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# Potential for Biomimetics in Austria

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## Purpose

The field of biomimetics (biomimicry, bionics) has in recent years gained scientific acceptance and standing, and has become an innovative research area at academic institutions and in industry worldwide. Many promising solutions for challenging complexity and future-oriented technologies with a wide range of applications have been inspired by nature. This study aimed to investigate the current status and level of activities in the field of biomimetics in Austria and to identify its potential for the future nationwide.

## The Emerging International Biomimetics Scene

Biomimetics is an interdisciplinary field of knowledge at the crossing point of biology and technology, which seeks to apply certain principles from biological systems to technological strategies. Biological structures, functions or forms of organization are used as analogies or abstractions and serve as models, idea concepts or inspiration for innovative breakthroughs in complex scientific, engineering and market problems.

The range of potential uses of biomimicry is enormous, and the fields of applications span architecture and design, surface and materials technologies as well as sensors, robotics, medical engineering and management.

### Recent Developments

The roots of transferring knowledge from nature to synthetic constructs date back to the 16th century (Leonardo da Vinci), but it has only been in the past few decades with the development of new and improved research methods (such as nanotechnology) that biomimetics has become established and may soon be recognized as a scientific discipline. Support for research and development in academia and industry on biomimicry subjects has greatly increased in recent years, so that the number of international publications, conferences, exhibitions, educational TV productions and spin-offs has also shown a steady gain. Some biologically inspired concepts have in fact already been turned into commercially available products. Classic applications for biomimicry are the Lotus effect in self-cleaning surface coatings, Velcro, coatings of artificial shark or dolphin skins on airplanes or ships, the bionics car by Mercedes Benz or winter tire treads inspired by cats of prey. The vast pool of ideas derived from nature has the potential for many new future highlights particularly with respect to sustainability, energy efficiency and green solutions.

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### International Initiatives

Research in biomimetics is conducted worldwide, though strongly centred in the USA, with a focus on materials and military applications, and in Japan foremost in the fields of robotics and locomotion. Notable biomimicry activities in Europe can be identified in France in the field of robotics, in Switzerland in the direction of management and cybernetics, and in Great Britain, with the formation of the Biomimetics Network for Industrial Sustainability (BIONIS). Germany has taken a leading role in Europe with the formation of research networks, clustering of competencies, extensive collaborations, academic courses and most notably the foundation of an elaborate Bionics Competence Network (BIOKON) and the joint foundation of the International Bionics Center.

### Analysis of Biomimicry Situation in Austria

In view of the rapid expansion of the international biomimetics scene as well as the highly promising outlook of biomimicry based approaches to innovation, knowledge transfer, cross-disciplinary education and new product and market developments, it was now essential for Austria to assess the current status of and to identify the potential for biomimetics in the country. This brief study was commissioned by the Austrian Federal Ministry of Transport, Innovation and Technology and is based on research of Internet sources and on interviews with experts from universities, research centres, management companies and industry. No thematic restrictions were imposed for the scope of this work, and all the manifold areas of biomimicry and resulting activities in Austria were investigated.

## Biomimetic Activities in Austria

The findings of this study demonstrate that biomimetics based approaches are used for complex problem solving and innovative applications at some universities, non-academic research institutions as well as certain companies. These activities are currently located primarily in Vienna, Upper Austria and Styria. They are, however, widely scattered and based on local initiatives with little or no exchange of ideas and results between the respective groups. As a result, there is no unified picture of the Austrian biomimetics community, as much of the focus of Austrian researchers in this field is directed abroad, including a brain drain of Austrian scientists.

### Competencies … not Only for Product Innovation and Design

Mature competencies for biomimetics in Austria are available in diverse fields of research and application. Several research institutions and consulting companies use bionic and cybernetic concepts as creative methods for innovation and product development. They further aim to encourage biomimetics approaches in small and medium-size companies for innovative and improved products. Strong competencies using biomimicry also exist in architecture and industrial design, focusing on construction systems, space architecture and eco-design, and are complemented by special educational programs, academic research, industrial and international collaborations. Very well developed activities for biomimetics can be found in materials and surface engineering at a multitude of academic institutions, independent research centres and companies. Competencies in these areas include biomaterials, structural modelling, lightweight compounds and new materials with improved mechanical and tribological properties and stability inspired by biological materials. Research and development in materials is furthermore enhanced by lectures and educational courses on biomimicry. The fields of sensors, robotics, medical engineering and biomechatronics also exhibit substantial proficiency.

