POSSIBLE STARTING POINTS FOR THE INTERNATIONALIZATION OF SCIENCE-INDUSTRY LINKAGES IN GERMANY

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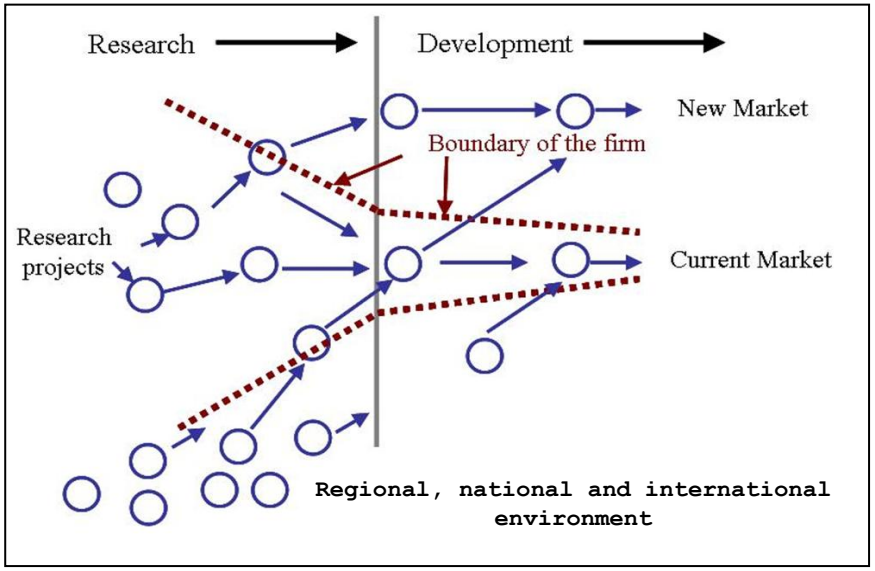
Open innovation approach

- The complexity of technology development and innovation processes increases. Strategy: **collective technological and financial risk minimization.**
- The **opening of the innovation process** is based on two directions (Gassmann/ Enkel 2006)
  - Inbound: Use of external knowledge in the enterprise
  - Outbound: Supply of knowledge created in the enterprise
- By integrating customers, users, heterogeneous external experts in all phases of the innovation process: obtaining information needs and contribution to the search for a solution; interactive value creation (Reichwald/Piller 2009).
- Thematization of substitution effects by external research and capacity building in the topics of the partners in order to develop and to integrate ideas together (Dahlander/Gann 2010) .



Source: Chesbrough et al. (2006) adapted

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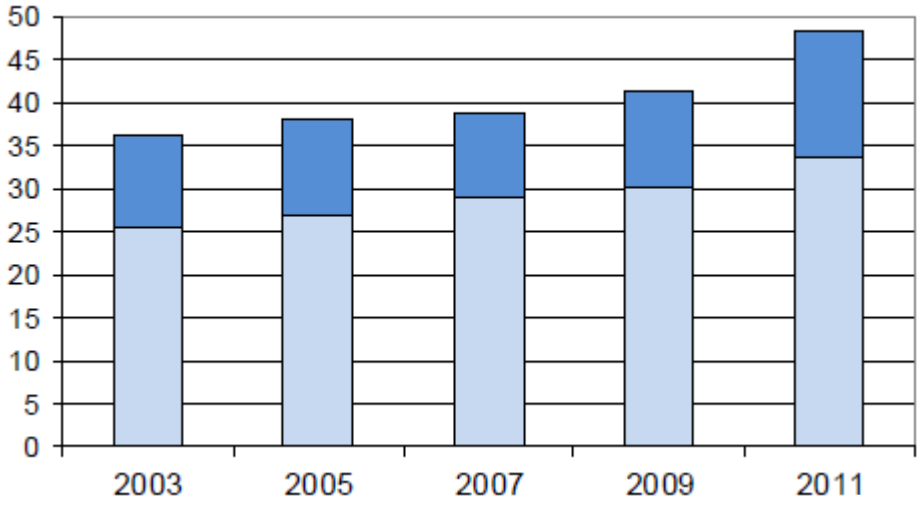
R&D expenditures of German companies abroad

