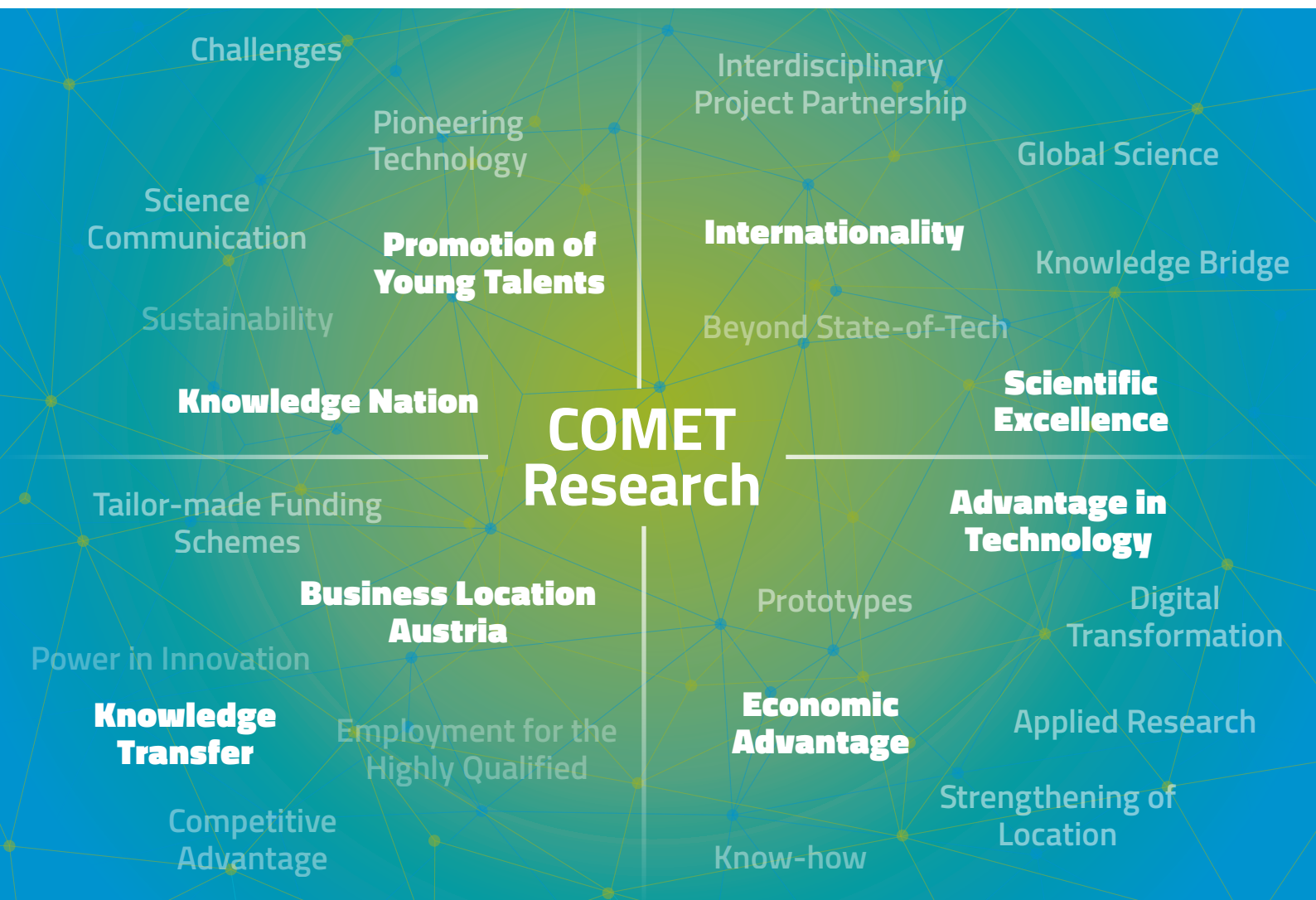


Top-Level Research from Vienna



VRVis and SBA Research share 35 years of experience, knowledge and success



Competence Centers for
Excellent Technologies

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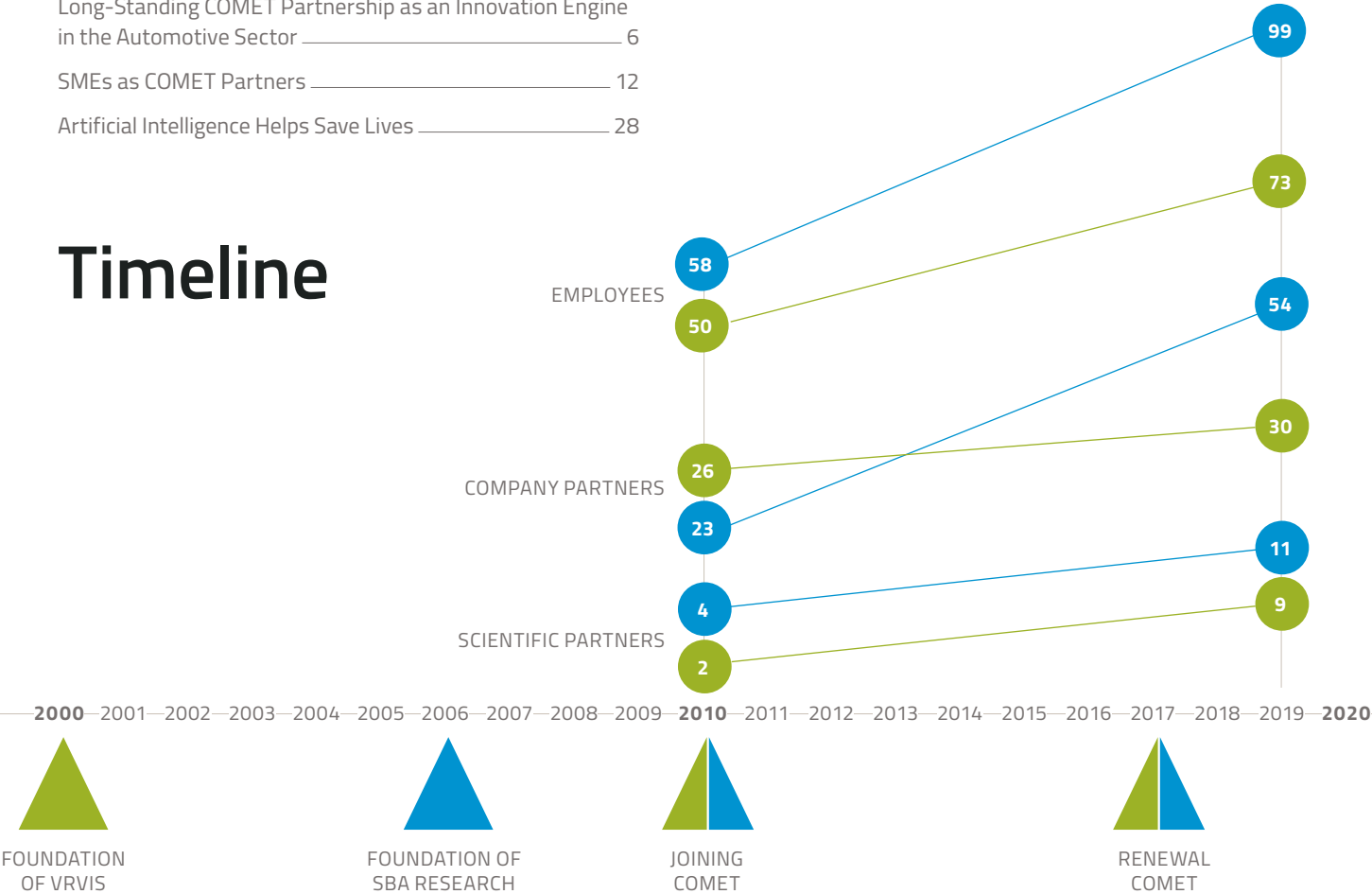
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Preface

