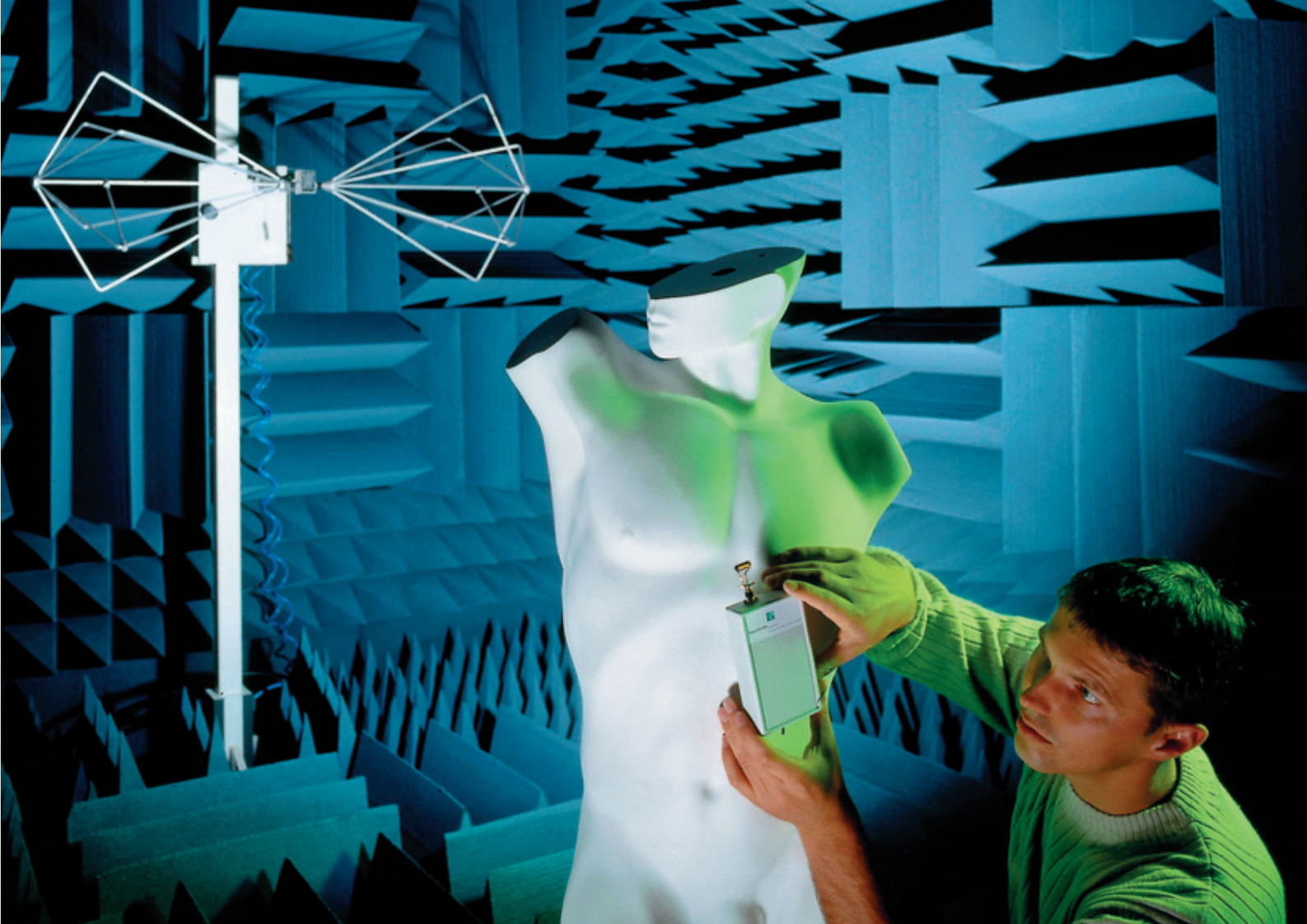




Profile of the Fraunhofer-Gesellschaft

Its purpose, capabilities
and prospects



Fraunhofer Gesellschaft

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Profile of the Fraunhofer-Gesellschaft

Its purpose, capabilities
and prospects



Innovations for industry

Innovation is one of the determinant factors in profitable business activity. Particularly in the countries of central Europe, with their limited natural resources, continual technological progress is the essential key to success in competitive global markets. This is the main focus of the Fraunhofer-Gesellschaft's mission: we create innovations and bring them to market.

