TNO does maintain, however, a close relationship with the Dutch Ministry of Education, Culture and Science, which acts as the coordinating ministry. For this and other ministries, TNO fulfils a number of tasks relating to issues of national importance. In addition, TNO acts as the principal laboratory and research institute for a number of ministries, in particular Ministry of Defense.

TNO has a **Supervisory Board**, which is responsible for supervising the policy of the Board of Management. The Supervisory Board comprises eight members appointed by Royal Decree. The chairman and three of the members are appointed on the recommendation of the Minister of Education, Culture and Science (one of whom is recommended by the Central Works Council). Three members are appointed on the recommendation of the Minister of Economic Affairs and a civil servant at the Ministry of Education, Culture and Science is an advisory member.

The **Board of Management** is charged with managing the organization and has full authority to do so insofar as this is not the responsibility of other bodies according to the TNO Act. The Board of Management consists of four members appointed by Royal Decree: the chairman and two members on the recommendation of the Minister of Education, Culture and Science and one member on the recommendation of the Minister of Defense.
3. Research policies and strategies

In 2004 an external evaluation of TNO and other technology institutes in the Netherlands concluded that the traditional intermediary role of TNO (between universities doing fundamental research and the market of public and private clients) was no longer relevant in today’s highly dynamic and increasingly fragmented innovation system. Universities, for example, increasingly commercialize their knowledge and intellectual property and do projects for clients. Large private companies also invest in their own research laboratories and build direct links to universities. New forms of collaboration and competition emerge between a variety of organizations. The role of government in steering and funding is also changing towards market type relations based on performance-based contracts. Given these dynamics the external evaluation concluded that the old “bridging metaphor”, based on the concept of a linear transfer of technology, had become outdated. Also it was felt that, in an increasingly competitive environment TNO should become more sharply focused on those areas where it can assume a position of leadership.

The policy recommendations, which TNO has accepted and started to implement from 2005, emphasize that TNO should:

- Become more demand-driven in its funding and operations
- Establish direct linkages with key actors in the innovation system
- Play its intermediary role in dynamic networks of knowledge organizations
- Increase its impact in society
- Increase its support to SME’s

Strategy

Once every four years, TNO defines its strategy. This strategic plan forms the basis for agreements between TNO and the Dutch government on, for example, government funding to TNO. Based on the agreed strategic plan, TNO also receives programme-directed government funding for the development and application of new, strategic technologies.

4. Organization and structure

Starting 2005 TNO has abolished its 15 institutes and consolidated them into four Core Areas:

- TNO Quality of Life
- TNO Defence, Security and Safety
- TNO Science and Industry
- TNO Environment and Geosciences
- TNO Information and Communication Technology

The main purpose of consolidation is to do away with compartments between institutes, enhance the possibilities of doing interdisciplinary research and increase TNO, improve the critical mass in key areas, reduce overhead and management costs and, in general, become more competitive.
**Business Centers.** Under the old TNO structure, the development of business centers has provided an important entry to the market place via which the combined expertise of different institutes was offered. These business centers are maintained within the new TNO organization and foster TNO’s market interests. In the new set-up each core area has a number of business centers. The Quality of Life area, for example, has five: Pharma, Work and Employment, Prevention and Healthcare, Food and Nutrition, and Chemistry.

Business centers reflect the blurring of the boundaries between various sectors. The individual TNO institutes have traditionally established links to particular sectors, and the business centers have been used in the past as a convenient ‘one-stop shop’ to access all information on a given topic whilst building relations with a specific clientele.

Business centers also act as a signpost to government to illustrate current areas of interest and concern within the market. TNO plays a special role in that it is a private body with a public interest, i.e. it can independently provide services that are both politically and socially important. In this role the business centers can also be said to be society driven.

Business centers have a virtual existence, with a small coordinating office at one of the old institutes. Centers have business/account managers that work primarily outside the boundaries of the centers and TNO to develop partnerships, projects and proposals. The Business Centers in particular undertake pro-active marketing to big clients that have complex research projects, projects which could not be tackled by one Institute alone. Some business centers have established offices outside the Netherlands.