VRVis Zentrum für Virtual Reality und Visualisierung and SBA Research are the longest-standing COMET Centers in Vienna. Together we represent 35 years of innovative research from Austria. Since our founding years 2000 (VRVis) and 2006 (SBA), we are building a bridge from science to industry. We support the domestic economy through know-how transfer: By translating the latest scientific findings into innovative solutions and visionary applications, we help companies to gain a technological edge. In this way, industry gets to know state-of-the-art technology, which it can independently develop further and incorporate into its products – we thus motivate our partners to anchor research

40 awards and over 1,000 publications are just a few of the markers of our scientific excellence. As an employer in Vienna, it is very important to us to set an example and act proactively in areas such as gender, diversity and corporate culture – together we employ around 170 highly specialized experts who contribute to the well-being of our society and to Austria's progress. Last but not least, we see ourselves as having a special social responsibility and therefore invest in the promotion of young talent and science communication in order to anchor top level research in Austria and make it known internationally. Based on this claim, the brochure at hand was created with the aim of providing an insight into

»... around 20 patents, 40 awards and over 1,000 publications are just a few of the markers of our scientific excellence.«

in their companies, even beyond joint projects. At the same time, it is important to us to position Austria as a hub of international research and development; we therefore cooperate with many renowned institutions as well as national and international scientific partners. In addition, we are constantly advancing our in-house basic research – around 20 patents,

our diverse fields of research, as well as to convey the associated challenges and our accumulated know-how as competence centers. In this regard, the following pages also highlight how essential the support of the FFG COMET Program Management team is for the implementation of successful research projects.



DI DR. GERD HESINA
VRVis Zentrum für Virtual Reality und Visualisierung



MAG. MARKUS KLEMEN
SBA Research

Interview with Federal Minister Leonore Gewessler, BA (BMK)

The Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology is responsible for applied research and technology development in Austria and promotes research, technology and innovation (RTI) to solve societal challenges. VRVis and SBA Research talked to Federal Minister Leonore Gewessler, BA about research funding in Austria, joint innovation work of science and industry, and the COMET program.

The BMK has defined the “contribution of research, technology and innovation (RTI) to solving societal challenges” as one of its key objectives. Together with the BMDW, it is one of the two ministries behind the COMET funding program. In your opinion, what role and importance do the COMET Centers have in achieving these goals?

In the government program, we anchored the commitment to the technology- and climate offensive in applied research in order to meet the societal challenges of our time. In the COMET funding scheme,

knowledge transfer and the coverage of a broad range of topics are important to us. Many centers are concerned with the question of how sustainability can be achieved through their research. In this context, progressive digitalization plays a major role in climate protection as well as for the environment.

The symbiosis between funding institutions and industry, as promoted since the 1990s through programs such as K+ and COMET, is very successful. What is the outlook for the future?

COMET is an internationally recognized best-practice model; historically, its continuous and consistent development has been important. Introduced as competence centers in 1998, the centers have established themselves as central nodes in the cooperation between science and business. Since 2016, the focus has been on building new competencies and advance internationalization. The most recent further development, the COMET modules, also give the centers the opportunity to establish particularly forward-looking research topics in order to prepare Austria as a research location for future societal challenges.

In top-level research, publication pressure, application and evaluation procedures and the acquisition of third-party funding are just some of the challenges. How does the BMK plan to provide structural support for Austrian researchers in this area?

The COMET Centers make an important contribution here, especially on a structural level. Over a period of up to eight years, the researchers are given the opportunity to work on a specific research program and establish themselves in a national and international research context. Transparency and clearly defined goals are needed to make the results and successes of the centers visible. This also applies to regular evaluations. At the same time, it is our concern to keep the administrative burden on the research institutions as low as possible so that the centers can concentrate on their actual (research) activities.

How could the COMET program be expanded to further establish Austrian research excellence and strengthen it with regards to the international competition?

Research excellence in the scientific and academic field is usually defined by publication activity. The COMET Centers are impressive in this respect: **since 2008, more than 16,000 publications have been published.** Concerning knowledge transfer to further developing and utilizing basic research towards economic applications, patents are an important benchmark, especially for keeping intellectual property (IP) in Austria. **Since 2008, more than 1,000 patents and licenses have been registered to or granted by COMET Centers.**

COMET facilitates innovative research cooperation between business and science. In which cases does this work particularly well, and where do you see further potential for optimization?

For both the Austrian companies and the participating scientific partners, the involvement of international partners in the COMET program facilitates access to highly qualified human resources, new methods and processes, and R&D infrastructure. In total, more than 1,500 companies have participated so far. The share of SMEs is at 36%, which is encouragingly high. As a result, smaller companies also have direct access to top-level research at an international level. A further increase in the proportion of SMEs is desirable.

COMET Centers are an important employer for highly qualified specialists,



and at the same time training centers for young talent. According to the BMK, how can this important dual role be further strengthened?

The program aims to create structured career models. **In terms of scientific training, more than 2,600 dissertations and 3,200 master's theses have already been produced.** In the future, we will look

closely at how young researchers can be promoted even more specifically, and this applies especially to female researchers. Although the proportion of women in non-university research has slowly but steadily increased to 27% and is just over 30% in the COMET Centers, there is still room for improvement.

»COMET is an internationally recognized best-practice model.«

Success Story

Long-standing COMET Partnership as an Innovation Engine in the Automotive Sector: VRVis and AVL List GmbH

AVL List GmbH is a founding member of the VRVis Zentrum für Virtual Reality und Visualisierung Forschungs-GmbH. Since 2000, this Graz-based company has been one of the most important and reliable research and development partners of VRVis.

This cooperation is an example for the core task of a competence center, says Jürgen Krasser, Head of Software Development in the Advanced Simulation Technologies division at AVL: "Within the COMET program, we are working together with VRVis on research projects on the visualization of multi-physical simulations of automotive drive systems; here, science and business go hand in hand."

The research work of VRVis and AVL focuses on innovative visualization methods and completely new explorative analysis methods for simulation results in the automotive industry. This cooperation was pioneering in several respects and, among other things, set the course for the future of an entire

research field. In 2005, VRVis and AVL started research on the visualization of ensemble simulations: for instance, engines are simulated in different variations, with up to 50,000 combinations to be examined for the various parameters and settings. At a time when the topic of ensemble simulation was barely present on the scientific radar, VRVis and AVL recognized the potential

of this technology. "In an effort to accelerate our customers' development processes through virtualization, it is important for us to obtain state-of-the-art visualizations and the latest findings from VRVis' basic research as a basis for our in-house R&D department. This is ultimately how our innovative software is created," says Jürgen Krasser. "Enabling the transfer of technology from science