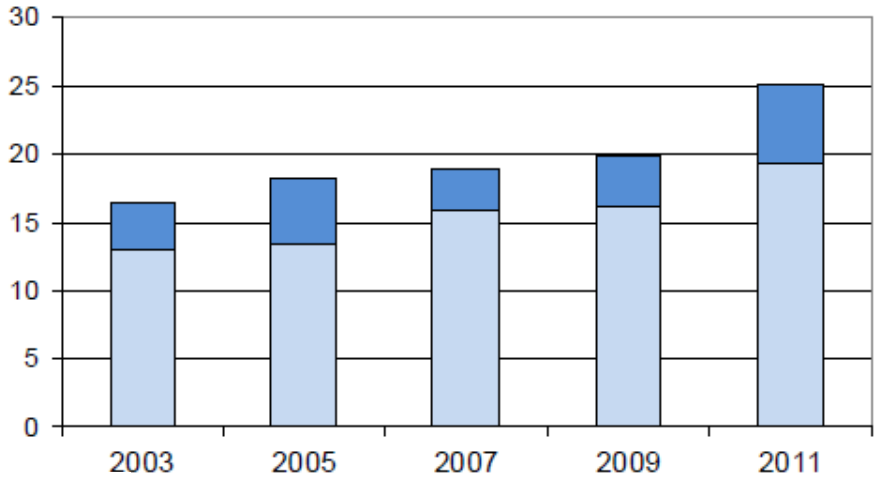
Bill. Euro

in total



Bill. Euro

automotive industry



- Nearly **31 % of the R&D expenditures of German companies are invested abroad**
- In the automotive industry, the share is 22 %, in the pharmaceutical industry 53 %

Source: SV Wissenschaftsstatistik / Schasse et al. (2014)

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R&D expenditures of German companies according to countries

Target Country	Mill. Euro	Year
USA	3,900	2011
Austria	1,321	2009
France	936	2011
United Kingdom	507	2011
Czech Republic	330	2009
Switzerland	327	2008
Japan	248	2007
Italy	200	2009
Spain	108	2009
Total	**8,095**	

Source: OECD, national statistics, Schasse et al. (2014)

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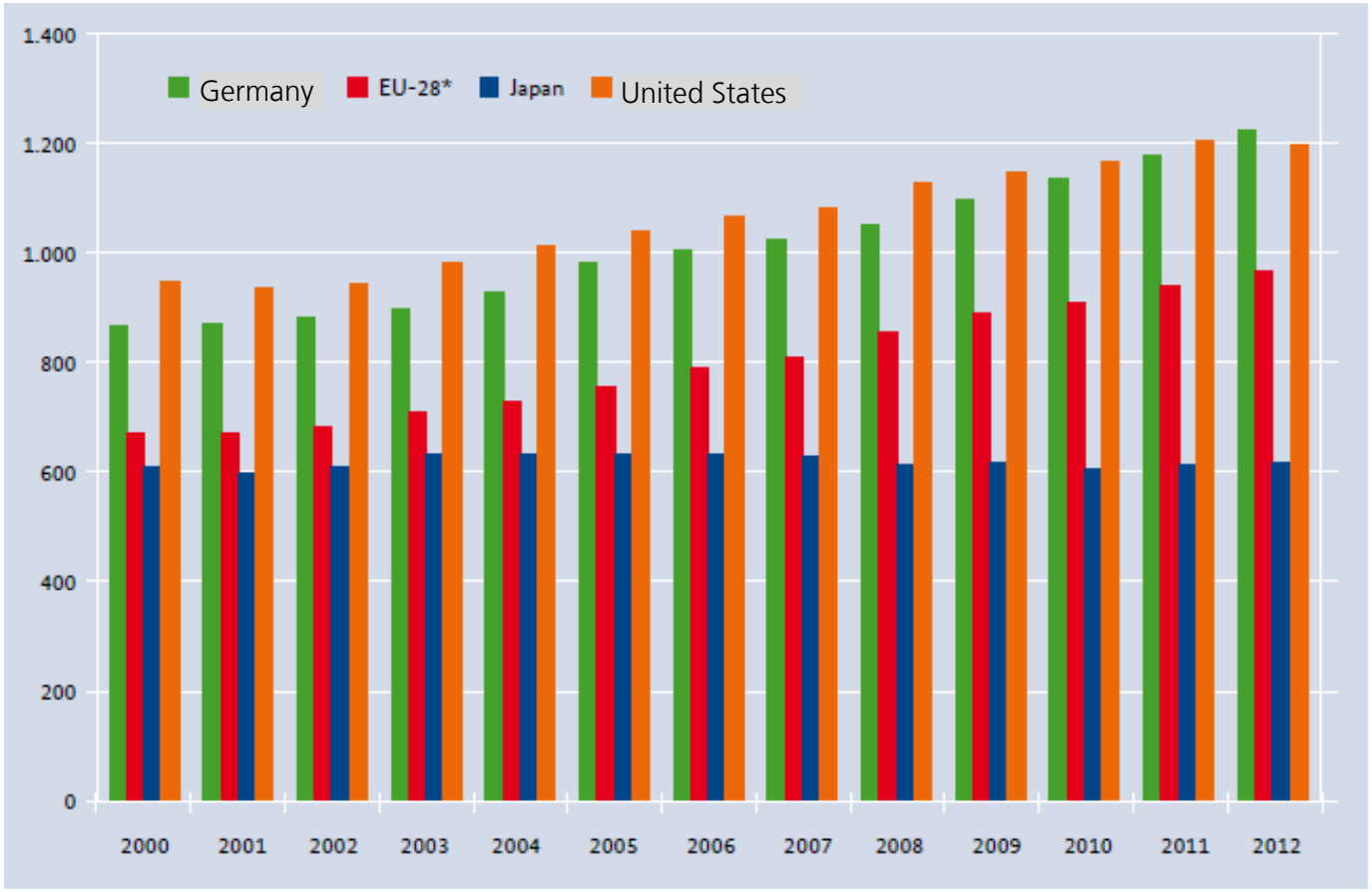
Number of scientific publications per million inhabitants