The Fraunhofer-Gesellschaft thus has a distinctive profile within the German research environment. Its hallmark is that it promotes the transfer of know-how from scientific research into practical application to a greater extent than any other research organization. Research of practical utility remains the focal objective in all activities, whether these involve contract research, preliminary research, consulting services or studies.

In this respect, the Fraunhofer-Gesellschaft is considerably influenced by its close ties to industry. Even when academic research is conducted at the institutes, and published in the form of a thesis or dissertation, the content of this work is usually directly related to contract research. The practical training and experience obtained at Fraunhofer Institutes provides students and staff with excellent career prospects and opportunities for advancement in industry.

The ability to identify technology trends and market developments is of indispensable value to the Fraunhofer-Gesellschaft. The institutes constantly tailor their fields of expertise to prevailing demands, realigning the range of services they provide. This is an essential part of being consistently attractive to new customers.

The Fraunhofer-Gesellschaft boosts the performance of German industry in many ways. It supplies innovations, encourages technological advancement, helps to improve public acceptance of modern technology, and provides information, motivation and training to the urgently required upcoming generation of young scientists and technologists.

Flexible strategies and structures play an essential role in the success of the Fraunhofer-Gesellschaft. These ensure us the sustained capability to fulfill our special mission in the years ahead – the promotion of applied research.



Hans-Jörg Bullinger
President of the Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft – Research of practical utility

Research of practical utility lies at the heart of all activities pursued by the Fraunhofer-Gesellschaft, which undertakes applied research of direct utility to private and public enterprise and of wide benefit to society. Its 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 demands faced by society in general.

By developing technological innovations and novel systems solutions for their customers, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their local region, and throughout Germany and Europe. Through their work, they aim to promote the economic development of industrial society, paying particular regard to social and environmental concerns.

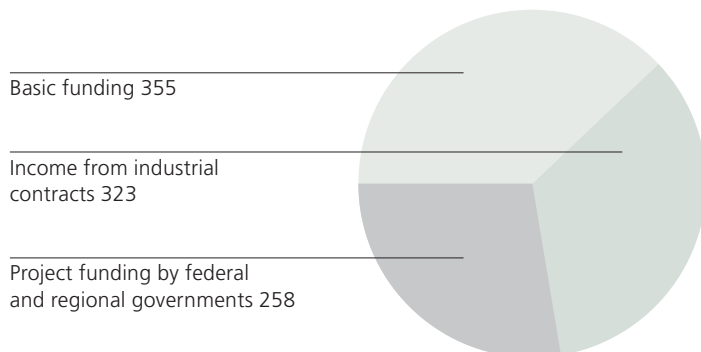
As an employer, the Fraunhofer-Gesellschaft offers a platform that enables its staff to acquire the necessary professional and personal qualifications to assume positions of responsibility within their institute, in industry and society, and in other scientific domains.

At present, the Fraunhofer-Gesellschaft maintains roughly 80 research units, including 58 Fraunhofer Institutes, at over 40 different locations in Germany. A staff of some 12,500, predominantly qualified scientists and engineers, work with an annual research budget of around €1 billion. Of this sum, approximately €900 million is generated through contract research. Roughly two thirds of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. The remaining one third is contributed by the German federal and *Länder* governments, as a means of enabling the institutes to pursue more fundamental research in areas that are likely to become relevant to industry and society in five or ten years' time.

Affiliated research centers and representative offices in Europe, the USA and Asia provide contact with the regions of greatest importance to future scientific progress and economic development.

The Fraunhofer-Gesellschaft was founded in 1949 and is a recognized non-profit organization. Its members include well-known companies and private patrons who help to shape its research policy and strategic development.

Contact research revenue 2005
in million euros



*The man behind the name:
Joseph von Fraunhofer*

The Fraunhofer-Gesellschaft owes its name to Joseph von Fraunhofer (1787–1826), the successful Munich researcher, inventor and entrepreneur.

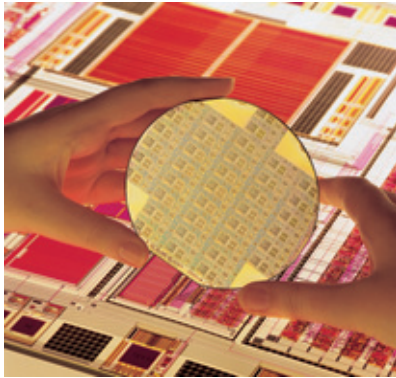
Born of a family of modest means, the glass-grinding apprentice Joseph von Fraunhofer joined the institute for optics headed by privy councilor Joseph von Utzschneider, who put the young researcher in charge of glass manufacturing at the early age of 22. Joseph von Fraunhofer's major developments include new methods of glass production and processing.