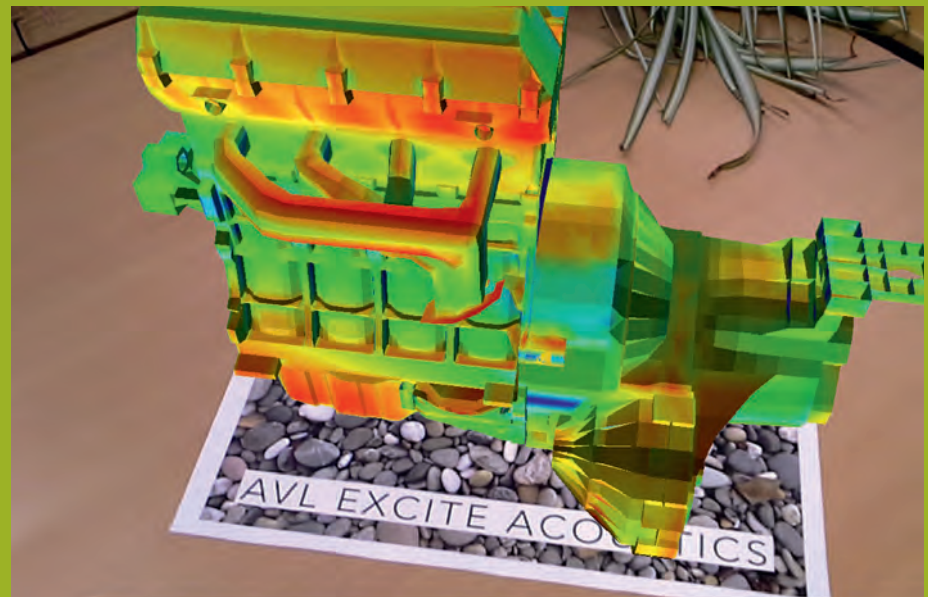
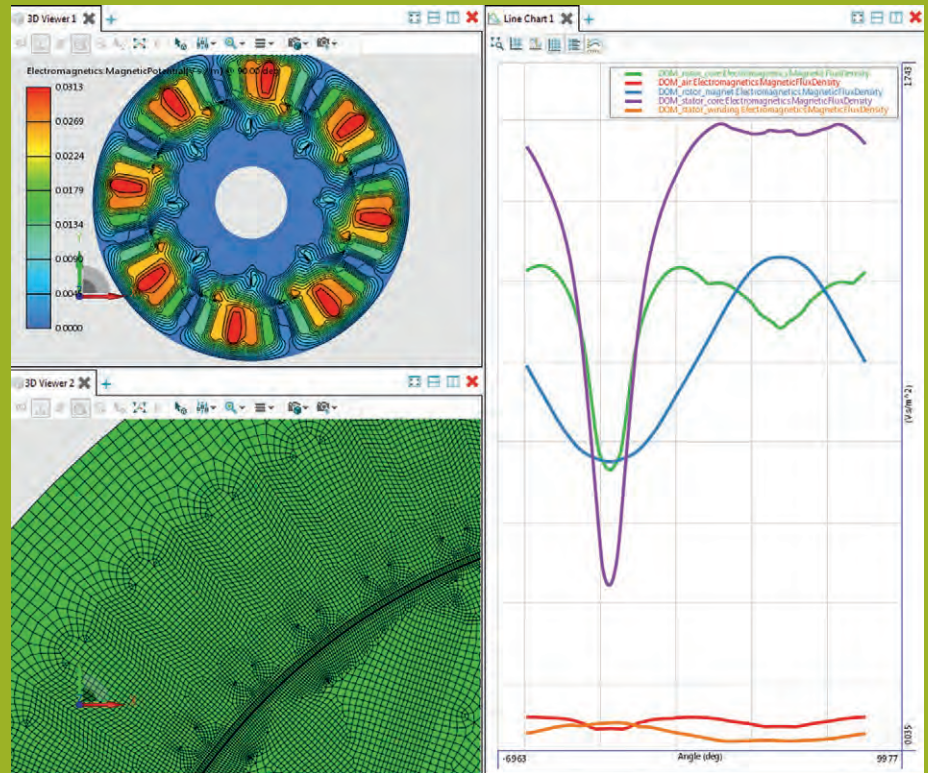
»We benefit enormously from VRVis' know-how, the strong cooperation and the competitive price-performance ratio of their research work.«

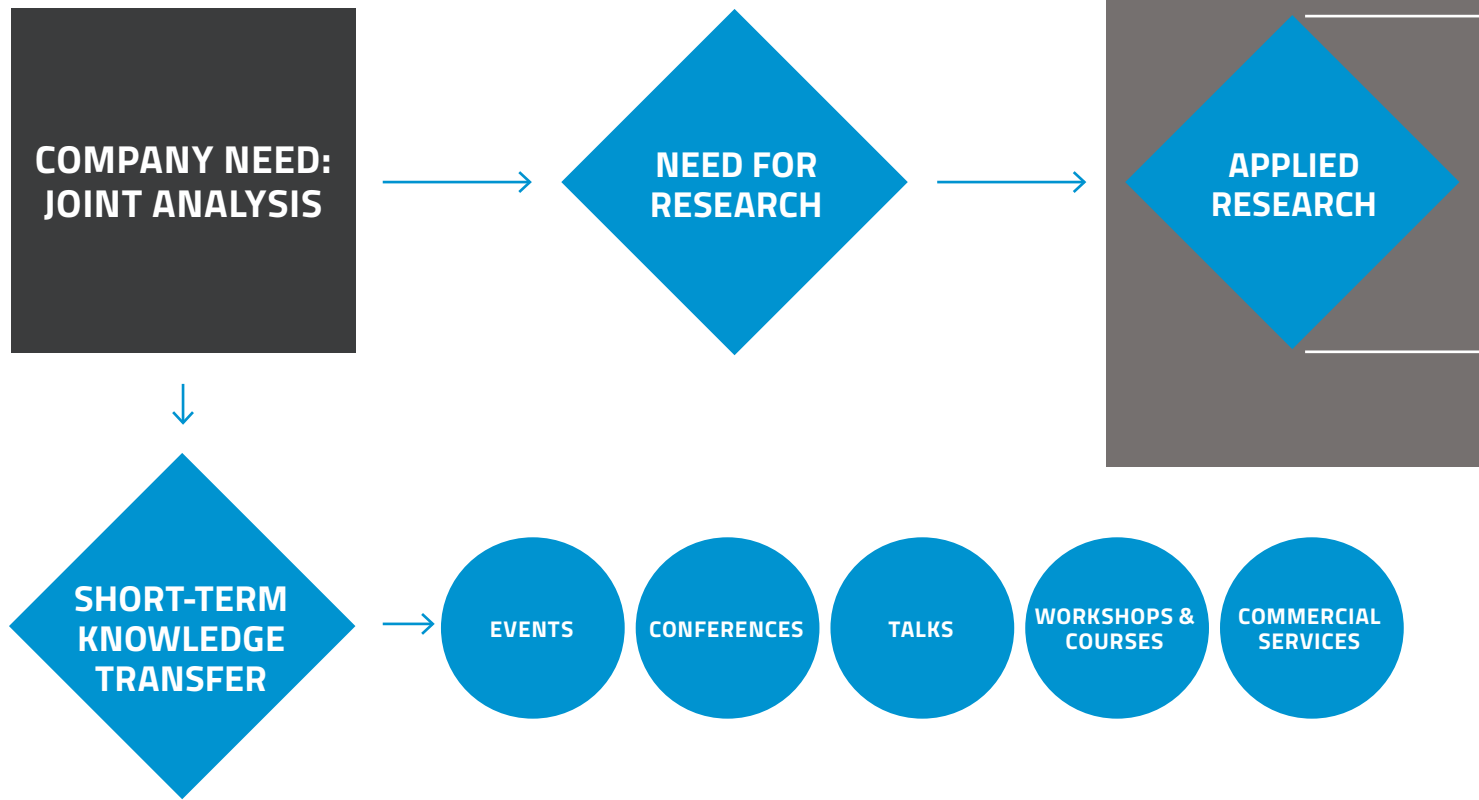
o industry is exactly what domestic research is supposed to do,” agrees Gerd Hesina, Managing Director of VRVis.

However, the joint work is not limited to ensemble simulations. Other projects deal with virtual/augmented reality, the combination of interactive 2D and 3D visualization for large, complex, time-dependent simulation data, as well as human-computer interaction interfaces, i.e., the interfaces between human user and machine. These interfaces must be designed to be intuitive and comprehensible so that the flow of communication functions well even in complex workflows.