For operational purposes, and because each core area is based in a number of different locations in the Netherlands, each core area also has a number of Business Units which are the basic work units of the new organization.

**5. Research funding and financial management**

In 2003 consolidated TNO turnover amounted to M€472 with international turnover amounting to m€100.

<table>
<thead>
<tr>
<th>TNO funding and finance (2003)</th>
<th>€</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic funding</td>
<td>72</td>
<td>15</td>
</tr>
<tr>
<td>Targeted funding</td>
<td>92</td>
<td>19</td>
</tr>
<tr>
<td>Contract research (public Netherlands)</td>
<td>56</td>
<td>13</td>
</tr>
<tr>
<td>Contract research (private Netherlands)</td>
<td>152</td>
<td>32</td>
</tr>
<tr>
<td>Contract research (private international)</td>
<td>80</td>
<td>17</td>
</tr>
<tr>
<td>Contract research (EU)</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>472</td>
<td>100</td>
</tr>
</tbody>
</table>
The strategic plan forms the basis for agreements between TNO and the Dutch government in the areas of funding and strategic national research. Increasingly, performance assessments are used, to determine public funding support. Performance questions are answered through external audits which focus on:

- **Market**: how well does TNO do in the market, including customer satisfaction audits
- **Knowledge-rating**: TNOs competitiveness of knowledge and technology by international audit committees
- **Research Infrastructure**: how active in TNO in networks with other partners
- **Finance**: financial results

Government funding to TNO comes in two types. Firstly is basic funding – TNO present its plans and the funding is granted on acceptance of the strategy. For this funding TNO is free to develop the areas of research in accordance with its own strategic interests. The second type of government funding is that of targeted funding. For ministries such as Defense, Environment, Agriculture a list of specific priorities is presented, which are integrated with TNO strategy. The Ministry of Economic Affairs has supported a matching fund with industry.

### 6. Human resources

At TNO, a staff volume of more than 5000, (or 4500 FTE) representing a wide variety of scientific disciplines, generate, market and apply technological knowledge for clients in the corporate and public sectors. Once every four years TNO measures the satisfaction of personnel. The results determine the direction of required changes to further improve the performance of TNO. Relations with the Environment An international audit commission assess the knowledge position and the market relevance of the TNO institutes every four years. These audits provide an insight into the competitive level of TNO technologies and their market relevance. *Client satisfaction* is audited every two to three years. The results form the basis for measures to make improvements and for internal training.

### 7. Management of organizational assets

Applied scientific research is TNO’s core business. Working on the edge of new and high-end technologies makes it important to enable the attraction of, sometimes massive, investments to put innovations on the market. For that reason TNO has an active policy to protect inventions through patents and other forms of IPR.

At the moment TNO’s patent portfolio consists of more than 500 patents issued, and up to 2000 pending based on more than 250 inventions, covering almost all of TNO’s activities in the field of applied scientific research.

Following its mission TNO offers the larger part of its patent portfolio for outside exploitation through out-licensing or full transfer. Many forms of partnerships are already present at the moment, ranging from royalty-payment schemes to joint-ventures in start-
up companies. Many research projects are carried out for partners to further develop inventions originating from TNO. Through an active out-licensing program with many partners over the world, ‘Patents & Licensing TNO’ seeks to fully exploit the commercial value of TNO's inventions.

8. Partnerships and networking

TNO is using a wide variety of mechanisms to link with partners and clients in the innovation system.

**Knowledge centres** are a co-operation between university and TNO Institutes. These are not market-oriented ventures, but have technology development as their motivation. Through partnerships TNO can access specialized knowledge, while working together with university staff to develop this knowledge further. The outcome is a joint research programme, with the majority of work being done at the university - in reality an outsourcing of research with agreements on patents and knowledge rights.

These virtual knowledge centres create a number of advantages. Firstly, they deepen the TNO technology base. They also provide fundamental input to TNO research and developments, while at the same time providing complimentary input into research. Importantly they prevent an environment of competition between TNO and the universities for funding and contract research, while helping the universities to become active in the applied sector. Overall they strengthen the level of knowledge at TNO.