The optical instruments he himself developed, such as the spectrometer and the diffraction grid, enabled Fraunhofer to conduct fundamental research in the fields of light and optics. He was the first scientist to measure the spectrum of sunlight and characterize the appearance of the dark absorption strips: the "Fraunhofer lines". Through his independent, autodidactic work, Joseph von Fraunhofer won great acclaim from industry and government. This prompted the enrollment of the former apprentice as a full member of the Bavarian Academy of Sciences.



Joseph von Fraunhofer personifies the aims of the Fraunhofer-Gesellschaft: He was equally successful as a scientist, inventor, and businessman.

The objective: Generating know-how that serves industry



Application-specific integrated circuits (ASICs): The basic components in innovative portable devices.

Application-oriented research

Research undertaken by the Fraunhofer-Gesellschaft is directly aimed at promoting industrial performance. Its clear focus on application-oriented research and practical implementation distinguishes the Fraunhofer-Gesellschaft from other large research establishments and institutions involved in pure or basic research. This focus applies equally to contract research commissioned directly by industry or government, as well as to advanced strategic research. The key objective of the Fraunhofer-Gesellschaft is to transform scientific expertise into applications of practical utility.

Training with a practical focus

The Fraunhofer-Gesellschaft's aim to generate application-oriented research and to transfer knowledge applies equally to its vocational training activities. Complementing theoretical courses of study in universities, Fraunhofer Institutes provide students of science and technology with the opportunity to extensively develop the professional skills required for a career in industry, either during their studies or directly after graduation.

Virtual reality: New hardware now makes this technology affordable for small and medium-sized firms.



Science in the service of industry

The transfer of knowledge – whether through training, research contracts or the employment of former Fraunhofer staff – benefits industry by strengthening its capability to compete in international markets. For this reason, many companies favor a location in close proximity to one of the Fraunhofer Institutes. These companies have frequently been set up by former Fraunhofer employees, who put their self-generated expertise to work as independent entrepreneurs.

The Fraunhofer-Gesellschaft is regarded as a top performer in innovation of practical utility: In terms of the number of international patent applications granted in Germany, the Fraunhofer lies ahead of other research organizations by a wide margin.

In support of Germany as an industrial location

Industry benefits from advances in promising new areas of technology as well as through the integration of innovations in individual companies. The presence of affiliate branches in Europe, Asia and the USA helps to maintain an international standard of scientific work. Furthermore, contracts and projects on behalf of federal and *Länder* government institutions exert a decisive influence on the political decision-making process. A commitment to technological innovation which specifically serves the public interest enhances overall acceptance of new technology.

The Fraunhofer-Gesellschaft supports industrial activity through all of these channels and ultimately strengthens Germany's status as an industrial location.

Molecular farming:
Drug manufacturing
using biological processes.



History: Foundation, development and achievements of the Fraunhofer-Gesellschaft

1949

The foundation of the Fraunhofer-Gesellschaft as a non-profit organization. Up until 1954, efforts focused on seeking funding for research of direct relevance to industry.

1955–1963

The first Fraunhofer research institutes gradually emerge. Activities in defense research are integrated as Germany rebuilds its armed forces. Opportunities grow in the contract-research market, and consequently for the Fraunhofer-Gesellschaft itself, as the pace of Germany's postwar economic recovery accelerates.

1964–1969

A political tail wind: The Fraunhofer-Gesellschaft qualifies for institutional funding granted by the German ministry of research and is thereafter acknowledged as the leading organization for applied research in Germany.

1970–1974

Restructuring and implementation of the "Fraunhofer model" makes basic financing by the government entirely dependent on contracts awarded by industry. This results in a surge in the volume of contract research. The Fraunhofer-Gesellschaft expands.