The joint success story not only yielded technological leadership for AVL, also VRVis’ basic research has been advanced considerably: to date, more than 20 joint publications have been published in high-ranking research journals and at conferences. AVL furthermore benefits from the numerous multi-firm projects of the COMET program: In large-scale cooperative projects, several companies join forces to exploit synergies and save costs. “We benefit enormously from VRVis’ know-how, the strong cooperation and the competitive price-performance ratio of their research work,” summarizes Krasser, “this is why it makes sense for us to conduct our visualization research together with VRVis as our core partner.” Gerd Hesina is also satisfied: “VRVis is pleased to have a top company in the simulation domain as an industrial partner. We are working on concrete industry-relevant problems and with real industry data. This provides us with valuable application knowledge that we can also transfer to other domains. This subsequently helps our research – because without use cases or relevant application areas, there is no applied research.”

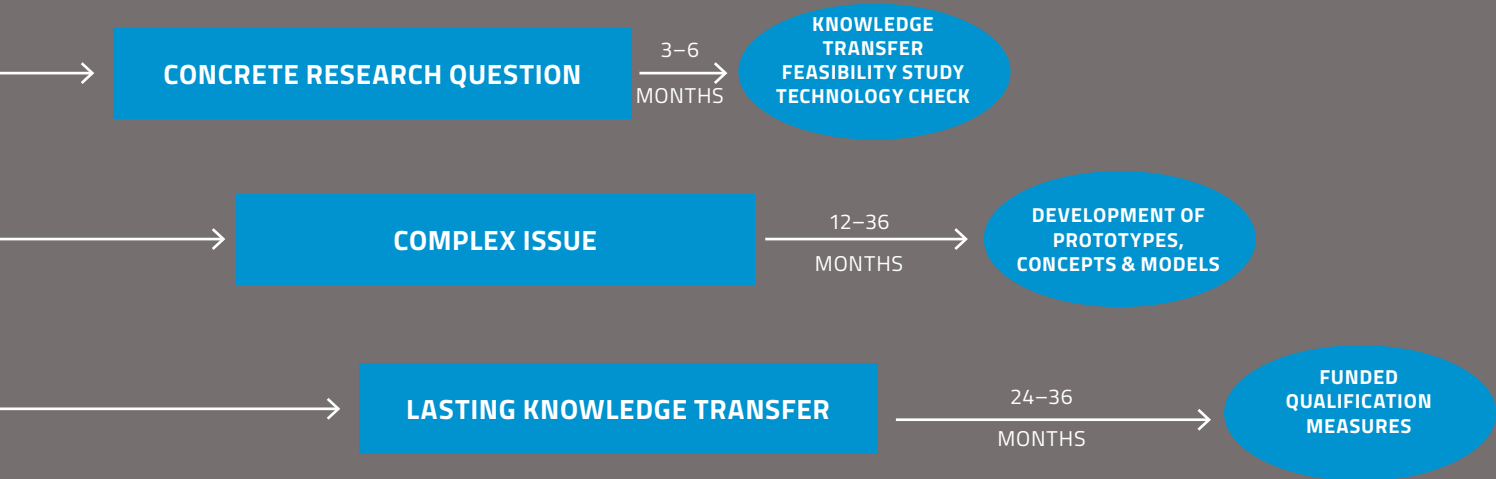
Examples from joint projects: A dashboard for the visualization of data and an augmented reality application to make engine noise visible





Researching with a COMET Center

COMET Centers have the scientific expertise as well as considerable experience with the appropriate funding tools to support companies of all sizes in assessing and implementing creative technological ideas. SBA Research and VRVis have had numerous successful collaborations with Austrian companies and are looking forward to cooperating with long-standing as well as new partners in innovative research and development projects.



A need for research can arise unexpectedly and at all times. Especially companies working on the implementation of innovative ideas sooner or later encounter problems they might not be able to solve with their often-limited resources. This is where research institutions can help, especially those in the COMET program, as it offers sufficient flexibility to help corporate partners quickly and integrate them into the overall research program. COMET Centers in particular have the task of conducting research together with companies and supporting their partners in translating scientific results to further develop products and services. The COMET Centers see themselves as partners who bring not only scientific expertise to the table, but also a great deal of know-how in applying for funding. Joint research projects that fit in well with the research program of the respective COMET Center can be started on very short notice (in contrast to externally funded projects). The aim is usually to find an immediate solution to the problem first, and then to transfer this support process into a long-term, multilateral cooperation.

In the sense of a direct, **short-term transfer of knowledge**, COMET Centers offer formats such as conferences, events, lectures or even workshops and training courses in the respective fields. If there

is an actual need for research, there are several possibilities:

In the case of a **concrete research question**, for example a technology check, medium-term instruments (three to six months) can be used, which are made available by the FFG, especially for SME funding. For example, the "innovation voucher with deductible" helps SMEs to purchase research services to a maximum value of EUR 12,500, with EUR 10,000 being paid out as a grant by the FFG. In order to check the technical practicality of more extensive ideas, one can apply for a "Feasibility Study"¹, for which up to EUR 48,000 in funding is provided. In both of these funding models, the submission has to be made by the companies, with the COMET Centers of course offering assistance with administrative and organizational matters.

If the **research requirement is more complex**, it may be useful to develop and submit a research project, usually with a duration of 12 to 36 months. In this case, the COMET Center usually leads the consortium and thus takes on the responsibility for coordinating scientific and organizational matters in the application phase and during

project implementation. Tried and tested funding programs include BRIDGE 1 and ICT of the Future (both FFG), under which projects with total volumes of EUR 450,000 (BRIDGE 1) to EUR 2 million (ICT of the Future) are funded. Together with their corporate partners, the COMET Centers research and develop prototypes, concepts and models, which are then advanced by the companies into marketable products and services.

The third and likewise long-term cooperation track (24 to 36 months) is the **lasting transfer of knowledge from research institutions to companies**. Here the COMET Centers generally work together with universities and universities of applied sciences as well as selected companies to develop and implement customized continuing education measures. These are training courses that are completely novel and convert current research results into know-how for the company partners. The FFG supports such qualification measures, for example, in the context of Qualification Networks (total volume EUR 500,000) or Tertiary Level Courses (EUR 1 million).

¹Feasibility Study was a FFG funding scheme until April 2020. It has been replaced by a new funding instrument, Small Scale Projects.

Interview with Federal Minister

Dr. Margarete Schramböck (BMDW)

The Federal Ministry for Digital and Economic affairs is an expert in positively shaping Austria's future by actively promoting cooperation between research and industry, for example through the COMET program. SBA Research and VRVis spoke with Federal Minister Dr. Margarete Schramböck about the past and future of COMET, innovation and digital transformation.

One of the priorities for the BMDW is to "further promote investment in research, development and innovation in order to strengthen the competitiveness of Austrian companies". In your opinion, what role do the COMET Centers play in fulfilling this vision?

According to studies done by the European Commission, two thirds of economic growth in Europe is attributable to research and innovation. Prosperity and employment are therefore largely dependent on R&D. In order to benefit from this, Austria as a business location must position itself accordingly. For this reason, the BMDW focuses on location-relevant research and, thus, on strengthening entrepreneurial innovation capacity.

The COMET Centers are bundling the competencies of our best players in science and business. This flagship program is one of the main reasons why Austria is among the EU top 3 in terms of science and industry cooperation.

The top-level research conducted by the COMET Centers contributes to positioning Austria as a trend-setting technological and knowledge-based region in Europe. In your opinion, is the majority of Austrian companies ready for the innovative research that is happening in COMET, or are there challenges?

In addition to some well-known technology companies, Austria also has many hidden champions. **The strong financial involvement of companies in the COMET program – they finance around EUR 70 million annually – shows that there is no lack of strong partners.** However, in order to reach the majority of Austrian companies and make them fit for innovation, especially in the field of digitalization, we need broad support measures. For this reason, the BMDW has set up the "KMU.DIGITAL 2.0" program – a funding scheme for SMEs – in cooperation with WKÖ¹ and aws². This program supports Austrian companies in taking advantage of the opportunities offered by digitalization and in mastering challenges by promoting individual advice on digitalization and the implementation of initial digitalization projects.

