

CSTI POLICY BRIEFING NOTE

Country Overview of Manufacturing Policy Germany

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Overview

Advanced manufacturing has long been a strength of the German economy, and it remains an important priority for the German government to maintain its standing as a world leader in high-technology manufacturing industries and exports. Maintaining a manufacturing base is critical to maintaining a capacity to innovate. According to the Manufacturers Alliance for Productivity and Innovation, manufacturing accounts for nearly 21% of the German economy (and 7.7 million jobs), compared with 13% for the United States and 12% for the United Kingdom. German firms are responsible for generating over a quarter of EU manufacturing turnover and for over a tenth of global exports of manufacturing products. Strong overseas demand has in recent years more than counterbalanced weaker demand from within the Eurozone.

German manufacturing encompasses a broad range of industries, notably automotive, machinery, electrical equipment, and chemicals, with a wide variety of company sizes and structures. Germany is prominent in consumer goods, and also has strengths in capital goods and industrial durables, which further underpins the nation's manufacturing capabilities. While Germany boasts some of the most prominent large multinational corporations engaged in manufacturing worldwide, most noteworthy are the small and medium sized enterprises (SMEs) usually collectively known as the Mittelstand (though not completely synonymous – the Mittelstand is a subset of German SMEs, typically family businesses generally focusing on niche products and markets, with roots stretching back for many decades or even generations), which account for around 70% of all manufacturing exports and almost 80% of employment. The Mittelstand possesses a reputation for quality, with over a thousand German SMEs holding the number one or two position in the world in their respective niche businesses. This has helped German firms to better resist Asian competition during the Great Recession, in contrast to other countries.

Germany has long had an institutional infrastructure in place that supports and promotes advanced manufacturing. German manufacturing firms are well supported at national and regional level, by education and training, the research infrastructure of the nation, and by other institutions such as employer associations and unions.

National Policy

At federal government level, the [prevailing viewpoint](#) is that the government's role is to be less directly active in manufacturing and industrial production, instead believing that individuals and companies should act according to their own initiative. The German government opposes protectionism, and also takes the view that future markets cannot be determined by policymakers. Instead, government should concentrate on creating a conducive environment for the economy to thrive, and setting policy in education, technology, energy and the environment accordingly. There are in fact few instruments at hand for the German Government to execute an industrial policy.

National and regional support for manufacturing firms derives from a decentralised and complex institutional framework, funded directly or indirectly by the government. Despite that complexity, however, German firms benefit from a stability that is built into the policy environment. Of late, there has been a greater focus on developing market opportunities abroad, coordinating policies around 'central missions' in which production is a core component, and an aim to boost both education and R&D expenditure (€12 billion more than previously planned in those areas between 2010 and 2013).

Another priority of the German state is to encourage manufacturing SMEs to retain production and good manufacturing jobs within the country, despite the lower costs that might be available elsewhere. The network of institutes supporting German firms, prominent among them being the Fraunhofer Society, offers skills, equipment, and services that those companies could not afford on their own. The sense of this being a core national mission is reflected in the resources, funding, and well-led institutions that make German manufacturing a success.

Central Government Policy Organisation

The arm of the federal German Government whose purview includes the promotion of advanced manufacturing in Germany is the [Federal Ministry of Education and Research](#) (Bundesministerium für Bildung und Forschung – BMBF). The BMBF is organised into [eight Directorates-General](#), each of which is responsible for different tasks. Several of these – e.g., Directorate-General 1 (Strategies and Policy Issues), Directorate-General 3 (Vocational Training and Lifelong Learning), Directorate-General 5 (Key Technologies – Research for Innovation) – touch upon different aspects of advanced manufacturing policy. Directorates-General also work closely with the Länder.

The BMBF has also recently unveiled Germany's [High-Tech Strategy](#) (HTS), the aim of which is to ensure long term prosperity based on innovative strength. Education and research are identified as Federal Government policy priorities, and the HTS seeks to provide scientific and technical solutions in 'mission-oriented', 'forward-looking' projects in a number of fields: climate/energy (e.g. 'CO₂-neutral, energy-efficient, and climate-adapted cities'), health/nutrition (e.g. 'individualized medicine'), mobility (e.g. 'a million electric vehicles in Germany by 2020'), security (e.g. 'more effective protection of communications network'), and communication (e.g. 'ICT Strategy 2020').