Source: BMBF 2014

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Motives for strategic research partnerships from the viewpoint of companies

- Increasing international competition and technological complexity lead to shorter product and technology life cycles and thus to an increasing **importance of strategic research partnerships.**

- **Motives** for strategic research partnerships from the perspective of industry:
  - Access to new technologies and the know-how of the partner
  - Securing competitiveness
  - time benefits
  - cost reduction
  - risk diversification
  - synergy effects
  - contact with potential employees

- Strategic research partnerships can also be influenced by **political measures** if these are effectively directed on the R&D cooperation between science and industry.

Sources: Coombs et al. 1996, Hagedoorn 2002, Archibugi/Coco 2004, Becker/Dietz 2004

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Challenges and barriers of research partnerships

- **Fear of loss of strategically important knowledge** can prevent or reduce exposure to research partnerships, especially in the international context.
- In order to use knowledge from outside, knowledge and skills must be available in the company (**absorptive capacity**). Often, small companies are at a disadvantage here.
- Small firms are due to their resource endowments at a disadvantage when it comes to the **financing of R&D and innovation activities.**
- Transaction costs may be reduced internally, but rise externally. In addition to the management of the innovation process itself, the **management of the research partnership** is a challenge (nationally and internationally).
- Too close connections to the partners can lead to lock-in situations. Flexibility and openness to new partnerships should be aspired. Internationalization is a specific chance for new partnerships.

Sources: Bapuji et al. 2011, Caloghirou et al. 2004, Escribano et al. 2009, d'Este et al. 2012, van de Vrande et al. 2009, Du et al. 2014

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The new High-Tech Strategy – understanding what belongs together

The new High-Tech Strategy is based on five pillars

1	Priority challenges with regard to value creation and quality of life	Enhance competitiveness Increase prosperity
2	Networking and transfer	Strengthen cooperation Support implementation
3	The pace of innovation in industry	Increase innovative strength Enhance value creation
4	Innovation-friendly framework	Provide the basis for creativity and innovation
5	Transparency and participation	Arouse curiosity Promote forward-thinking

BMBF: International Cooperation Action Plan

1. More mobile: Germany must continue to increase the mobility of trainees, students and scientists both to and from Germany in order, among other things, to meet the future demand for skilled staff.
2. More effective: Cooperation and funding procedures are to be made as easy as possible; obstacles to bilateral and multilateral cooperation must be reduced.
3. More efficient: Germany must improve its networking activities and promote networking at all levels as well as between all stakeholders, both national and international.
4. More focused: Germany must focus even more consistently on quality and excellence in its global relations to the benefit of all concerned.
5. More site-aware: Germany must define its interests more closely and consider international collaborations from the aspect of strengthening the competitiveness of German industry (opening up markets) and science.