¹WKÖ – Wirtschaftskammer Österreich, The Austrian Federal Economic Chamber

²aws – austria wirtschaftsservice, an Austrian economic service agency

The "digital transformation of economy and society in Austria" is one of the main concerns of the BMDW. COMET Centers are already making a significant contribution through outreach and awareness initiatives (e.g., lectures in schools, participation in the Vienna Research Festival or the Long Night of Research). In your opinion, what role should the COMET Centers play in the future?

In order to further the mindset of the population towards research and technology in Austria and to increase understanding for the use of tax funds for this purpose, activities such as the "Long Night of Research" or the "Jugend Innovativ" competition for young people are supported by the Federal Ministry of Education, Science and Research. We do not want to overload the COMET program with additional objectives.

The government program defines the COMET program as "an essential pillar of knowledge transfer". How could COMET be expanded in order to further establish Austrian research excellence and strengthen it with regards to the international competition on the one hand, and to contribute to the digitalization of society on the other?

The COMET program is a tried and tested format that is constantly being adapted to current challenges. Most recently, the two program lines K1 and K2 were merged and supplemented by the new program line COMET modules. This also gives the existing K1 centers the opportunity to increase their research volume, establish forward-looking research topics and thus build up new areas of expertise. Another advantage of



COMET is its thematic openness, which enables a competition of the best ideas and topics. Digitalization is a central theme which runs through the research programs in all areas.

COMET Centers are an important non-university employer for highly educated professionals. A further contribution is the promotion and training of young academics – an important dual role. According to the BMDW, how can this role be further expanded?

One of COMET's most important tasks has always been the expansion and improvement of human resources. The 25 COMET Centers currently employ almost 2,000 researchers, whose highly qualified expertise is in great demand by companies. **COMET's strength in the area of young academics is evident from the high number of completed master's theses (3,260) and dissertations (2,670).** Companies see the COMET Centers as a pool of know-how and as a personnel reserve; through cooperation, they can more often secure or create R&D jobs. The topic of human resources will be one of the subjects of the interim evaluation of the program. From this we can derive possible improvements for COMET if necessary.

»The COMET Centers are bundling the competencies of our best players in science and business.«

Success Story

SMEs as COMET Partners

Small and medium-sized enterprises are important partners for COMET Centers; of the approximately 40 corporate partners of SBA Research, well over half are SMEs.

Most of them have been working with SBA Research for many years in COMET and/or externally funded projects, such as Repuco Unternehmensberatung GmbH, HeartBalance GmbH, Stadler Völkel Rechtsanwälte and CYAN Security Group GmbH, to name a few examples. "Long-term partnerships with companies, especially with SMEs, have been the secret of success for us as COMET Center in establishing and maintaining a stable and effective network from which every new company can directly benefit", says Markus Klemen, Managing Director of SBA Research, who considers the connecting of competent and reliable partners as an important task of COMET Centers.

Often it is such companies in the small and medium-sized sector, including start-ups, that work on and with particularly innovative ideas and methods – this results in projects that depend on special

know-how and often raise specific research questions. In contrast to large companies, which are able to afford their own R&D department, SMEs reach their limits here. Even if many SMEs, such as Repuco, are aware of the economic exploitation potential of (even basic) research, the "return on investment" is often too long-term and potentially risky to justify the direct costs. Here, COMET Centers are particularly well suited to deliver results very quickly and flexibly, while developing a longer-term and stable research strategy for and with the companies by involving the network partners. "The basis found together with the COMET Center is the essential advantage in comparison to other research project constellations, which always

bring a certain amount of uncertainty with regard to the performance and stability of the consortium," says Frank Christian Sprengel, manager at Repuco, a business consultancy.

Nevertheless, there are hurdles which limit SMEs with regard to research cooperation. For example, it is sometimes not possible for SMEs to participate in several research projects or even calls for proposals at the same time; current COMET partner companies, for example, cannot participate in certain externally funded projects of the center, as new consortia are often explicitly asked for. If certain externally funded programs are to be addressed, the timing of a COMET membership must be carefully considered.

»SMEs require special know-how and raise specific research questions.«

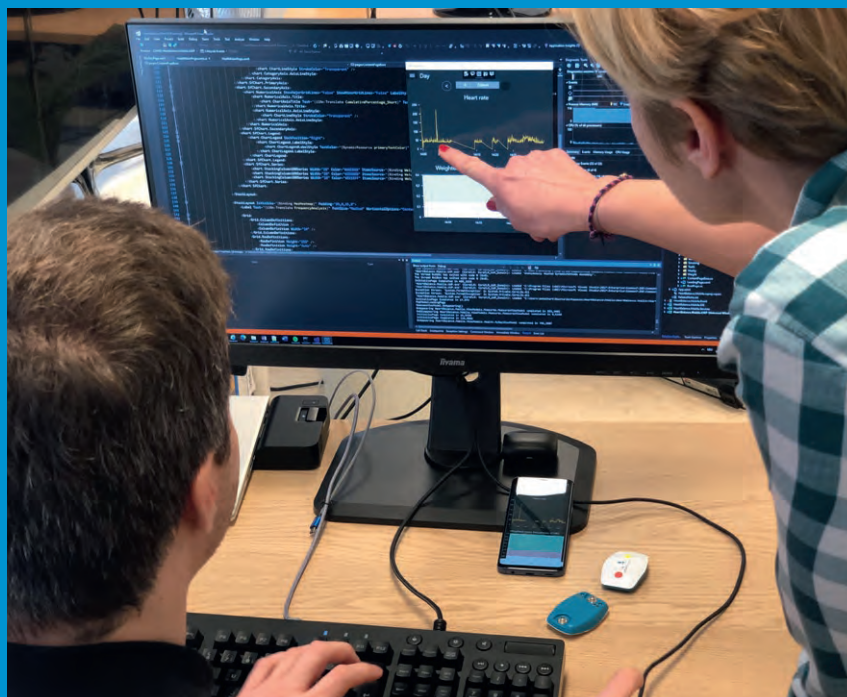
The SME partners of SBA Research particularly appreciate the uncomplicated access to research and cybersecurity expertise, especially in the context of interdisciplinary cooperation. Frank Christian Sprengel of Repuco sees the COMET Center as a “reliable contact point in cybersecurity issues and in the context of ICT-related solution competence”. For Stadler Völkel, a Viennese law firm with a focus on digital currencies, the cooperation in an externally funded project has provided access to comprehensive technical expertise in the field of distributed ledger technologies, especially for the use case of smart contracts. In return, researchers of SBA Research get the opportunity to directly apply their scientific work and results in a business- and societal context.

For micro-enterprises it has proven to be a good idea to use other FFG funding schemes as an initial step, e.g., the “innovation voucher with deductible”, the “Feasibility Study”¹ or BRIDGE 1. This way, SBA Research and its company partner HeartBalance – which develops and distributes a health monitoring device for early detection of diseases – were able to gradually establish a research cooperation on data security and encryption of medical data. In addition to scientific expertise, the company partner was supported with know-how on funding – from the innovation voucher to a full COMET membership. Peter Hauschild, founder and managing director of HeartBalance GmbH: “The innovative possibilities offered by SBA Research enrich our activities in many ways and place HeartBalance on a much higher level of development than would be possible within our own setting”.

¹Feasibility Study was a FFG funding scheme until April 2020. It has been replaced by a new funding instrument, Small Scale Projects.