1975–1983

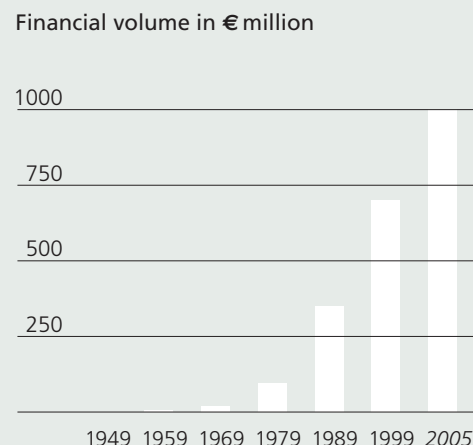
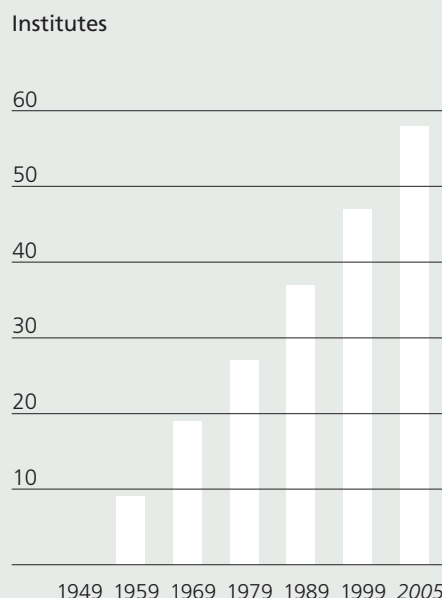
Energetic and focused expansion of the Fraunhofer-Gesellschaft into a flexible and efficient organization able to satisfy the need for collaboration between industry and government in advanced scientific research.

1984–1989

Transformation of the Fraunhofer-Gesellschaft into a market-oriented organization providing R&D services. Creation of the first alliances to optimize internal collaboration.

1990–2000

As political tensions ease worldwide, many institutes and specialist departments are successful in shifting their research efforts away from defense towards industrial contract research, which becomes the most important source of business revenue of the Fraunhofer-Gesellschaft. Research establishments in the former GDR are taken over and integrated. The Executive Board responds to the increasing globalization of the scientific community and markets by introducing a strategy to expand the organization's presence in the major economic regions of the world: Branches are established in Europe, the USA and Asia.



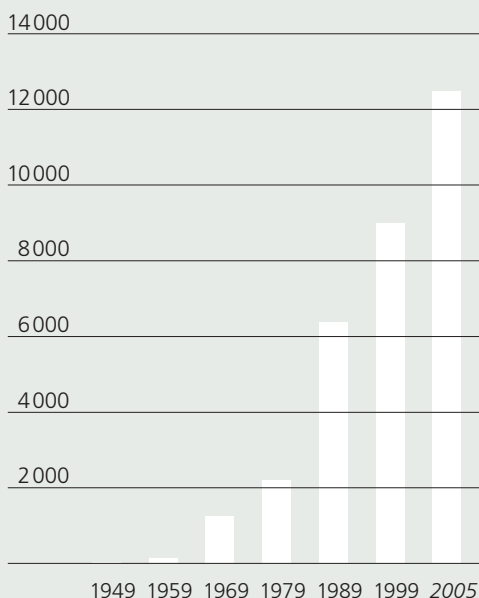
A milestone: The integration of the East German Länder

During the course of its development, the Fraunhofer-Gesellschaft has repeatedly proved successful in its integration of other application-oriented research establishments. In 1991, the takeover of numerous larger and smaller research establishments in the former GDR was the most significant achievement in this area. Thanks to the high level of commitment demonstrated by almost 1,000 new colleagues, research in the Länder of former East Germany was brought into line with international standards in terms of technology and organization in just a few years. All of the nine independent research institutions and eight branch laboratories have now been integrated permanently within the family of Fraunhofer Institutes.

2001 – today

Through the integration of GMD – Forschungszentrum Informationstechnik GmbH, the Fraunhofer-Gesellschaft becomes Europe's largest provider of research and development services in the field of information and communications technology. All Fraunhofer Institutes working in this field join forces as members of the ICT Group. The life sciences are also developing into an area of expanding activity. The grouping of Fraunhofer Institutes in largely autonomous research alliances has meanwhile become a major strategic planning instrument.

Employees



A laboratory in the first research establishment belonging to the Fraunhofer-Gesellschaft, the Fraunhofer Institute for Applied Microscopy, Photography and Cinematography IMPK.



An industrial robot being tested for compliance with clean-room specifications.





Modern machine tools are capable of performing more rapid and precise sequences of movements than their predecessors. Their design often imitates examples in the world of nature – for instance the locomotion of insects.

Research of practical utility – Direct transfer of expertise

Research thrives through people – people thrive on research. In seeking to maintain a leading position alongside the strongest industrial countries in the world, countries such as Germany must devote a consistently high proportion of their efforts on developing new innovations. This is an imperative of international competitiveness. A knowledge of fundamental scientific principles is equally essential – particularly in high-tech fields such as biotechnology and information technology. We therefore place high priority on scientific education, training and development, and on the motivation of engineers and scientists.