One of the main challenges for TNO is to intensify relationships with the business world, a policy that is being pursued along different routes. One successful approach has been to undertake large **joint strategic R&D projects** together with R&D-intensive companies and develop special projects geared towards the SME sector. To anticipate the need to structure extensive, long-term research programs for innovative knowledge development, agreements are being made with the Dutch government for this purpose. TNO is developing various commercial and market-gearred activities through TNO Management B.V., a subsidiary.

An integral part of TNO’s mission is to commercialize knowledge. One increasingly important strategy for TNO is to commercialize mature technologies through the creation of spin-off companies. TNO has established a number of limited companies which function as the holding for a number of **spin-off companies**.

At present TNO generates about a quarter of the turnover from R&D contracts outside the Netherlands. International activities are made up of two main components: contract R&D for clients - companies and governments in Europe, USA, and Japan; participation in European research programs such as the EU Framework Program and TACIS. TNO is currently expanding their markets particularly in the USA, Western Europe, Central and Eastern Europe, and Asia Pacific. TNO’s international market-driven orientation is supported by sales and marketing offices located in Japan, Central and Eastern Europe, and the USA. In view of the international character of the knowledge
market, TNO aims to take advantage of growth opportunities which foreign markets offer by expanding activities abroad that are geared towards accessing new clients. Many of TNO’s clients are companies on the international stage.

10. Evaluation and impact assessment

In addition to basic financial indicators, TNO has in place a number of mechanisms to measure, on a regular basis, the quality of its projects, the satisfaction of its clients, and the quality and relevance of its knowledge base. A major challenge identify by the TNO Management Board is to increase TNO’s impact in society as a knowledge organization. TNO performs a customer satisfaction audit (CSA). Before 1996 TNO had different forms of complaint procedures, internal evaluations and external measurements on project basis. However, there was no systematic knowledge of customer satisfaction. The CSA is now part of a ‘knowledge position audit’ of which ISO and the Employee satisfaction audit also are part. The CSA is designed in the following manner:

1. preliminary investigation
2. selection of audit design
3. selection of customers
4. draft of the questionnaire
5. pre-test of the questionnaire
6. announcement of the audit
7. execution of the audit
8. report
9. evaluation

The conditions for success are commitment, cohesion between the various improvement actions and the extend to which one hangs on to the improvements achieved. General aspects in the questionnaire are: strengths, weaknesses, image, transparency, decisive reason to contract TNO, acquaintance with products. Service aspects are speed, quality, delivery time, communication, accessibility, support staff, customer focus. Product aspects are reporting method, final product, practical applicability, knowledge/expertise. And price aspects are perception of price

11. Renewal and learning

Like all contract research organizations TNO has to ensure it future relevance to client needs by ensuring continuous learning renewal. The current TNO reorganization is a key instrument to realign the organization’s policies and strategies with the dynamics of the environment in which it operates. Strengthening the organization’s partnerships with universities, innovative companies, and government organizations is very important. Special attention needs to be given to international partnership the innovation systems become increasingly regional and global.
Internally TNO is work to ensure that responsiveness to client needs is improved. Staff capacity and motivation are key organizational assets for a knowledge organization and need to be maintained at the highest level.

12. Conclusions

To ensure that TNO maintains a leading position amongst Europe’s contract research organizations its Board has decided to initiate a major restructuring and reorganization process. The restructuring is aimed at breaking down compartments within the organization, increase critical mass, and promote inter-disciplinary research that is oriented towards problems solving. In addition, a new organizational culture is being promoted that values commitment, entrepreneurship, and responsiveness to client needs.
8. VTT - Finland

1. General information about the organization

VTT was established in 1942 as an independent research body under the Ministry of Trade and Industry, based on legislation adopted by the Finnish Parliament. The centre was established in part to test materials and composite structures for the state, private companies and individuals. From the beginning the Centre has the right to negotiate its own contracts for research assignment. VTT has more than 2800 employees (31/12/2003) who are located in four areas of Finland. There are no units abroad.

2. Institute governance

The purpose of VTT is to enhance technical research activities for the sake of the public good. VTT’s vision is to be one of Europe’s leading R&D organizations in its field. As part of this vision VTT wants to enhance actively the competitiveness of industry and other business sectors, and thus to increase the welfare of society. All the activities are based on the ethical norms: impartiality, reliability, integrity and responsibility.