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Starting points for international research partnerships

- **More mobility** of trainees, students and scientists
- **More efficient** networking activities on an international scale
- **More focused** on quality and excellence
- **More site-aware** with regard to the strengthening the competitiveness of German industry

Two examples:

- Fraunhofer Society
- Research Campus ('Forschungscampus') programme

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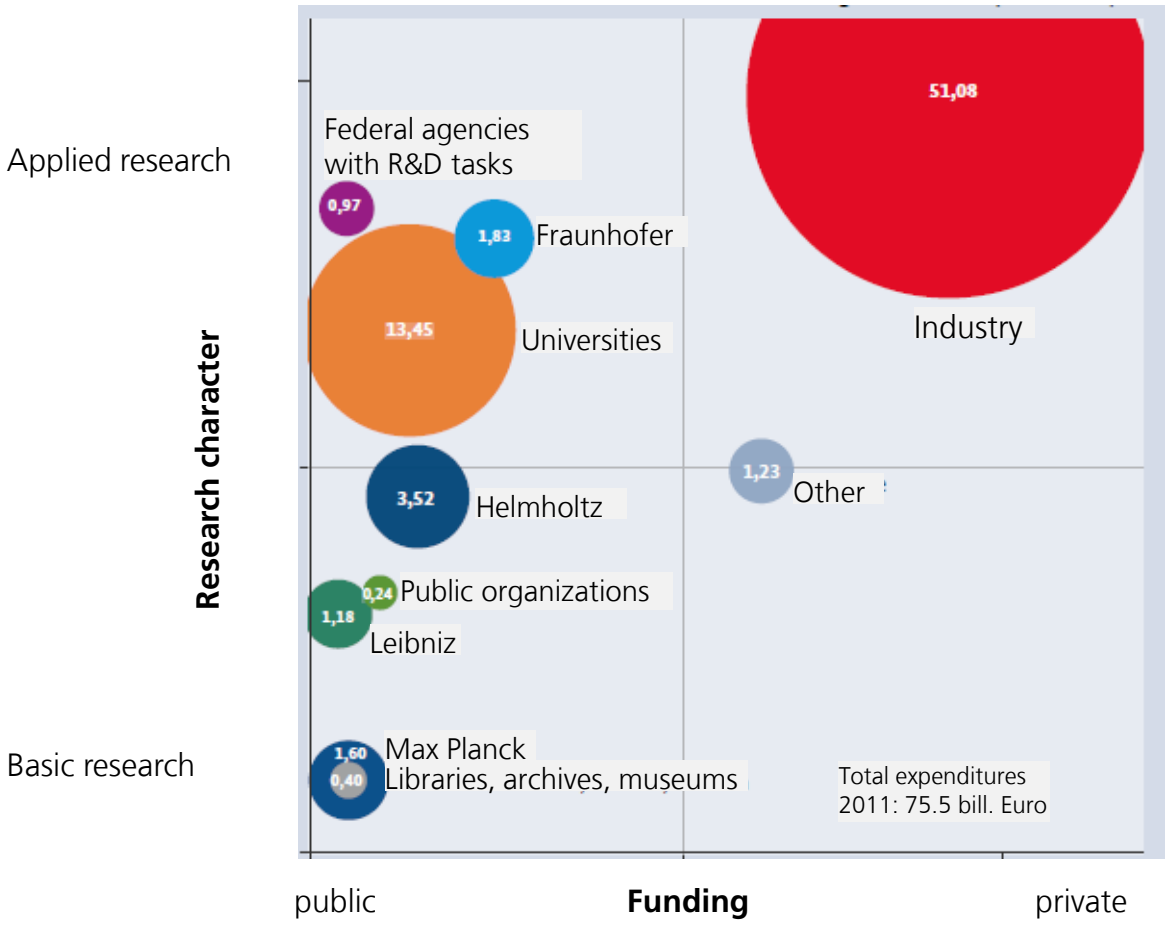
German research landscape



Source: BMBF 2014

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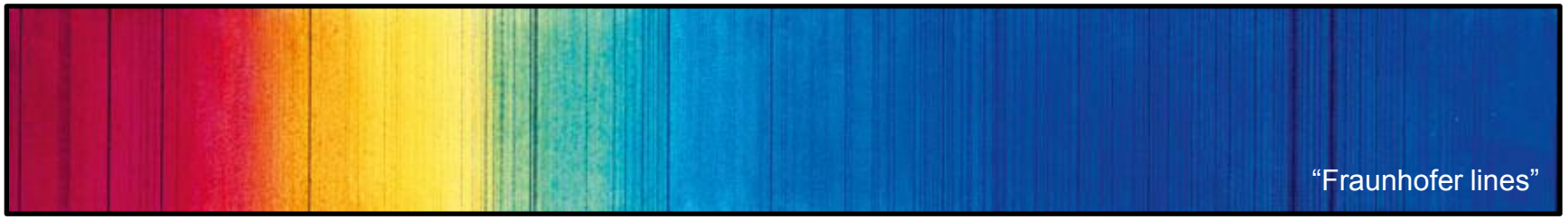
Fraunhofer Society, the largest organization for applied research in Europe