The Fraunhofer-Gesellschaft assumes a special role in the alliance existing between science and industry in the pursuit of innovation. This is evident in its constant emphasis on the transfer of knowledge into practical application – a characteristic distinguishing it from other research organizations. On the one hand, the institutes maintain close ties with the higher educational system, and are generally headed by active professors simultaneously holding a chair at a university. Graduates, too, can complete their theses and dissertations directly within a Fraunhofer Institute. At the same time, it is the institutes' declared policy to provide engineers and scientists with training in skills subsequently required for a career in industry. A high fluctuation of scientific staff – providing a "transfer of expertise through the experts themselves" – is thus indeed welcome.



The office of the future:
Available where needed,
serving the stuff with
any technological support
required.

Attracting interest through information

The Fraunhofer-Gesellschaft recognizes that its responsibility to technology, also with respect to the present shortage of qualified engineers, begins at a much earlier stage. Acceptance of technology by the population at large relies on the ability to encourage school-leavers to pursue a career in practically oriented science. Projects like TheoPrax – originally proposed by the Fraunhofer Institute for Chemical Technology ICT and now operating nationwide – are an excellent vehicle for spreading awareness of careers in advanced areas of technology.

Career prospects with the Fraunhofer-Gesellschaft

According to several recent surveys, the Fraunhofer-Gesellschaft is for a wide variety of reasons one of the most favored employers in Germany. While an obligation to adhere to civil service pay scales does enforce certain limitations on staff earnings, this remuneration system does provide a number of related social benefits. Staff members point to several other favorable arguments, including:

- the excellent reputation of the Fraunhofer-Gesellschaft,
- flexible working hours and modern employment schemes,
- jobs featuring exceptional subject variety, wide-ranging responsibilities,
- good opportunities for further training and advancement within the institutes,
- excellent career prospects upon subsequent employment in industry,
- and the diverse forms of support made available to staff wishing to start up their own company.

The right motivation

Human resources policy within the Fraunhofer-Gesellschaft is guided significantly by the need to maintain a balance between its assumed obligation to provide industry with new talent and the necessity to keep experience and know-how within its own ranks. Within the institutes, there is naturally a great deal of scope for professional development. The Fraunhofer-Gesellschaft uses all available resources relating to its personnel policy to recruit and motivate its research and management staff.

Scientific awards play an important role in boosting the motivation of institute staff. The Fraunhofer Prize is awarded each year for examples of excellence in applied research by the institutes. It is presented during the annual meeting of the General Assembly. Junior scientists working at the Fraunhofer-Gesellschaft can aspire to the Hugo Geiger Prize, donated by the Bavarian ministry of economic affairs for outstanding work in the domain of the life sciences. Every two years, the science foundation "Stifterverband für die Deutsche Wissenschaft" presents its science award for R&D work of an exceptional standard produced in the context of joint collaborative projects involving Fraunhofer Institutes and other research groups, such as industrial research departments. Another award presented on a biennial basis is the prize for "human-centered technology" ("Technik für den Menschen"), which honors researchers at the Fraunhofer Institutes whose work has made a significant contribution to technical progress that improves the quality of human life. Lastly, the Fraunhofer Bessel Research Award is an annual distinction presented jointly by the Fraunhofer-Gesellschaft and the Alexander von Humboldt Foundation to internationally renowned American research scientists. The purpose of this award is to strengthen collaborative ties between the Fraunhofer Institutes and research establishments in the USA.

Equal opportunities

The number of women scientists working for the Fraunhofer-Gesellschaft is still relatively low, at just over fifteen percent of the total, although this number has doubled over the past ten years. Personnel policy must therefore continue to seek further increases in the number of women in scientific fields and the establishment of genuine equal opportunity – through motivation, firm commitments and working conditions which cater to the needs of families.

Besides being driven by a sense of social responsibility, this policy also has a more pragmatic side: Given the present shortage of highly qualified staff, it makes sense to exploit the existing potential more thoroughly.



Virtual reality for businesses: The ultimate in product design and development tools.

Smart materials for new applications: Piezo-electric fibers can act as sensors and also change their length when an electrical voltage is applied.



Location-finding in space: A new system allows the exact position of geostationary satellites to be determined.



Analysis techniques in materials research: A newly developed instrument is capable of making precise measurements of finely distributed, microscopic particles, for instance in silica gels.



European cooperation: Fraunhofer researchers intend to collaborate with partners in the UK, Austria, Spain and Germany in the "European

Vision Alliance – EVA". Their aim is to set up a network dedicated to optical test and measurement techniques.

