

Fundamental vs. Applied Research – Interview with the Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft is one of Germany's most important research associations with its main emphasis on applied research. It was founded in 1949 and it goes back to Joseph von Fraunhofer (1787 – 1826). He was famous for his way of accurate conduct of science combined with a sense for entrepreneurship, which is why he became the role model for the Fraunhofer-Gesellschaft. We have talked to Prof. Dr. Michael Maskos¹ and Beate Koch². Prof. Dr. Michael Maskos is the director of Fraunhofer ICT – IMM in Mainz, which focuses among others on the synthesis and characterization of nanoparticles for different applications. Beate Koch is head of internal and external communications of the Fraunhofer-Gesellschaft.



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JUUnQ: Could you briefly tell us about the tasks and vision of the Fraunhofer-Gesellschaft?

Fraunhofer: Research of practical utility lies at the heart of all activities pursued by the Fraunhofer-Gesellschaft. Founded in 1949 and based in Munich, the Fraunhofer-Gesellschaft is a non-profit research organization that undertakes applied research and development (R&D) in areas of the natural and engineering sciences that are of importance to Germany's economic competitiveness. It currently operates 67 Fraunhofer-Institutes and Research Institutions across Germany, whose mission is to develop innovative solutions of direct benefit to industry and society as a whole. Fraunhofer's research portfolio covers a broad spectrum of topical areas, which are also featured in the German government's latest High-Tech Strategy, including resource-efficient manufacturing, transportation and mobility, energy and housing, information and communication technologies (ICT), protection and security, as well as healthcare, nutrition and the environment.

JUUnQ: Could you please tell us a little about the historic background of the Fraunhofer-Gesellschaft?

Fraunhofer: The Fraunhofer-Gesellschaft was founded in Munich on March 26 1949, as part of a program to reorganize and expand Germany's research infrastructure. The organization takes its name from Joseph von Fraunhofer (1787 – 1826), the successful Munich researcher, inventor and entrepreneur. In its early years, the main function of this non-profit organization was predominantly administrative: to raise funds through government bodies, donations and association members for distribution to research projects of relevance to industry. Initial activities primarily focused on industry in Bavaria. This being the early post-war period, there was particular need for research in the fields of mining, the iron and steel industry and mechanical engineering. These activities developed into a wide range of

application-oriented research with a focus on key technologies of relevance to the future.

JUUnQ: What is the organizational structure of the Fraunhofer-Gesellschaft?

Fraunhofer: Fraunhofer profits from a decentralized organizational model. Today, Fraunhofer means 67 institutes in Germany working in different fields yet under one legal framework and strong brand: Fraunhofer. This comes along with the close alignment of every Fraunhofer-Institute to one affiliated German university. This special relationship is reflected by the fact that every Institute's director at the same time holds a chair at the affiliated university institute.

JUUnQ: How many different Fraunhofer-Institutes are there currently in Germany and what is their main emphasis respectively?

Fraunhofer: Currently there are 67 Fraunhofer-Institutes in Germany. Their fields of research center around:

- **Health and Environment:** In addition to medical care, two key factors that also affect people's health are nutrition and the environment. Current Fraunhofer research in the area of environmental and life sciences derives its key goals from these three factors.
- **Security and Protection:** The objective of safety researchers is to provide people and the environment with the best possible protection from threats. They adopt a long-term approach in order to gain control of all the different phases that occur in a disaster, focusing on early detection, prevention, direct protection and quickly overcoming the consequences of a disastrous event.
- **Mobility and Transport:** The mobility of goods and

passengers has become an indispensable factor for industry and society, and continually poses new challenges for the scientific community: from vehicle development to traffic management, from new safety requirements to efficient transport logistics. Fraunhofer researchers are working on ways to make mobility safer, more efficient and more economical.

- **Production and Supply of Services:** A scarcity of raw materials, a shortage of qualified workers, competitive pressure – these are only a few of the challenges manufacturers face. Researchers are working on energy- and resource-efficient processes for tomorrow's manufacturing.
- **Communication and Knowledge:** Information and communication technology is an overlapping area that covers almost all other research fields and sectors, from medicine and the media industry through to the manufacturing sector. Digital technologies open up many new ways to communicate. Personalized, interactive and mobile learning methods help us to prepare for the work environment of the future.
- **Energy and Resources:** If we want heated homes, hot water for showers, and electricity to power our ovens, appliances and computers, we need energy. Until now it's been mainly oil, coal and gas that have driven the economy and supplied our home comforts. The problem is that, slowly but surely, these finite resources are running out. It is imperative that we use raw materials more efficiently – and that includes using energy more efficiently, finding reliable ways to store it and redoubling efforts to tap renewables.

The main emphasis of the individual institutes is indicated by their names. You can find a list here: <http://www.fraunhofer.de/en/institutes-research-establishments.html>

JUnQ: What is your main way of funding?

Fraunhofer: An important step for Fraunhofer towards being a decisive column in the German innovation system was the introduction of the so-called Fraunhofer model of financing - a performance-related system of financial management. The underlying model of allocating and distributing public funding to Fraunhofer and subsequently within Fraunhofer to specific research groups (institutes) is one of the success factors of Fraunhofer. About 70 percent of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. Around 30 percent of Fraunhofer's contract research budget is accounted for by base funding provided by the German Federal Ministry of Education and Research (BMBF) and the state governments in a ratio of 90:10 for the internal use of the organization at its

own discretion. This enables the institutes to work ahead on solutions to problems that will not become acutely relevant to industry and society until five or ten years from now.