- 66 institutes and research units
- More than 24,000 staff
- Over €2 billion annual research budget totaling. Of this sum, more than 1.7 billion euros is generated through contract research
  - Roughly two thirds of this sum is generated through contract research on behalf of industry and publicly funded research projects
  - Roughly one third is contributed by the German federal and Länder governments in the form of base funding



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COOPERATION MODELS: Different ways of working with Fraunhofer

ONE-OFF CONTRACTS	LARGE-SCALE PROJECTS WITH MULTIPLE PARTNERS	INTERNATIONAL COOPERATION
➔ Solve the problem ➔ Launch the innovation in the business or the marketplace	➔ Cooperation between multiple Fraunhofer institutes, external partners and companies	➔ Fraunhofer offices abroad
STRATEGIC PARTNERSHIPS	**INNOVATION CLUSTERS**	**SPIN-OFFS**
➔ Long-term partnerships that evolve from non-contract, pre-competitive research	➔ Regional partners from research, industry and universities	➔ Fraunhofer researchers branch out on their own, often with the customer taking a stake

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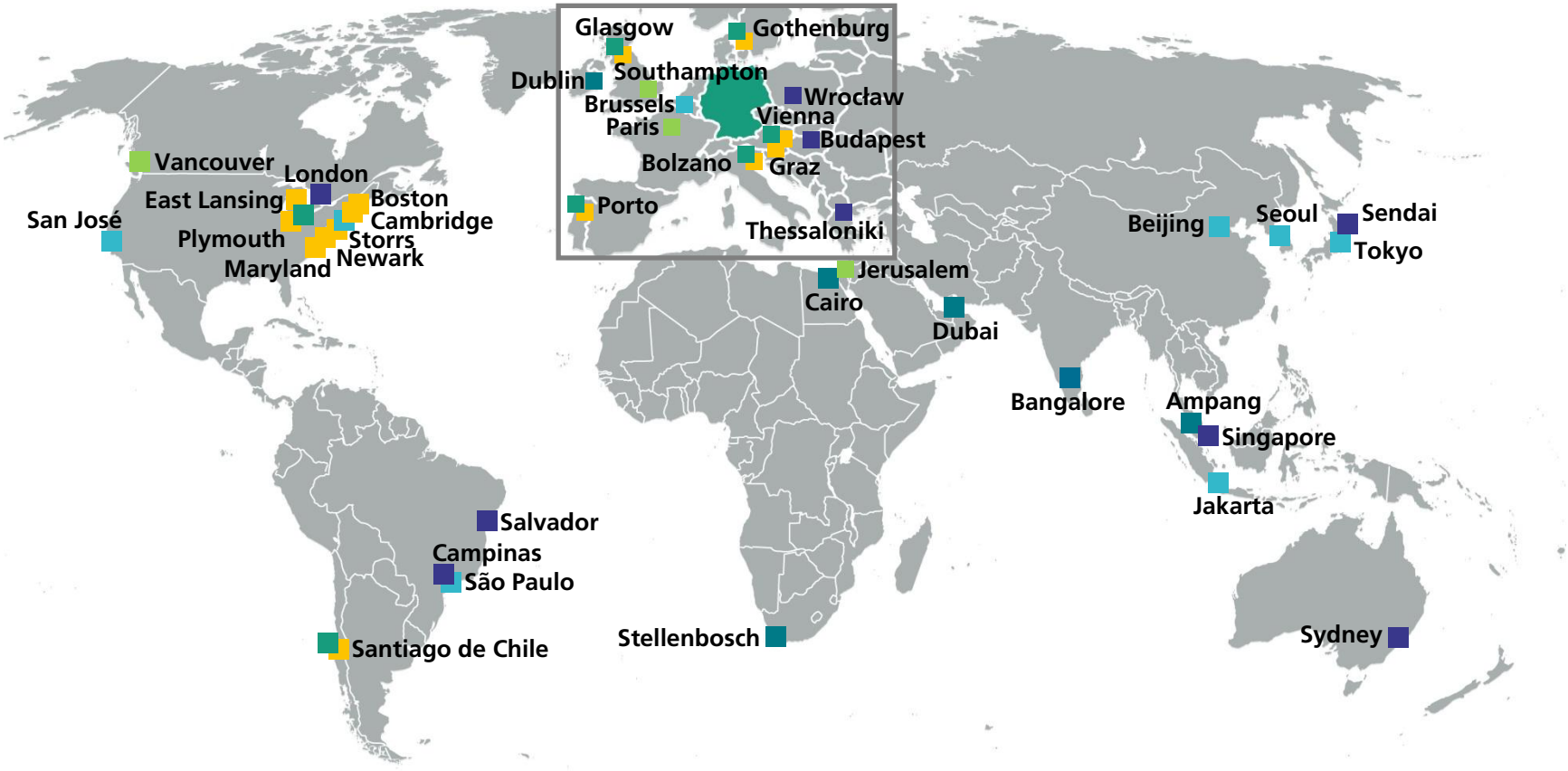
Fraunhofer worldwide