State-of-the-art research as basis for each cooperation



The Heart Rate Variability Sensor by HeartBalance

Performance Indicators – An Overview

2010–2019

Education

Internships

119

VRVis



101

SBA Research

completed PhDs

22

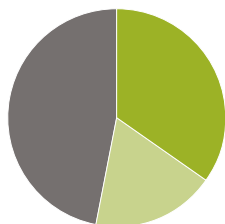
VRVis



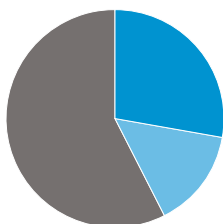
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SBA Research

Research Funds



VRVis



SBA Research

€ 18.217.000 research funds COMET € 13.442.000

€ 9.531.000 external research funds € 7.087.000

€ 24.332.000 industry contributions € 27.770.000

Excellence

Patents

21

VRVis



Publications

504

VRVis



556

SBA Research

actively advanced Start-ups

21

VRVis



52

SBA Research

Public

350

VRVis
media coverage



89

SBA Research
events & conferences



VRVis uses classical image processing methods as well as latest artificial intelligence technology to support modern medicine

Interview with Dr. Henrietta Egerth and Dr. Klaus Pseiner

Management of the FFG

The Austrian Research Promotion Agency is the national funding institution for applied research. The FFG handles numerous funding programs, including COMET – Competence Centers for Excellent Technologies. VRVis and SBA Research talked to Dr. Henrietta Egerth and Dr. Klaus Pseiner about the COMET program, the cooperation between science and industry and Austria as a location for research and innovation.

The FFG is the funding agency for Austrian innovation. What has been the focus of attention so far and what is the outlook for the future?

Egerth: Austria is a central business and innovation location in Europe. A location that creates jobs and ensures prosperity. FFG funding makes a significant contribution to generating new knowledge, developing new products and services and thus to being more competitive on the world market. This facilitates the financing of research and innovation

projects and thus helps to cushion the research risk. **Research funding has been a success model for more than 50 years.** This gives us confidence, and based on this tradition we will focus on the future.

What are the unique features of COMET compared to other funding programs? How important is COMET in FFG's portfolio?

Pseiner: As a one-stop shop, FFG offers not only many national funding

programs, but also advice and support for international programs and a wide range of complementary services. COMET is Austria's flagship program with a considerable amount of funding. It is the only FFG instrument that supports research institutions over a period of eight years. COMET Centers therefore have a very long-term perspective. **COMET Centers have a strong international presence and play a leading role in a number of international committees and EU projects.** All this contributes to Austria as a business location.

What makes you particularly proud about COMET?

Egerth: COMET is a European flagship program and is considered "best practice" in the EU. That makes us proud. However, it is much more a matter of evaluating what makes sense. In any case, it makes sense when all forces work together, and success proves us right! With COMET, we equally link the national and international level, although there is only one funding recipient, namely the COMET Center. All partners – companies, scientific partners, and funding agencies – together provide the financing for the COMET Centers, EUR 2.2 billion since 2008. This is truly remarkable and successful, because all those involved are convinced of the impact and meaningfulness of their investment and their actions. The federal funds, which make up the lion's share of the financing, are jointly provided by the BMDW and the BMK – which cannot be taken for granted.

Are Austrian companies ready for the innovative research that is happening in COMET, or are there challenges?

Pseiner: Austrian research and innovation is closely integrated into international developments, is well networked and also plays a pioneering role in specific areas. For example, several hundred companies based in Austria are among the global market- or technology leaders in their field of activity. And a lot of these frontrunners in turn work very closely with COMET Centers. But yes, the challenges lie in change and constant competition.

One objective of the COMET program is to strengthen human resources and train specialists. Do you see this goal fulfilled?

Egerth: Overall, researchers in Austria have an optimal working environment, both in the field of scientific research at universities or non-university institutes and in application-oriented, operational research. And COMET contributes to this. **COMET Centers currently employ nearly 2,000 researchers and support them with structured career models.** Their highly qualified expertise – especially in application-oriented research – is in great demand by companies. COMET Centers thus form important hubs with many interfaces to the entire research and innovation landscape and are regarded as catalysts for industry.

Researchers are confronted, among other things, with temporary employment contracts and the necessary acquisition of external funding. Is the COMET program, which operates without basic funding, sufficiently future-oriented?

Pseiner: COMET supports research projects in competition and, thus, only the best projects. However, this support is at the highest level and with a considerable amount of funding over a period of eight years. This is a long time period

»COMET is Austria's flagship program with a considerable amount of funding.«

in research and allows for stable working conditions. Research funding is certainly multi-layered and is largely carried by the responsible departments at federal level together with the federal states. This includes not only the expansion of the university landscape and non-university research institutes such as COMET Centers, but also the system of research and innovation funding, cooperative structures, technology transfer initiatives and the international orientation of Austrian research and innovation.

How do you see the future of the COMET program?

Pseiner: In any case, the outcomes of the COMET Centers are essential, and whether it will be possible to generate positive effects for Austria and to promote Austria. Our goal as a funding agency is to use financial support to achieve maximum impact in the innovation system. We are working on making the innovation system as a whole even more effective and efficient. **The successes achieved so far show that we are on the right track.** We are therefore looking into the future with optimism.





To improve application security through design and concept proposals,
SBA Research focuses on research in usable security & privacy

denne

More than a Quota

You encounter it everywhere – in media reports, in legislation and in voluntary commitments. And also in research it's a big issue: the quota.

But what exactly is this quota? A quota for more publications, more international academic partners or external funding? This question no longer arises, because the term "quota" has become a contraction and synonym for one thing: the number of women in the workforce. "The quota" concerns only them.

Some research institutions, both university and non-university, have implemented a quota of women in the scientific sector – either on a voluntary basis or because of funding requirements. This is one of the most frequently discussed indicators in recent years, if not decades. And that is exactly the point: it is ONE indicator. One of many. The quota is one of numerous, very different target values which make up the success of a company. Even scientific institutions are constantly asking themselves how a successful research center is defined. Is success quantifiable? When it comes to countable variables – such as patents, partners, PhDs – the answer is "yes", and also target values such as sales growth, new customer acquisition or media reach are considered meaningful and are hardly ever discussed or even questioned. Trust

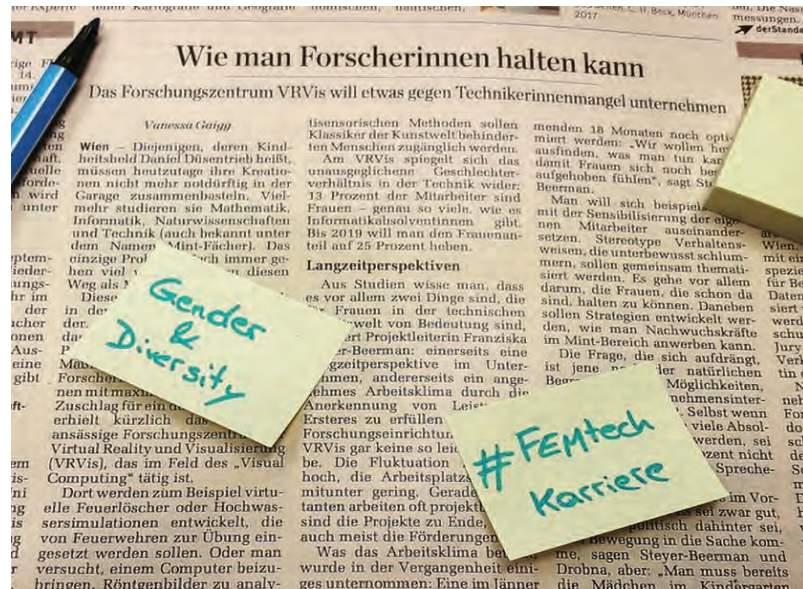
in numbers is everywhere. Only when it comes to personnel, percentages tend to be rejected and are often perceived as too restrictive and difficult to implement.