Innovation Agencies and their Initiatives

Concerning the BMBF's new [High-Tech Strategy](#) (HTS), investment ([€11 billion in 2014 alone](#)) is focused on research topics "that are of particular relevance for the society as well as for growth and prosperity in the future". The HTS is accompanied by a board with representatives from key stakeholders from academia, industry and society. It is co-chaired by Andreas Barner, Chairman of the Management Board of Boehringer Ingelheim and president of the Donors' Association for German Science, and Reimund Neugebauer, President of the Fraunhofer-Gesellschaft.

The ambitions for the HTS are that third level institutions are to be strengthened, and that "top cluster and similar networks should be better focused internationally". It is also envisaged that industry and science will cooperate in numerous projects with the support of the federal government, and that partners from science and industry can be involved in pilot projects. There is also to be a particular focus on SMEs, who already benefit from the [Central Innovation Programme](#) for SMEs and industrial research run by the Federal Ministry of Economics and Technology ([BMWj](#) – now Federal Ministry of Economic Affairs and Energy). There is a cross-departmental approach to

this new high tech strategy, with almost all federal departments to participate. This new strategy is intended to sustain and reaffirm [previous innovation policies](#) dating to 2006, and will feature both an evaluation of previous measures and more integration with European and international activities.

The new high-tech strategy is based on [five pillars](#).

- 1) The first of those is the set of priority tasks for the future that have been identified across six themes:
 - [Digital economy and society](#)
 - [Sustainable business and energy](#)
 - [Innovative work world](#)
 - [Healthy Living](#)
 - [Intelligent Mobility](#)
 - [Civilian security](#)
- 2) The second is to improve regional, national, and international networking of science and industry.
- 3) The Federal Government wishes to increase the pace of innovation, supporting innovative SMEs and technology-oriented start-up entrepreneurs.
- 4) Improving the pool of skilled people, in part by attracting foreign workers to Germany.
- 5) Strengthening dialogue by fostering openness to new technologies and encouraging more active public participation and social innovation. This would include making research funding more transparent.

The architects of the strategy, while mindful of areas of traditional innovative strength – e.g., automotive, mechanical engineering – do not wish to specialise too much. As such the HTS will seek to widen the circle of companies (particularly innovative SMEs) that they support, and in so doing increase the number of innovative start-ups in Germany. Furthermore, other programs, such as the [Excellence Initiative](#) (€2.7 billion increased funding for university based research between 2011 and 2017, 75 per cent of which funded by the federal government) and the [Pact for Research and Innovation](#) (increased funding to German research organisations by 5 per cent each year between 2011 and 2015), are also significant for promoting young research talent. The latter is designed to give financial planning security to institutions that are jointly funded by the Federal Government and the Länder ([Helmholtz Society](#) (HGF), [Max Planck Society](#) (MPG), [Fraunhofer Society](#) (FhG), [Leibniz Science Association](#) (Gottfried Wilhelm Leibniz Science Association, WGL), as well as the German Research Association ([Deutsche Forschungsgemeinschaft](#), DFG)). In return, they commit to research policy goals, including the promotion of networks in the academic system, international cooperation strategies, and sustainable partnerships between science and industry. The HTS is also to be embellished with research programs such as "[Innovations for the production, service and work tomorrow](#)" (in which €1 billion will be invested by 2020), which has an holistic aim to combine technical and social progress, adapting work practices to increasing mechanisation, automation, and digitisation.

Various export promotion measures have also been packaged in a single 'programme to develop foreign markets', which includes various export initiatives, as well as a manager training programme. Similarly, [Germany Trade and Invest](#) (GTAI), the economic development agency of the Federal Republic of Germany, has earmarked additional funds for a network of bilateral chambers of commerce. A number of large-scale bilateral projects have been also financed.