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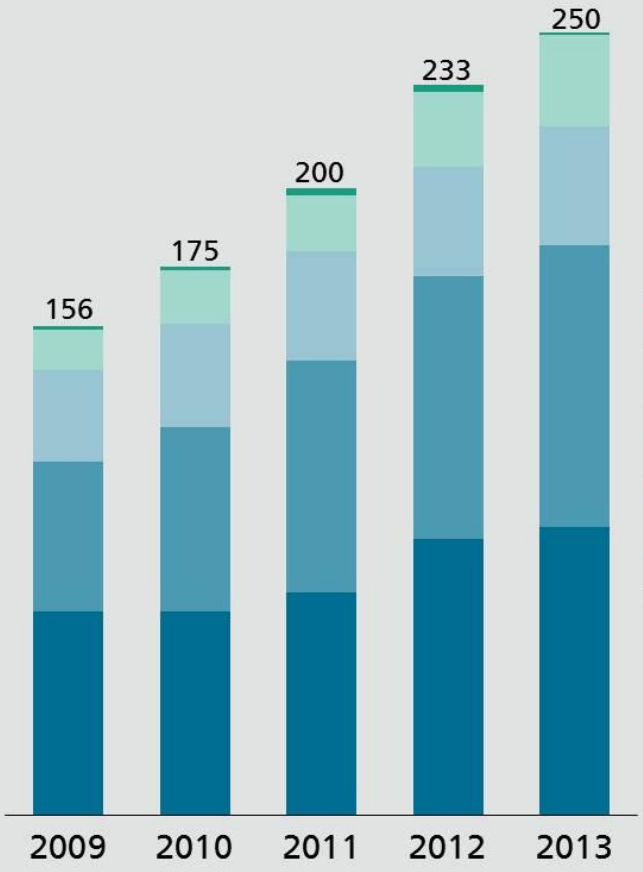
International revenue of the Fraunhofer Society: 2009 – 2013 (in € million)



	2009	2010	2011	2012	2013
Other countries	1	1	2	2	1
Asia	13	17	18	24	29
North and South America	29	33	35	35	38
European Countries	48	59	74	84	90
European Commission	65	65	71	88	92
Total:	**156**	**175**	**200**	**233**	**250**

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New tendencies of research cooperation between universities and industry

- **Significant change of the role of universities** in innovation systems: entrepreneurial behaviour of universities, entrepreneurship education, targeted spin-off promotion programs play an important role.
- Long-term, stable institutional structures to organize research and technology **transfer** are more and more replaced **by flexible solutions** and problem-related research cooperations between science and industry.
- Implementation of **Public-Private Partnerships** currently discussed in policy and policy research (e.g. TIP Activity on Opportunities and Options for Public-Private Partnerships at the OECD).
- **Examples** are: Industry-University Cooperative Research Centers (IUCRCs), Centers of Excellence (CoEs), Competence Research Centers

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Three characteristics form the bases for establishing a Research Campus

FORSCHUNGS CAMPUS

Three distinct characteristics shall be fulfilled:

- **Proximity** – the bundling of research activities and competencies at one location, as possible on a university or public research campus
- The medium- to long-term **adaptation of a specific research topic**, ideally within a research program
- A **mandatory public-private partnership**

In practice

- The RCs are active in diverse fields like energy, health/medicine, automotive/mobility
- Several companies should be part of a Research Campus (RC), ideally SMEs; but large (multinational) companies are drives in most cases
- Together, the partners of a RC shall contribute at least 50% of total budget
- Various forms of organisational forms and contracts are established suiting the specific demand of each RC. One important aspect IPR
- Working "under one roof" sometimes implies considering aspects related to labour protection, contracts and payment