In 1972 the legal status and structure of the Centre changed, and VTT became more autonomous. VTT has a corporate structure, including independent research units. Within their respective branches, the research units are responsible for research activities, resources and customer connections.

Management by results is being used in consultation both with the Ministry of Trade and industry and between the VTT corporate level and research units. In each unit, the respective research manager is in charge of planning, monitoring and attaining the targeted results. Merit payment is a part of the management and reward system. The board of VTT consists of representatives from ministries, industry and staff. It has a steering and guiding role. The main decisions are made by the director general and executives. Representatives of industry are present in the advisory committees of research units. Research managers from each unit are included in executive-level decision-making. The director however has a relatively broad executive responsibility. Responsibilities are defined in the legislation establishing VTT. VTT currently consists of 8 units.

3. Research policies and strategies

VTT is a ‘not-for-profit’ organization; the primary task is to carry out research and development, technology transfer and testing. VTT operates in accordance with Finland’s technology, industrial and energy policies, and plays an active role in their formulation. VTT has formulated strategic technology themes: Future Communication Technologies, Clean world, Intelligent products and Systems, and Safety and Reliability. VTT’s policy emphasis is more and more on international activities and EU framework programmes. Furthermore, VTT’s strategy is to develop international collaboration at
VTT is becoming more oriented towards economic needs. Currently, the main aim of VTT is to improve competitiveness to a new international level.

Part of the research (30%) is long-term research on VTT’s own initiative. Strategic research (14% of this) which is basic or applied industrial research, is aimed at increasing VTT’s core competence and competitiveness in key areas. Jointly funded activities are demand-based and they enable the participating companies to follow the latest technological innovations and create contacts. Strategic research can be either basic or applied industrial research. Strategic research precedes commercial activities, offering promising application opportunities in the future. VTT invests in areas that are able to benefit the whole society. The research activities are based on scientific know-how, exerting a positive surrounding economy and business, creating genuine innovations. VTT acts as a partner with its customers in the creation of innovations. The focused and flexible organization of research tasks is carried out according to the demands of customers.

VTT’s units are: VTT Electronics, Information Technology, Industrial Systems, Processes, Biotechnology, Building and Transport, Information Service, Corporate Management Services

Realising VTT’s vision and the goals associated with it requires a systematic approach to good relations with customers. The vision includes separate components for individual target groups: for customers the mission is intended to express that VTT is an internationally recognized, synergetic and flexible partner. For owners (the state) and finance providers (government bodies, private companies), it means that VTT is an engine for technology development in Finland and the best investment option in the innovation environment. For the personnel, the vision signifies that VTT is the most desirable workplace for experts to improve their know-how and professional careers. VTT identifies and foresees the emerging demands arising in society and business, especially from industry, and reacts quickly and in every sector for the benefit of its customers.

Customer satisfaction is being monitored continuously by surveys.

R&D activities are preformed in projects. The status as performer of research and development is mainly in applied research in co-operation with universities, which mostly carry out basic research, and industry, which correspondingly is responsible for the product development. VTT’s role is to develop know-how in core technologies and product ideas, which then are handed over to corporate partners for commercialization on market terms.

SMEs are an important customer group for VTT. Services targeted at the SME sector included the activities of Tekes's technology clinics, networking projects, and co-operation with regional technology centres.
4. Research funding and financial management

The activities are either self-financed, joint projects (with research institutes, universities, government or industry), or commercial assignments.

The basic governmental funding, +/- 30% of the annual turnover, is used mainly for long-term research on VTT’s own initiative (16%) or jointly funded strategic research (14%). External funding for jointly funded activities totals 30% of the annual income. About 40% of the annual VTT income is from commercial activities. The main form of jointly funded R&D projects is the national technology programme. These generate new knowledge and technology that is transferred to companies even while the programmes are still in progress. The majority of the programmes have been coordinated by the National Technology Agency (TEKES). VTT participates in the planning, implementation and coordination of several long-term national research programmes.

5. Management of organizational assets

According to the VTT IPR (Intellectual Property Rights) policy, VTT focuses on developing internationally valuable high technologies and on technology transfer. The resources are directed toward improving the existing products of the clients, toward generating and developing new products and to finding durable success factors.