Fraunhofer Society

The [Fraunhofer-Gesellschaft](#), an independent nongovernmental entity, is the largest organisation for applied research in Europe, comprising 67 government-backed institutes and research units, and with a €2 billion annual research budget. Its customers and contractual partners are generally industry, the service sector, and public administration. Institutes are required to balance their own budgets, which requires them to generate contract research. Over 70% of the Fraunhofer Society's contract research revenue comes from publicly funded research projects and contracts with industry, with the remainder contributed by the German federal and Länder governments in the form of base funding. The Fraunhofer Society has an international focus as well, having set up research centres and representative offices to act as a bridge to regions deemed to be of "greatest importance to present and future scientific progress and economic development".

The society has over 250 business focus areas and core competencies. There is an emphasis on applied research with practical industrial value in their research, mostly in areas including healthcare, security, communication, mobility, energy and the environment. Fraunhofer Institutes tend also to focus on short term applied research projects – 6,000 to 8,000 annually and typically lasting shorter than two years – with immediate business applications. The society generates a lot of knowledge in its own laboratories, and employees are encouraged to start their own companies, selling the technologies developed in the institutes (the founders pay a license fee to use patented discoveries for commercial use). Fraunhofer has also established seven institutes in the United States and research subsidiaries in Chile, Austria, Portugal, and Italy. A primary rationale for establishing these foreign-based institutes appears to be in order to learn about technology development in other parts of the world.

Management of the various institutes is largely performed by academics with industry experience, typically engineering professors. Ph.D. students account for 30% of the Fraunhofer Society's 23,000 employees. The average institute employs between 300 and 400 people, though some are much larger. The Fraunhofer's structure is quite distributed. Each institute, which is linked with a German university, selects its own research fields and projects. With several research institutes focusing on innovation in technology and manufacturing, the Fraunhofer Society, with the ecosystem it has created as its funding has steadily grown over the years, provides critical support to the Mittelstand, enabling SMEs to continually upgrade their processes and products, a key factor in their sustained competitive advantage.

Characteristics of Fraunhofer Society:

- Each institute is paired with a university with similar research interests. The institutes are well equipped, and most operate multiple pilot manufacturing lines and demonstration facilities.
- Fraunhofer's model is a classic government-industry partnership, and funding accrues via a complex set of relationships and arrangements. The federal and state governments, private contract research, and publicly funded contract research each provide roughly one-third of its funding. However, a substantial amount of "industry" research can be funded through government grants and incentives.
- Funding is very stable, in large part because of a cross party consensus on the importance of applied research to German firms.
- Vocational education in Germany, combining academic studies with factory apprenticeships, produces a well-trained and technologically adept work force. Fraunhofer emulates this system, employing part-time post-docs and Master's and Ph.D. candidates, who acquire practical experience while simultaneously pursuing their studies.
- Fraunhofer holds a significant IP portfolio.

It is argued that the weakness of Fraunhofer's strategy is its focus on established industries, which means it is not typically a pioneer of new technologies. However, its overall success has demonstrated that a high-cost, high-wage country can compete effectively in global markets.

Fraunhofer Institutes focused on Production

One of Fraunhofer's core research topics is [production](#), and indeed seven Fraunhofer Institutes have combined to form a [Fraunhofer Group for Production](#) (see Appendix 2 for information on individual institutes). The Fraunhofer Group for Production VP is a [cooperative venture](#) with the aim of collaborating on production-oriented research and development. From pooling the expertise and experience of the individual institutes, it is intended that comprehensive single-source solutions can be offered to clients in the manufacturing, commercial and service sectors. The Fraunhofer Group for Production offers a range of services that covers the entire product life cycle or value chain, and operates in the following business areas:

- Product development
- Manufacturing technologies
- Manufacturing systems
- Production processes
- Production organization
- Logistics

Other Key Actors and Initiatives in German Manufacturing Policy System

Länder

The German states (Länder) play a significant role in Germany's multi-layered policy landscape. National institutions significantly interact with the Länder as well as the federal government, and the Länder jointly fund many of the initiatives that originate in Berlin.

German Federation of Industrial Research Associations (AiF)

The [German Federation of Industrial Research Associations](#) (AiF), founded in 1954, is a non-profit association organised by industry that promotes R&D in all industrial sectors in order to support the competitive strength of small and medium-sized enterprises (SMEs). The AiF is a network of 100 industrial research associations from all sectors (industry and service sector) with 50,000 affiliated companies. In 2012, the AiF received 485 million euros of public funding for research projects by SMEs, and it is currently a partner to the Federal Ministry for Economic Affairs and Energy (BMWi).