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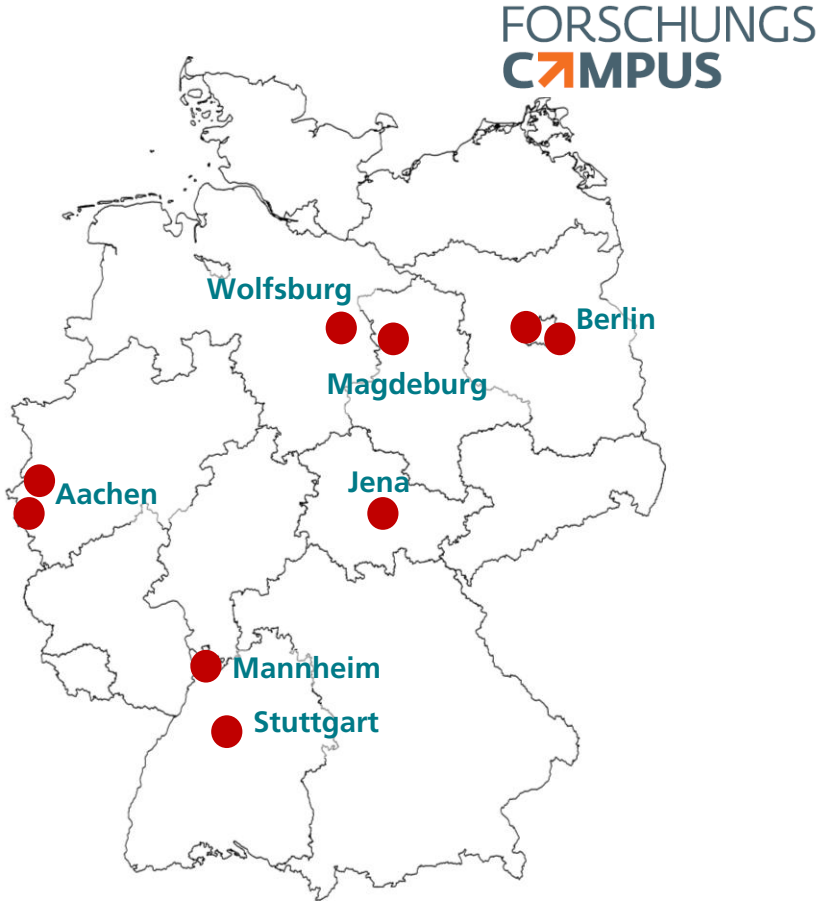
Science-Industry interaction support in Germany - Research Campus

A more recent example is the **Research Campus Program**

- National program, competition-based
- Applied basic research with **long-term market orientation**
- In September 2012, **10 Research Campus projects** were selected
- Most RC enter the **main phase at the end of 2014**. **Nine** are still operating.
- **Preparation** and **main phases** will be supported up to altogether **15 years** with a maximal amount of 2 mill. Euro per year
- The selected Research Campus can be regarded as pilot models for other universities and companies



Source: own figure

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International Public Private Partnership Programs

Country	Name	Duration	Responsibility	Type
Australia	Cooperative Research Centres	1990-2010	Ministry of Industry	Competence Centre
Austria	Kplus / Kind, Knet; COMET	1998-2009; since 2006	BMVIT/TiG, FFG BMWA/FFG	Competence Centre
Estonia	Competence Centres Estonia	2004-2007	Ministry of Industry	Competence Centre
Finland	Strategic Centres for Science, Technology and Innovation (SHOK)	since 2006	TEKE	Competence Centre / Cluster
Canada	National Centres of Excellence (NCE)	since 1989	NSERC, CHIR, SSHRC	Network
Norway	Centres for Research-based Innovation Scheme (SFI), Centres of Excellence scheme (SFF)	2006-2014	Research Council of Norway	Competence Centre
Sweden	Swedish Competence Centres Program VINN Excellence Center	1994-2003; 2003-2018	NUTEK/STEM/ VINNOVA	Competence Centre
USA	Engineering Research Centres (ERC), Industry/University Cooperative Research Center (IURCR)	since 1985 since 1979	National Science Foundation	Competence Centre

Source: Kaplun 2013

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Research Campus: Starting points for internationalization

- **More mobile:** Attraction of foreign trainees, students and scientists to work in a Research Campus - this takes place already.
- **More effective:** Matched funding to reduce obstacles to bilateral and multilateral cooperation is so far not realized.
- **More efficient:** Improvement of networking activities nationally and internationally is on the agenda (call for the internationalization of the leading-edge clusters), but not yet for the Research Campuses.
- **More focused:** Research Campus is a programme which is based on quality and excellence. Research Campuses are therefore attractive partners for international bilateral cooperation.
- **More site-aware:** Research campuses should strengthen Germany's competitiveness in a mid- to long-term perspective. Adding international expertise could support both industrial and scientific competitiveness.

