

Germany, a world leader in technology, engineering and innovation

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Few countries have contributed so much to science and technology as Germany. From physics and chemistry to cars and consumer products, Germany is a world leader in innovation, boasting leading universities and research institutes alongside major engineering, IT and manufacturing industries. A range of EU-funded projects, coordinated by German companies, universities and research institutes, highlight the diversity of German science and technology innovation even within the field of 'Information and communication technologies' (ICT).

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Few countries have contributed so much to science and technology as Germany. From physics and chemistry to cars and consumer products, Germany is a world leader in innovation, boasting leading universities and research institutes alongside major engineering, IT and manufacturing industries.

For most of the 20th century, Germany had more Nobel Prizes in the sciences than any other nation, and today the raw output of German scientific research consistently ranks among the world's best.

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In [Flexnet](#) [1] (1), for example, VDI/VDE Innovation + Technik is leading the development of new materials, devices and systems to help make Europe a world leader in flexible, organic and large area electronics. Also involving Chemnitz Technical University and 15 other European partners, this 'Network of excellence' is focusing particularly on helping European SMEs develop technologies and products using organic and flexible materials that have a wide range of applications, from solar panels and batteries to lighting and displays.

Also focused on manufacturing SMEs, the [SMERobotics](#) [2] (2) project aims to develop a new kind of manufacturing robot that is simple and intuitive to use, without the need for complex programming, and which, crucially, is able to adapt to changes in manufacturing processes rather than being

designed to simply carry out repetitive tasks.

'The purpose of SMErobotics is to create the technological foundation for profitable and intelligent robot solutions for small and medium-sized manufacturing businesses,' explains project coordinator Martin Hägele from the Fraunhofer Institute for Manufacturing Engineering and Automation. 'An intelligent robotic system does not rigidly follow a specific computer program. Instead, it learns from and with its human co-worker. It continuously improves the quality of its work through human-machine interaction and can be assigned new tasks by the worker himself without the need for the involvement of an external system integrator or a lengthy stoppage in work.'

The end result, Hägele indicates, will be adaptive robots that can be flexibly used without high follow-up costs for a variety of different tasks and will pay for themselves through increasing competitiveness and productivity.

With any robotic system, sensors play a big role, but it may be that the smallest sensors are actually the most effective and efficient, and not just for robots. In the [e-Brains](#) [3] (3) project, Infineon Technologies is leading a pan-European consortium developing new nano-scale sensor systems for ambient living applications. Enabling the integration of heterogeneous technologies, the high-performance nano-sensor devices being developed by the project partners promise to mark a major step forward in the miniaturisation, smart wireless communication, reliability, cost and energy efficiency of existing sensor technologies for applications ranging from biosensors and infrared imagers to smart gas sensors and ultrasound probes.

e-Brains nano-scale devices are extremely small, but another German coordinated project is looking even smaller. The [Diamant](#) [4] (4) initiative, led by the University of Ulm, is focused on developing technologies that can engineer materials at the level of single atoms. The focus is on using diamonds, because of their unique optical and magnetic properties, for solid-state molecular technologies that will enable the placement of one atom at a time into a diamond lattice with nanometre precision. That, in turn, could lead to the miniaturisation of electronic devices down to the size of single molecules, with applications in fields as diverse as biological imaging, precision sensing, data storage and information processing.

Some of those applications may be a few years away from commercial use, but other technologies currently under development in Germany are likely to have practical, commercial uses in the near future.

In the [SSL4EU](#) [5] (5) project, for example, German lighting manufacturer Osram is leading research on LED lighting technologies. The goal is to lay the groundwork for high quality LED solid state lighting that is relatively low cost and can gain widespread consumer acceptance.

The researchers are confident that this can be achieved, with important benefits for consumers, society in general and especially the environment.

'Solid state light sources based on inorganic semiconductors will revolutionise modern lighting due to their unique properties such as long lifetime, colour tuneability, and instantaneous switching. But most important: LEDs are mercury-free and will become the light source with the highest energy efficiency in the near future,' the team says.