Many broad-based studies have proven that diversity in companies leads to measurably more success and sales (e.g. "Delivering through Diversity", McKinsey, 2018, or "Getting to Equal", Accenture, 2019). A quota can be a necessary corrective to focus attention on a specific issue and subsequently free up resources – whether financial, material or human – to overcome challenges. At the same time, a quota is not enough. After all, the number of women in the workforce does not necessarily indicate whether there is equality and inclusion in a company or whether the working climate is gender-equitable. A quota is a momentary snapshot. The advancement of women must be given further thought. In order to promote women in science

effectively and sustainably, companies must become more family-friendly and provide sufficient maternity and paternity leave, as well as flexible working time models and real possibilities to work from home. Qualification measures are also important. A company can make changes in many different areas: in recruiting, in personnel management, in the promotion of young talent, at management level. This requires sustainable corporate key figures that also include questions such as: Where are we? Where do we want to go? And how do we do it best?

The quota – whether imposed by voluntary commitment, funding or legislation – can be an important key figure for a company. But it is only one of many indicators that reflect the success of a research institution. After all, the benchmark for invention and innovation is not just a number, but a diversified portfolio.

»The benchmark for invention and innovation is not just a number, but a diversified portfolio.«



Recruiting Relaunches at VRVis

Within five years, VRVis raised the percentage of women among its scientific personnel from the single-digit percentage range to 27% – even though the number of female university graduates in the IT sector has been constant for years at only 13%.

Time and again, companies use the term “desperately” when searching for specialists in the technical and scientific field. The recruitment of well-trained and competent employees from the MINT sector is one of the major issues in human resources departments. This is especially true for the IT sector and even more so for science. Especially research institutions find it difficult to keep up with the competitive salaries paid in the industry sector and have to deal with additional hurdles such as high publication pressure. If the new specialists are also required to

be female, in order to promote diversity in the company and – as international studies have shown – in the long term, business success, it is going to be a tight spot. So, investing even more effort?

A practice report

Thanks to a number of targeted measures, VRVis had a 13% share of female researchers at the end of 2016. Although this reflected the female MINT graduate rate in Austria, there was agreement that this simply could not be enough. In 2017, the FFG was therefore brought on board

for a two-year FEMtech career project to anchor issues such as gender-sensitive recruiting and equal opportunities in the company.

It became apparent that often just some fine-tuning would do the trick. For instance, women and their concerns were given more space in the company, a position dedicated to diversity management was created, and the VRVis management explicitly committed themselves to equal opportunities and the importance of diversity for the success of the company. VRVis also receives a lot of positive feedback for its adapted web presence and its press and social media work. Next to communicating complex research topics, the focus is always on people.

In recruiting and personnel management, simply running things by the book does not work (anymore)

Additional and much more extensive measures included sharpening the employer branding, presenting VRVis more strongly in external communications as an attractive employer, and taking a more active approach in the search for qualified applicants. The restructuring of the recruiting process has paid off: In the course of just a few years, VRVis was able to increase the proportion of female researchers to over 27%. At VRVis, the importance of being an attractive employer for researchers can now be seen at first glance: in the job advertisements, on the website, and of course during conversations over lunch.

»In the course of just a few years, VRVis was able to increase the proportion of female researchers to over 27%.«

1. Employer Branding: Those are the foundations

- Who are we? What do we offer?
How do we want to be perceived?
- implementation into internal and external communication
- supporting a common "vision"

2. Job Advertisement

- The first impression counts: the job advertisement is the first point of contact between applicant and company.
- gender-sensitive wording
- low-threshold wording
- not just requirements, but also presenting what the company offers

3. Active Search

- using diverse channels and networks
- longer periods of advertising

4. Job Interview

- prompt information for the applicant
- structured questions
- allow for questions of the applicant
- appoint a diverse selection committee:
 - ideally one subject-specific person and one person from Human Resources
 - ideally one man and one woman
- document the process

5. Onboarding

- prepare organizational matters (payroll, working station, contract, etc.)
- welcoming tour on the first day of work
- provide a mentor as main contact person (for the first steps and beyond)

6. Accompany Career Path

- mentoring
- annual employee dialogue
- further education and support
- individual solutions

7. End of Employment

- accept reorientation
- exit support
- Former employees are figureheads for the company and potential new business partners.

Interview with ao. Univ.-Prof. Kurt Matyas

Vice Rector for Studies and Teaching
at the TU Wien

The Vienna University of Technology is an important academic partner for COMET Centers and a significant source of young researchers. SBA Research and VRVis talked to Prof. Kurt Matyas, Vice Rector for Studies and Teaching, about the quota of women, mentoring programs and social responsibility for more equality.



What measures have been taken to sustainably increase the proportion of women at the TU Wien?

Our goal is to offer women and men the development opportunities appropriate to their qualifications. The elimination of disadvantages for women is a common task. The measures range from strategic anchoring and institutional responsibility to mentoring programs to career positions for women to a girls' program at the Children's University.

Which of these measures has the greatest potential to increase the number of female students?

One measure alone will not lead to the desired goal. **It is about developing a culture in which women are naturally**

part of the university's image. Role models are a good way to show career and life paths, e.g., through the Women's Prize of the TU Wien. Concrete support is provided by the mentoring programs, which enable access to information, personal contact and exchange of experiences.

How is the acceptance of the TU Wien's online mentoring program? In your opinion, how important is mentoring, especially for female students?

The online mentoring program is designed to support and encourage female high school students and first-year female TUW students and is well received. Successes are difficult to quantify but are reflected in the very positive feedback. **The aim is to encourage interested women who are still confronted with false stereotypes.** I see mentoring as an offer of support to cope with everyday life at the university, for extended insights and more self-confidence. The Vice-Rectorate for Studies and Teaching has also established a mentoring program for first-year students which is aimed at underrepresented groups; among the mentees, the proportion of women is particularly high.

There is a lot of discussion about the "women's quota" – to what extent do quotas make sense, given that the responsibility for sufficient numbers of female juniors is often "passed on"?

On the one hand, quotas lead to women being more visible – this is how role models are created. On the other hand, the term "quota woman" often has a certain connotation, allowing performance to fade into the background. This makes life unnecessarily difficult for women. **Social rethinking is essential in this context.** If classic role and job descriptions can be broken down, the gender distribution in schools, universities and companies



Katja Bühler (center) with members of her research group

Katja Bühler, head of the Biomedical Image Informatics research group at VRVis, was awarded the TU Women's Prize 2020. At the award ceremony on March 3, 2020, not only the impressive professional achievements of the mathematician and computer scientist were highlighted, but above all her commitment to the promotion of young talents – supporting especially young female researchers and diploma students as a mentor.

will also change. It is important to see this as a joint task, to become active and not to wait for someone else to solve the problem.

What measures are taken in the "study preparation and reflection" phase (VoR phase) to make the entry for women low threshold?

I think this is when the differences between the sexes are the smallest.

Studying, especially in the beginning, is always a challenge. Admission procedures and the VoR phase ensure that students start their studies with the right expectations. We pay particular attention to the gender-appropriate design of these procedures. Technical (school) knowledge is not a prerequisite for successful studies at the TU Wien. So-called "bridge courses" serve to enable a smooth start into one's studies.

Personal Insights into Everyday Researchs

**Thomas Konrad, senior security consultant, Software Security Group
at SBA Research since 2010**

When I started at SBA, my team consisted of men about my age; that has changed somewhat over time. From my point of view, more diversity has brought a greater balance and a better discussion culture within the team.



**Simin Ghesmati, researcher,
Decentralized Systems Group
at SBA Research since 2019**

It makes me happy to be at SBA among other female researchers, as the number of women in technical studies is still low. It encourages me when I see their success, because our female senior researchers are an impressive role model for me.



**Janne Mihola, researcher,
GeoSMAQ Group
at VRVis since 2017**

For me, the FEMtech internship was a great opportunity to get a taste of everyday research at VRVis. As a result, I was able to get a part-time job, which I am very proud of as a student and mother of a small child.



**Georg Stonawski, founding member and former managing director
at VRVis since 2000**

I have been with VRVis since its foundation and was the center's managing director from 2000 to 2017. In order for researchers to have the opportunity to innovate, design and invent new things, they need freedom and funding, so that they can realize their (research) goals and make results available to companies. It is important for us not to be an industrial company with an "assembly line", but rather a site for individual production of innovative solutions.