Shared success – Our international commitment

Worldwide contacts are a must in the global economy

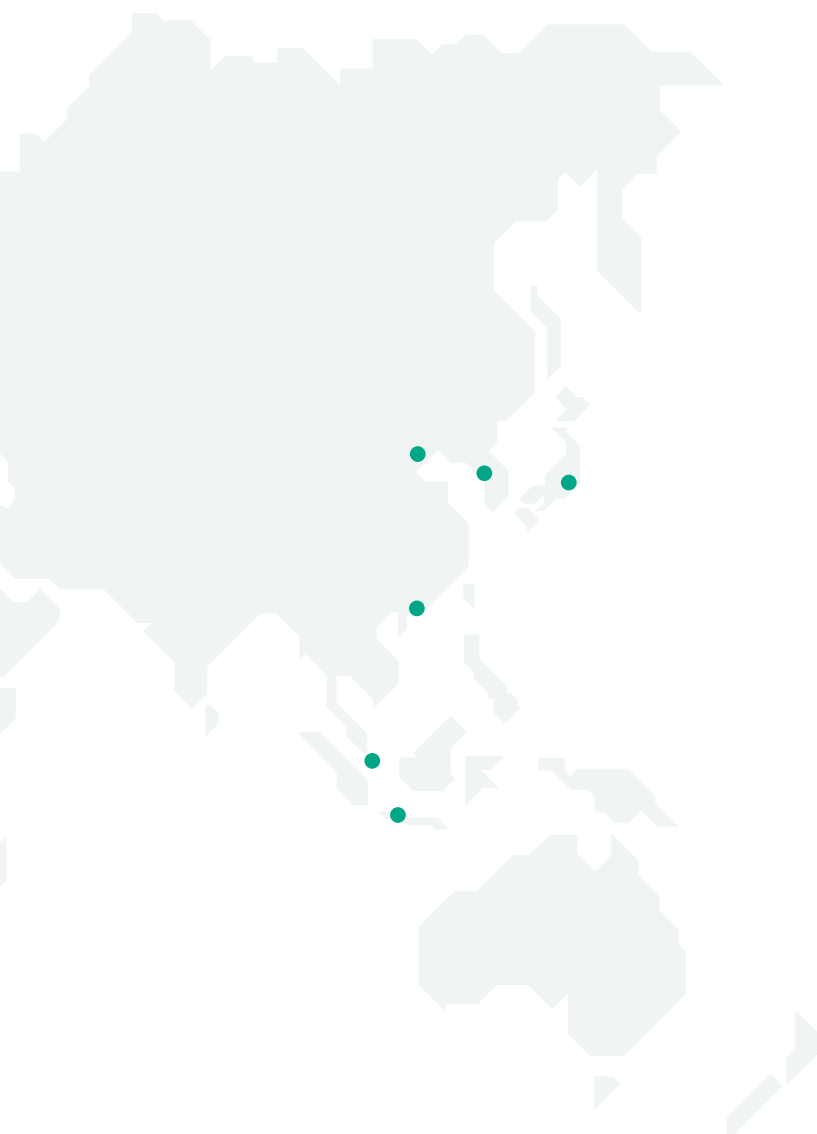
The world has changed. The global network allows companies to pursue their activities with ease across national frontiers. This has had the corollary effect of confronting smaller companies with competitors from around the world, where formerly competition was locally confined.

Globalization thus affects all sectors of industry – including the market for R&D services. An international presence is synonymous with the ability to compete, establish contacts and to actively pursue technological trends. This led the Fraunhofer-Gesellschaft to establish branches within major economic centers some years ago. Today, in addition to its European contact offices, it maintains five Fraunhofer Centers in the USA and representative offices or centers in Japan, Korea, Singapore, China and Indonesia. Further locations are planned.

The objectives pursued through international activities

Integration within leading centers of excellence worldwide plays an essential role in enabling German industry to maintain top performance, and to generate competitive developments and products marketable internationally. In this context, international strategy must be guided by genuinely shared benefit: Success relies on a balanced trade of services provided by either party, generating trust and a long-term foundation for business.

Involvement in the global arena is also an important factor in personnel policy. Fraunhofer staff working abroad not only enhance their professional and social skills, but also gain better awareness of perspectives, business cultures and markets that would otherwise remain foreign to them. This provides an additional pool of talent for German industry.