Energy efficiency on a broader scale, as well as local power generation, is at the heart of another project coordinated by Hannover-based Edacentrum. The focus of the [Smartcode](#) [6] (6) initiative is on buildings and entire neighbourhoods, with the project researchers looking to develop low-cost and easy-to-implement technology for smart energy management. Their goal is to efficiently manage demand from electrical devices in buildings and coordinate supply from local energy sources, which could be solar panels on individual homes or small wind farms, creating local smart sub-grids interconnected with larger power networks.

'The outcome of this "think globally, act locally" project will reduce overall energy intensity and simultaneously enable residences and small commercial premises to profit from an open European electricity market,' says Prof. Dr. Christoph Grimm, the Smartcode scientific coordinator.

Meanwhile, the [Cascade](#) [7] (7) project, coordinated by Fraunhofer, is looking specifically at methods and systems to improve energy efficiency at airports. Because, as the researchers point out, large modern airports consume as much energy as small cities, improving airport energy efficiency and energy management are increasingly critical issues. The team is therefore working on a framework and methodology to underpin the execution of customised ICT solutions building upon existing ICT infrastructure, focused particularly on fault detection to spot problems in system design, equipment efficiency and operational settings. Their goal is to build a system that offers a three-year return on investment and a 20 % reduction in energy consumption and CO2 emissions.

Whether it is a big public infrastructure project like an airport or a proposal for new legislation, citizens need to be able to communicate their thoughts, opinions and concerns easily and efficiently to policymakers. The [Life+Gov](#) [8] (8) project, coordinated by Koblenz-Landau University and involving partners from Belgium, Spain, Greece, the Netherlands and Finland, is working on a mobile e-government solution to make it much easier for citizens to express their needs and for policy makers and government officials to understand the current concerns of society. Combining smartphone technologies and e-participation tools with data mining and sensing, the system is due to be provided as a software-as-a-service package following extensive trials covering mobility, urban maintenance and urban planning.

Data mining, citizen communication and social networking also play a big part in the [M-ECO](#) [9] (9) project. Coordinated by the Gottfried Wilhelm Leibniz University Hannover, the researchers are working on an advanced epidemic intelligence and medical data system to closely monitor diseases and forewarn of epidemics.

'The only way to curb a pandemic is through the early detection of very small signals - followed by a quick response,' says project researcher Avaré Stewart.

The key tool for early detection, the M-ECO team believe, is the internet. Online media, blogs, social networks, scientific and non-scientific discussion forums and electronic communication can provide complementary information on the occurrence of diseases and their symptoms, in addition to data from official sources such as hospitals and health organisation. The M-ECO system therefore uses web 2.0 technologies such as open access media and user generated content as unofficial but quick and efficient information sources for epidemic intelligence, potentially greatly reducing the risks of diseases spreading.

The range of projects undertaken probably reflects Germany's status as the largest country in the European Union, but it is clear that research and innovation are alive and well, and that German scientists will continue their contributions to expanding knowledge and improving technology.

The projects featured in this article have been supported by the Seventh Framework Programme (FP7) for research.

- (1) Flexnet: NoE FlexNet - Network of Excellence for building up Knowledge for improved Systems Integration for Flexible Organic and Large Area Electronics (FOLAE) and its exploitation
- (2) SMERobotics: The European Robotics Initiative for Strengthening the Competitiveness of SMEs in Manufacturing by integrating aspects of cognitive systems
- (3) e-Brains: Best-Reliable Ambient Intelligent Nano Sensor Systems
- (4) Diamant: Diamond based atomic nanotechnologies
- (5) SSL4EU: Solid State Lighting for Europe
- (6) Smartcode: Smart Control of Demand for Consumption and Supply to enable balanced, energy-positive buildings and neighbourhoods
- (7) Cascade: ICT for Energy Efficient Airports
- (8) Life+Gov: Reality Sensing, Mining and Augmentation for Mobile CitizenGovernment Dialogue
- (9) M-ECO: Medical EcoSystem

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