VTT protects its technological property in an effective manner. VTT possesses core technologies, and by further developing these core technologies it aims at the highest world-class level of research. Each core technology is administered as a technical and juridical entity, which maximizes the advantage of exploitation. Unnecessary fragmentation of these entities is avoided. If the core technology is not one of VTT’s research service products, it can be transferred as a whole to one or more undertakings for exploitation. VTT strength is in core technologies, know-how and in the creation of product ideas.

Corporate partners, in turn, possess business know-how and market knowledge. Product development takes place in the interface of these elements. VTT general research policy states that in joint projects with industry, results and product ideas are transferred to corporate partners for commercialization on market terms. One form of technology transfer is the mobility of researchers. The great share (82 per cent) of the employees leaving VTT is hired by the private sector. Since the 1970s, over 70 spin-offs have started from VTT.

According to Finnish law on inventions, under which VTT functions, employees are required to make an announcement of their inventions. The employer must decide within four months whether it is willing to take the rights to the invention. For commercialization, VTT established Finntech Finnish Technology Ltd, which recently merged with Helsinki University Licensing Ltd to form Licentia Oy (www.licentia.fi). Licentia Oy is a company that focuses on the licensing and commercialization of
scientific research results. Licentia offers services to researchers and the academic community by identifying innovative technologies and marketing them selectively to companies. It creates added value for innovations by ensuring industrial protection for them and co-ordinates development work that improves prospects for licensing. Besides VTT, the current shareholders are the University of Helsinki, Helsinki University of Technology, and the Finnish National Fund for Research and Development (SITRA).

Ethical norms; VTT is committed to complying with the procedural instructions prescribed by the Advisory Committee on Research Ethics, and has adopted the principles of impartiality, reliability, integrity and responsibility as ethical standards. The essential content of VTT’s ethical standards are defined in VTT’s Code of Conduct.

6. Partnerships and networking

Via publications and patents, articles, conferences notes. The national technology programmes generate new knowledge and technology that is transferred to companies even while the programmes are still in progress. The research programmes lead to the development of new expertise and increase the divers interaction between the research units and companies. According to an ongoing study, VTT seems to have a central position in Finnish R&D and innovation activity. Collaboration with VTT has been important for almost 20 per cent of the innovations identified in the study. The study has thus far analysed 1600 Finnish innovations commercialised during the 1980s and 1990s. The results of the study highlight the role of VTT as an important mediator, working through collaboration with companies in developing technologies for international markets.

Genuine interconnection of the know-how of partners enables these partners to achieve better performance. The collaboration network of VTT is both internal as external, extending to customers and partners in Finland and abroad. The work community, the development of work and the direction of goals are jointly defined, as well as commitment to these goals. Results are acquired together.

During its first three decades, VTT had a very close relationship to the Helsinki University of Technology. Professors often were dept. managers at the Centre and VTT offered facilities to researchers and students for carrying out research. The legal status and structure of the Centre were changed in 1972, and VTT’s autonomy changed by that. However, VTT still directs and develops its activities in close interaction with industry, research institutes and universities as well as government authorities responsible for coordinating policy and the financing of R&D. Established forms of co-operation with universities include jointly funded research projects and programmes, joint professorships, joint units, teaching by VTT staff, post-graduate academic advising, the shared use of equipment, and sub-contracting. For instance, the Maritime Institute of Finland is a joint venture sponsored by VTT and the Helsinki University of Technology. Some VTT units are located on the campuses of technical universities or other local universities.
VTT has also connections to the private sector which is reflected in the number of customer organizations. Participation in Tekes technology programmes and technology clinics offer connections to different companies. Also VTT's own strategic research involves co-operation with companies. The largest customers (??) and percentage of profit from private sector SMEs are an important customer group for VTT.

7. Renewal and learning

Everyone encourages each other to performances that are valuable and beneficial for the customers and the society. Work is considered to be the constant learning of novel things. It is everyone’s duty and possibility to develop oneself. VTT guarantees facilities for top performances. The value basis includes satisfaction and staff commitment to continuous development of know-how and performance levels.