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Conclusions

- While industrial R&D reflects a reasonable amount of international engagement, the **international orientation of industry-related linkages of research organizations** like universities or the Fraunhofer Society to industry is only beginning to develop.
- Other than in comparable programmes in other countries, in the "Research Campus" initiative **international partnerships are not obligatory**, but only welcomed.
- BMBF is triggering internationalization in a first step through a programme which should stimulate the **internationalization of the leading-edge clusters** and thus indirectly affects the research campuses as well.
- More **research** is necessary to understand motives, objectives and bottlenecks of international science-industry links (e.g. funding, IPR, knowledge management, personnel exchange) and to develop good practice models of different forms of exchange.

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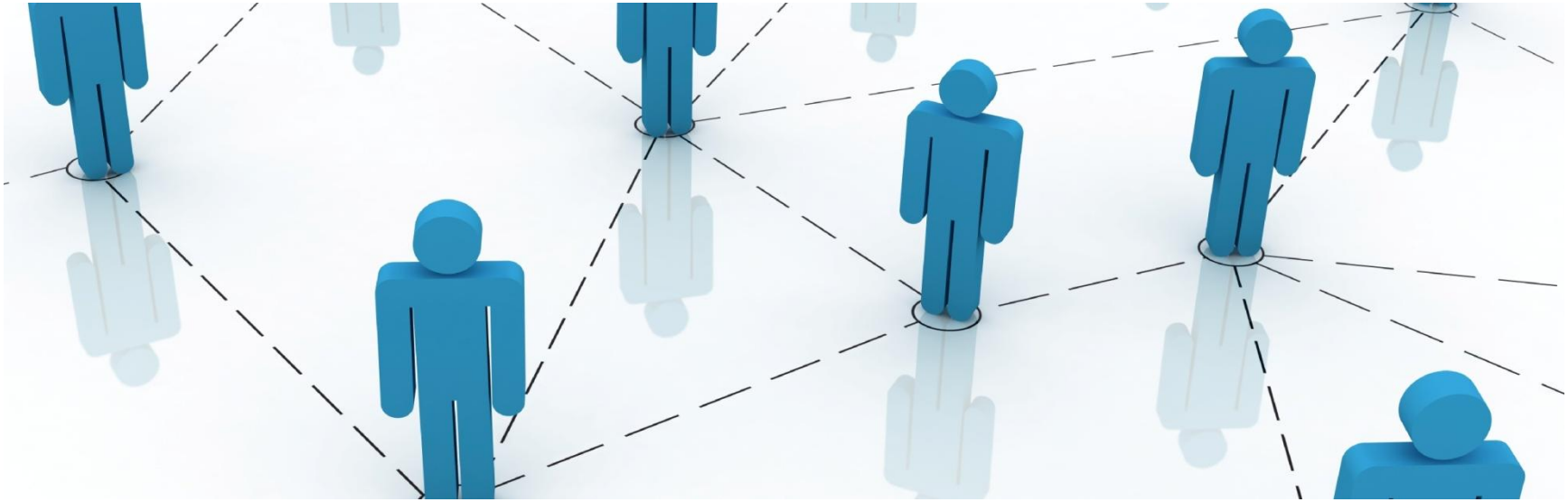

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Subjects of the Research Campus

Campus	Subject	Location
ARENA 2036	Development of multifunctional composite materials	Stuttgart
Digital Photonic Production	3D-printing and construction of composites	Aachen
Electrical Nets of the Future	Direct current voltage for power transmission	Aachen
EUREF	E-mobility and mobility and urban concepts	Berlin
INFECTOGNOSTICS	Efficient and rapid on site proof of infection agents	Jena
M2OLIE	Medical intervention environment regarding cancer	Mannheim
MODAL AG	Mathematical optimization of complex processes	Berlin
Open Hybrid LabFactory	Hybrid light construction for automobiles	Wolfsburg
STIMULATE	Screening of minimal-invasive methods in medicine	Magdeburg

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