JUnQ: The Fraunhofer-Gesellschaft is known to promote primarily applied research. What are the reasons for that? Is fundamental research a topic at all?

Fraunhofer: With its clearly defined mission of application oriented research and its focus on key technologies of relevance to the future, Fraunhofer plays a prominent role in the German and European innovation process. Applied research has a knock-on effect that extends beyond the direct benefits perceived by the customer. Through their research and development work, the Fraunhofer-Institutes help to reinforce the competitive strength of the economy in their local region, and throughout Germany and Europe.

They do so by promoting innovation, strengthening the technological base, improving the acceptance of new technologies, and helping to train the urgently needed future generation of scientists and engineers. In addition, Fraunhofer-Gesellschaft carries out publicly funded pre-competitive research. This forms the basis of the contract research projects conducted for customers.

JUnQ: In this context, do you think that a differentiation between fundamental and applied research makes sense or isn't it rather becoming more and more difficult to clearly distinguish between the two?

Fraunhofer: Although the two are interlinked on many levels, there is still an essential difference: Fundamental research provides answers to basic scientific questions bringing forward science itself. Applied science on the other hand provides solutions for practical problems; the research results are technologies that can be put into practical use.

JUnQ: Do you put special emphasis on technology transfer? How important are cooperations with industry (also with respect to funding)?

Fraunhofer: Fraunhofer's mission cannot be fulfilled by excellent research alone, but has to be complemented by the transfer of this research into real-life applications – in other words: innovations. Fraunhofer has various mechanisms for transferring knowledge to business and industry:

- **Direct bilateral contract research:** A Fraunhofer-Institute is contracted to perform work for a company and invoices that work accordingly. The results to be delivered and the price are fixed in a contract. Negotiations on the use of intellectual property rights are often a critical step because for Fraunhofer it is essential to be allowed to use generated knowledge for further applications without compromising the interests of the original client. Fraunhofer takes care not to depend on a few individual companies for large

portions of its contract work, so as not to be exposed to financial risk if and when such customers discontinue the relationship.

- **Spin-offs:** Companies founded by former Fraunhofer staff. They often retain close ties to Fraunhofer because their business is normally based on patented Fraunhofer inventions. In some cases, Fraunhofer may take on the role of a minority shareholder of the spin-off company, on condition that its shares are sold by the latest after 8 years.
- **Licenses:** Some Fraunhofer technologies or intellectual properties are licensed to customers without any further contract research.
- **Transfer of skilled minds:** Every year, several hundred scientists leave the Fraunhofer-Institutes in order to take up a position in industry. They are highly qualified and put to new use the know-how they gained at Fraunhofer.
- **Strategic cooperation with companies on their own premises or at a Fraunhofer laboratory:** For companies requiring long-term cooperation and ongoing support, Fraunhofer sometimes establishes small project groups on the company's premises where researchers from both parties work together. An alternative option for companies is to lease laboratory space on the premises of a Fraunhofer-Institute, where they can conduct their own R&D with the assistance of Fraunhofer researchers.
- **Innovation clusters:** Given the increasing complexity of innovations and the need to assemble teams composed of specialists in different fields, Fraunhofer has adopted the concept of "innovation clusters". Different companies representing all links in the value chain are brought together in order to develop common standards and system solutions (for example a group of 18 partners was formed to develop the "intelligent home"); Fraunhofer takes on the role of coordinator or prime contractor.
- **Fraunhofer Academy:** Fraunhofer organizes its activities in training and human resources development

as a separate business unit. As part of lifelong learning, specialists and managers from business and industry can acquire additional skills at Fraunhofer. Knowledge from the research conducted by the various institutes is transferred directly to companies by seminars and complete courses provided in cooperation with major universities.

JUnQ: Do companies contact you as an external scientific consultant?

Fraunhofer: Companies rather contact Fraunhofer looking for expertise in R&D. One of many practical examples from Fraunhofer ICT-IMM is related to the expert's knowledge of nanoparticle technology: the internationally renowned research in nanoparticle synthesis and characterization is a typical door opener for industrial requests.

JUnQ: Additionally, it appears as if a lot of your institutes are dedicated towards studying social trends. Is that avenue a fallout of the entrepreneurial mindset of the Fraunhofer-Gesellschaft? Does this kind of monitoring help to prioritize, which research areas to focus on primarily?

Fraunhofer: Social trends are actually only a rather marginal subject of Fraunhofer research – but they do play an important role when doing research on solutions for real-life problems: Research in electro mobility, for instance, ties in with general developments in society's mobility, research in solutions for energy supply cannot be conducted without keeping in mind the society's energy needs, research in IT security will always have to consider society's use of IT.

JUnQ: In your opinion, what sets the Fraunhofer-Gesellschaft apart from other scientific societies like Max Planck or Helmholtz?

Fraunhofer: The Fraunhofer-Gesellschaft is the only research organization of these three specializing in applied sciences. Our research always results in technologies that provide solutions for practical problems. Fraunhofer's focus lies on the transfer of research results to the markets.

JUnQ: Thank you very much for this interview.

—Kristina Klinker