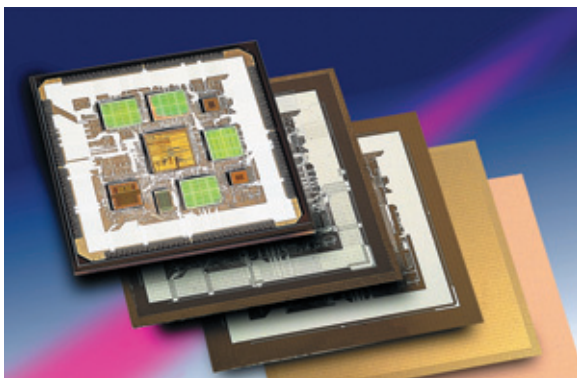
Beyond the need to secure required expertise, international activities aim to further expand the field of business. Services provided to customers outside Germany broaden the mix of funding sources within the Fraunhofer model and improve the deployment of resources for innovative basic research at home. Revenue generated outside Germany, as a percentage of total contract research volume, has steadily increased over the past years. Direct support in foreign markets is also an essential part of the comprehensive service provided to customers operating on a global scale.

Worldwide activities – Strengthening the home base

The Fraunhofer-Gesellschaft pursues its international activities with the long-term objective of maintaining its position as a top-class provider of high-quality services in Germany. Internationally networked contract research ultimately strengthens all partners: While it stimulates the national economies of developing countries in the long term, such research also promotes the export of appropriate products. Worldwide acknowledgement of the superior quality of research services provided by the Fraunhofer-Gesellschaft underscores the quality of the existing technological infrastructure. Such services thus represent a true asset in encouraging foreign investment in Germany.

The Fraunhofer-Gesellschaft's involvement in international markets ultimately makes a lasting strategic contribution to Germany's competitiveness as an industrial and business location.

Joint research with international partners: innovative assembly and interconnect technology.



Focal fields and services:

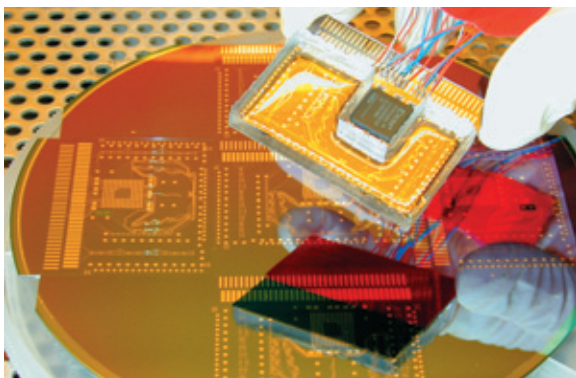
Research, development, advice and support

Contract research in the service of industry and government

Contract research is the most important of all Fraunhofer-Gesellschaft activities. These services focus on the needs of industry as well as of government and society. The Fraunhofer-Gesellschaft develops solutions of direct practical value to technical and organizational problems and contributes to the wide-scale implementation of new technologies. Companies of all sizes in the manufacturing and service sectors benefit from contract research. The Fraunhofer-Gesellschaft represents an important source of innovative know-how for small and medium-sized companies that do not maintain their own R&D departments.

Federal and *Länder* governments and ministries also assign extensive project contracts to the Fraunhofer-Gesellschaft, enabling them to base their political decisions on the latest scientifically proven facts.

New microengineering product: A miniaturized biochemical laboratory.



Application-oriented basic research

Research activity undertaken by the Fraunhofer-Gesellschaft encompasses far more than fulfilling contract obligations. Basic and project-related funding by the German federal ministry of education and research enables the Fraunhofer-Gesellschaft to conduct non-contract advanced research into technological fields which hold high promise for the future. This paves the way for entry into new markets. Expertise acquired through this research by the Fraunhofer Institutes is of course made available to industry through collaborative projects.

Research alliances – cooperative and strategic

Any organization seeking to attract industry as a universal partner for R&D must also be able to demonstrate universal expertise. Fraunhofer Institutes are actively involved in all major fields of research relevant to the interests of industry and government policy.

Suppliers of R&D services can no longer rely on their proven expertise in narrow fields of specialization. Extensive internal cooperation ensures that customers can always call on the cumulative expertise of all Fraunhofer Institutes whenever the need arises.

Over the last few years, the Fraunhofer-Gesellschaft has systematically reviewed and revised its structure on the basis of research alliances, whose tasks include the conception of visions for products and technologies and the joint development and implementation of long-term research strategies. The flexibility of the collaborative networks, and the resulting greater capacity and range of skills, enables the institutes to confidently tackle even the most large-scale projects.