### Austrian Biomimetics Competence Network Founded

Awareness and acceptance of the benefits of looking to nature for solutions has gradually developed within the past ten years along with a gradual increase of activities at least within a small group of movers. Efforts have been made within these circles to further education on the vast potential source of ideas provided by nature, to integrate aspects of biomimicry in educational programs and to support specialization of studies along with graduate theses in this field. Some initial scientific collaborative projects were arranged within Austria, but these remained mostly of temporary nature and were limited by a lack of support and funding.

Starting in the year 2000, several **exhibitions** in museums, research parks and at technology fairs have been devoted to subjects of biomimicry and occasional lectures have been organized, mostly held by foreign guest speakers. Television programs on future technologies have also broadcast short reports on discoveries and innovations from biomimetics.

Increasing numbers of attempts have been made the last few years by **consulting companies** to try and inform small- and medium-sized businesses of the potential of biomimetics for innovation and market position. Several awareness events have been organized with specific targets of industrial communities and business to improve the accessibility and transparency of biomimicry as a technique of fostering creativity.

An increased openness towards biomimicry has consequently been observed in Austria in recent years, but large numbers of people, especially those outside research and **educational institutions** are still not aware of the variety of ideas found in nature and their possible applications.

In the summer of 2006, the Austrian Federal Ministry of Transport, Innovation and Technology commissioned the present study with the aim to identify biomimetics activities nationwide, to evaluate future potential in this field and to provide a basis for decisions on possible **funding initiatives**. The initiation and execution of this study had the effect of tying the

isolated biomimetics groups closer together, contributed to their visibility and, most importantly, provided an incentive to realize the formation of a nationwide network that had only been thought about before. Subsequently, an Austrian bionics competence network was indeed founded in the spring of 2007 with regular meetings and the participation of experts in the field nationwide.

A **web platform** is about to be established with the goal of informing, concentrating and fostering communication, to exchange ideas and to facilitate cooperative projects. Finally, the opening of a bionics park in Styria is planned for the fall of 2007, which will be dedicated to all areas of biomimetics, from education and research to applications in business and industry. The current protagonists of activities in biomimetics also envisage networking and collaborations on the level of the European Union and the organization of national, application-oriented biomimicry meetings and conferences in Austria.

## Expecting Inputs for Sustainability, Nanotechnology, Biocybernetics

A large number of ideas, suggestions and concepts for a research network as well as strategies to increase the visibility of biomimicry in Austria were put forth by the persons interviewed for the report. However, neither industry nor government has provided support or financial means for such initiatives to date (May 2007). The report concludes that significant potential and competencies for biomimetics exist in Austria. The current view suggests that these will provide important contributions in the fields of creativity techniques, architecture and design, surfaces, materials, robotics and sensor technology as well as biomechatronics and medical technology. Because of the nature of this future growth industry, new breakthroughs in applications and solutions can also be expected in the near future in the areas of sustainability, nanotechnology and biocybernetics.

### Policy Initiatives

Based on the findings of this study and the recognition of the strong potential for biomimicry in Austria, the Austrian Federal Ministry of Transport, Innovation and Technology plans to install financial incentives to be in place by the end of 2007. These initiatives may take the form of support for the formation of networks or calls for funding of research proposals, announcements of competitions or prizes for innovation.

As far as future policy making in the field of biomimicry is concerned, it is strongly advised to avoid short-lived hype or marketing gimmicks associated with this area and instead to fund activities with a well defined long-term perspective which involve participants from all levels by means of integrated common projects. It is of crucial importance to note that biomimicry is an interdisciplinary, innovative field of knowledge and that for this reason the manner in which projects are categorized, evaluated and selected for funding may well have to be adapted accordingly. Innovation, the transfer of knowledge and the development of products resulting from Austrian work in biomimicry may well benefit from policies that focus on applications and partnerships between research institutions and industrial companies.

### Raising Public Awareness

Above all, this study demonstrates that there is an urgent need to inform and educate the relevant communities and the public in general. Educational establishments are a crucial starting point for teaching and raising awareness of the manifold opportunities offered by biomimicry and to promote cross-disciplinary thinking. The planned theme park in Styria, the web community as well as additional measures as the marketing of current books on the subject and placement of television programmes are most likely to successfully raise public awareness.

### International Collaboration

The establishment of and support for a nationwide Austrian network seems ever more important as a strong international biomimetics community is currently emerging. This applies equally strongly to the need to build collaborations and exchange programmes with international partners.

## Sources and References

ITA report of September 2006, online available at: http://epub.oeaw.ac.at/ita/ita-projektberichte/d2-2e18.pdf