Deutsche Forschungsgemeinschaft (DFG)

The [DFG](#) is the largest independent research funding organisation in Germany, serving all branches of science and the humanities. Its membership consists of German research universities, non-university research institutions, scientific associations and the Academies of Science and the Humanities. [In 2013](#), the DFG funded almost 30,000 new and ongoing projects "with a funding volume of €2.6 billion for the reporting period". The budget is [provided primarily](#) by the German government and the states (~ 2:1 ratio), and also includes EU funds and private donations. The states and Federal Government are represented in all Grants Committees, although "the voting system and procedural regulations guarantee science-driven decisions". Funding is distributed between individual grants, collaborative research centres, excellence initiatives, infrastructure funding, etc.

The structure of the DFG features three departments, the second of which is concerned with Scientific Affairs. Contained within that department is a division called [Engineering Sciences](#), a number of whose responsibilities include aspects of advanced manufacturing. The DFG's [funding atlas](#) is illuminating in how it demonstrates where funding is allocated, and where those investments are made. There are several funding profile subject maps based on DFG awards, including one for Engineering Sciences. Production technology, which is the research field within Engineering Sciences that receives the largest amount of funding, dominates DFG-funded research at the universities of Hannover, Dortmund, Erlangen-Nürnberg and Aachen.

Steinbeis Foundation (but in the context of its MAS-like services)

The [Steinbeis Foundation](#), established in 1971 by the state of Baden-Württemberg, is an institute specialising in technology transfer of academic research. Headquartered in Stuttgart, it comprises approximately 1,000 “transfer enterprises”, which, depending on the focus of work, employ 6,000 experts in “either legally dependent Steinbeis Transfer Centers, Steinbeis Research and Innovation Centers, Steinbeis Consulting Centers, Steinbeis Transfer Institutes or companies of an independent legal nature”. Many of these various centres and institutes are based in German universities. Steinbeis Enterprises achieved a total turnover of 145 million euros in 2013. Many of the [services](#) Steinbeis provides touch on various aspects of manufacturing,

Appendix 1

Key Documents

2012

DFG

- [Funding Atlas 2012 – Key Indicators for Publicly Funded Research in Germany](#)

2013

Fraunhofer

- [Annual Report 2013](#)

2014

BMBF

- [Die neue Hightech-Strategie – Innovationen für Deutschland](#)

BMBF

- [Innovationen für die Produktion, Dienstleistung und Arbeit von morgen](#)

BMWi

- [Central Innovation Programmes for SMEs](#)

Key Agencies

- Federal Ministry of Education and Research (BMBF)
- Federal Ministry of Economic Affairs and Energy (BMWi)
- German Research Foundation (DFG)

Appendix 2

Institutes in the [Fraunhofer Group for Production](#)

Name	Fraunhofer Institute for Factory Operation and Automation IFF
Established	1991
Location	Magdeburg
Annual budget	€17.4 million
Name	Fraunhofer Institute for Material Flow and Logistics IML
Established	1981
Location	Dortmund
Annual budget	
Name	Fraunhofer Institute for Production Systems and Design Technology IPK
Established	ca. 1980
Location	Berlin
Annual budget	€18.5 million
Name	Fraunhofer Institute for Manufacturing Engineering and Automation IPA
Established	1959
Location	Stuttgart
Annual budget	€58.4 million
Name	Fraunhofer Institute for Production Technology IPT
Established	1980
Locations	Aachen (also Paderborn and Boston)
Annual budget	
Name	Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT
Established	1990
Location	Oberhausen (also Nuremberg)
Annual budget	€30.5 million
Name	Fraunhofer Institute for Machine Tools and Forming Technology IWU
Established	1992
Locations	Chemnitz (also Dresden, Augsburg, and Zittau)
Annual budget	€37.6 million

Other Fraunhofer Institute concerned with manufacturing

Name	Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM
Divisions	<ul style="list-style-type: none"> • Shaping and Functional Materials • Adhesive Bonding Technology and Surfaces
Established	1969
Locations	Bremen, Dresden, Oldenburg, and Stade
Annual budget	> €40 million