Spectrum of Fraunhofer services

- Contract research; R&D contracts on behalf of small and medium-sized companies, government agencies and ministries
- Pre-competitive research; initial and ongoing development of future-oriented technologies and emerging markets, supported by the German research ministry
- Consulting services, appraisals and investigative studies for customers in industry and government
- Training and development of students, scientists and skilled workers
- Defense research commissioned by the German ministry of defense
- Participation in spin-off companies and licensing with a view to supporting new companies and refinancing research activities of the Fraunhofer-Gesellschaft

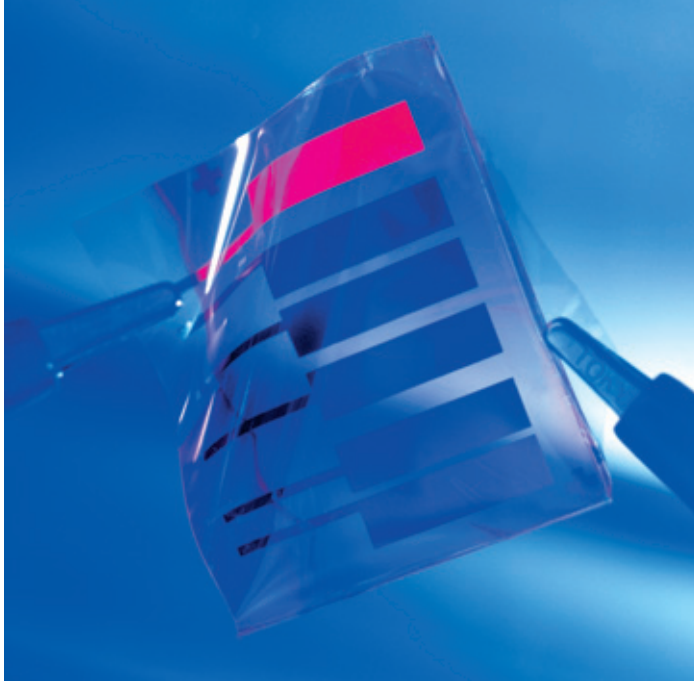
Fraunhofer Alliances and Networks

Fraunhofer Institutes working in related disciplines have formed alliances and networks to promote internal cooperation:

- Fraunhofer Defense and Security Alliance
- Fraunhofer Information and Communication Technology Group
- Fraunhofer Life Sciences Alliance
- Fraunhofer Materials and Components Alliance
- Fraunhofer Microelectronics Alliance
- Fraunhofer Production Alliance
- Fraunhofer Surface Technology and Photonics Alliance
- Fraunhofer Adaptronics Alliance
- Fraunhofer Energy Alliance
- Fraunhofer Alliance for High Performance Ceramics
- Fraunhofer Nanotechnology Alliance
- Fraunhofer Alliance for Numerical Simulation of Products, Processes
- Fraunhofer Polymer Surfaces Alliance
- Fraunhofer Traffic and Transportation Alliance
- Fraunhofer Network for Cleaning Technology
- Fraunhofer Network for Digital Cinema
- Fraunhofer eGovernment Center
- Fraunhofer Network for Grid Computing
- Fraunhofer Network for Optical-Functional Surfaces
- Fraunhofer Network for Photocatalysis
- Fraunhofer Network for Protein Chips
- Fraunhofer Network for Rapid Prototyping
- Fraunhofer Network "Vision" (image processing)



To ensure successful product development, staff from different departments of a Fraunhofer Institute work together.



Organic light-emitting diodes, encapsulated in ultra-barrier film: Fraunhofer research for tomorrow's flexible displays.

New markets – new goals

Technological and industrial developments have demonstrated over the past few years how markets can change at a rapid, indeed even turbulent pace. The Internet provides worldwide communication links and business contacts. Mobile phones have become an everyday phenomenon, the power of computer technology seems to know no limits, and achievements in genetic engineering surge ahead more rapidly than predicted.

As a supplier in the market for applied research and development, the Fraunhofer-Gesellschaft cannot afford simply to respond to existing trends, but must help to initiate them. Market and trend research thus exert a genuine influence on the work of Fraunhofer Institutes.

This is exemplified by a significant expansion of activities in the field of information and communications technology through the merger with GMD – Forschungszentrum Informationstechnik GmbH and the integration of the Fraunhofer Institute for Telecommunications, Heinrich-Hertz-Institut, HHI. The institutes of the former GMD have come together with other similarly oriented Fraunhofer Institutes to form the Fraunhofer Information and Communication Technology Group. Together they represent the largest research capacity in this sphere of technology in Europe.

Fraunhofer-Gesellschaft

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