**Stefanie Schedlbauer, chief financial officer, authorized signatory
at SBA Research since 2007**

In 2007 my team consisted of four women, all Austrian except me. Due to the international orientation of our research, even back then we had a very cosmopolitan working atmosphere. Over the years, the diversity among our staff has increased constantly, which has further strengthened the basic, open mindset. Diversity needs structures for uncomplicated exchange put into practice, so that misunderstandings can be quickly resolved, and any discriminatory behavior can be counteracted.



SBA Research and VRVis are the workplaces of around 170 highly motivated employees. How important diversity, a good working atmosphere, and much more, are for successful top-level research is shown through the quotes gathered on the following pages.



Maria Wimmer, researcher, Biomedical Image Informatics Group at VRVis since 2012

It is very obvious that VRVis reaches women from various fields through carefully targeted measures (e.g., web presence) on a national and international level. This is particularly noticeable to me, as I was used to working in a male-dominated field. The interaction with and the climate among each other - across project teams - have developed very positively due to the increased diversity (also with regard to specialization).

Andreas Ekelhart, senior researcher, authorized signatory at SBA Research since 2006

The SBA founding team was all male. Since then, the company has grown considerably, today almost all teams are made up of different nationalities, genders and backgrounds, which has a positive effect on the working climate. A company should create an integrative culture in which the employees feel part of the team and can concentrate on their work.



Christoph Traxler, senior researcher and manager of the Smart Worlds Area at VRVis since 2011

I applied to VRVis in 2011 on my own initiative because I am interested in applied and industry-oriented research. The working atmosphere was very good right from the start and has improved further thanks to more female colleagues. In my experience, diversity, especially in research, leads to a broader spectrum of ideas and solutions and a significant improvement in teamwork.

From FEMtech Intern to Key Researcher

A Portrait of Johanna Ullrich

Johanna Ullrich's professional path shows how a career in a COMET Center can unfold. An exemplary journey from intern to key researcher.

Johanna Ullrich first took on holiday jobs in the software development team of SBA Research and with a company partner, and then gained her first research experience during a FEMtech internship. The independent nature of her everyday research work was particularly appealing to her; during her internship, she wrote a grant application that enabled her to continue her research in the field of information security. After completing her doctorate, she became a senior researcher with the goal of establishing a new research group for network- and CPS security. Since 1.1.2020 she is key researcher at SBA Research. There and as a university lecturer at the Vienna University of Technology as well, Johanna Ullrich breaks with traditional role models. She is a mother and returned to a full-time position after her maternity leave – which often earns her disbelief or even criticism outside her sphere at the COMET Center: “If a father has professional ambitions, that is normal; as a mother, you are constantly asked whether you really need to do this.”

For the IT expert, the reasons why female researchers still have a ‘leaky pipeline’ are mainly due to the role of women when starting a family. Many women return after maternity leave only in part-time positions or have quit inwardly even before maternity leave has begun. This can also lead to women being accused of no longer being interested in a career. Furthermore, in Johanna Ullrich's experience, women are often underestimating themselves and therefore do not apply for management positions in the first place. Here it is primarily up to society to rethink role models and demand real equality in family organization. In this regard, COMET Centers play a pioneering role in society, because as a matter of course parental leave or part-time work can be used equally by mothers and fathers, and many men take parental leave for much longer than the usual two months.

Women are still seldom to be found in leading positions in both the research and ICT sectors, which is why Johanna Ullrich is often adduced as a role model – a role

»Rethink role models and support actual equality in family organisation.«

she sees ambivalently: On the one hand, she is often reduced to the role model function and actual achievements take a back seat; her scientific successes clearly show that she is by no means a "quota woman". "Sometimes that has a certain connotation," she says. On the other hand, it is very important to the key researcher to make equality visible, and she enjoys motivating and promoting the next generation of women. She attaches particular importance to ensuring that young women continue to develop, gain new experience and acquire new knowledge: "This not only strengthens their self-confidence but also increases their chances on the job market," says Johanna Ullrich, whose own team has an almost balanced gender ratio. In her opinion, diversity (including different nationalities) and interdisciplinarity generally make a decisive contribution, for example in finding new approaches.

It is extremely important to support young people and to live equal rights – an approach that is already well implemented in science, as Johanna Ullrich believes. One reason for this is the flexibility in working hours and attendance time, which makes research a relatively family-friendly sector. Funding programs are often used to create the necessary conditions. For example, FFG's FEMtech internships offer a great incentive to particularly promote young female researchers. COMET Centers also offer conditions that are rarely found in this form at universities or in the industry: unlimited employment contracts, manageable structures and flat hierarchies give plenty of room for scientific and personal development, while at the same time providing job security.



Success Story

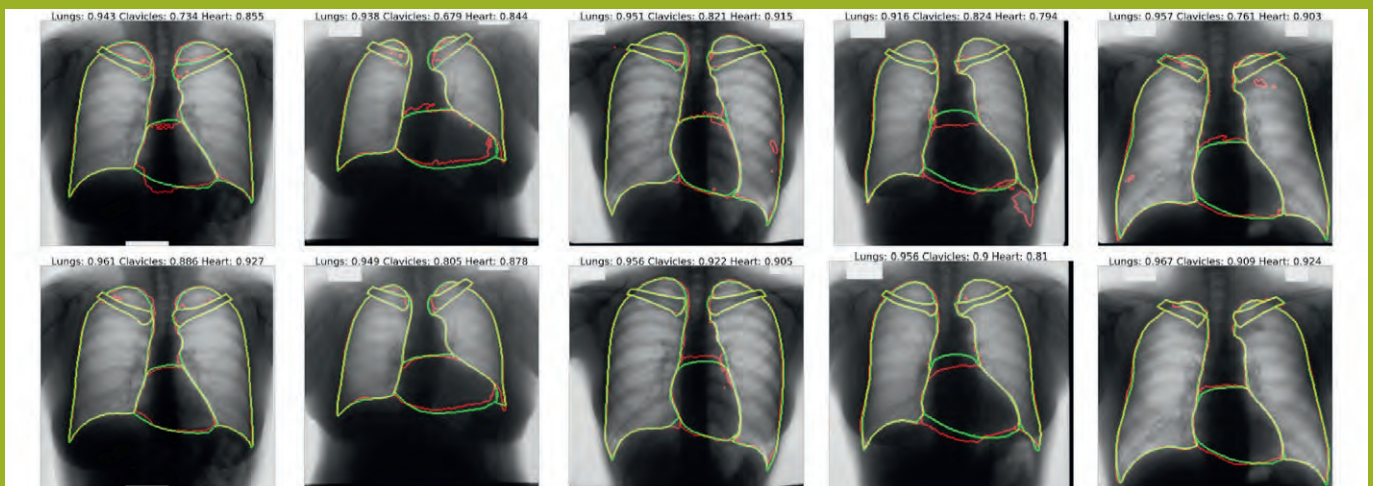
Artificial Intelligence Helps Save Lives

Challenge: The evaluation of imaging diagnostics, for example of X-rays, not only requires a great deal of time from medical personnel but, above all, enormous diagnostic precision.

Solution: Artificial intelligence (AI) is a crucial technology for the development of medical assistance systems which are indispensable in modern healthcare. VRVis has been researching the potential of applying artificial intelligence in biomedicine for years and has already developed several AI-based, patented solutions that facilitate the diagnostic work of physicians by detecting, annotating and qualifying organs or pathologies on radiological image data.

Contribution: In order to support physicians in the highly complex diagnosis of tuberculosis, VRVis together with Agfa Healthcare has developed a deep learning-based solution for the detection and classification of tuberculosis, funded through the COMET project INFUTURA. Automated screening means an enormous acceleration of the diagnostic process, which in the case of a tuberculosis disease can make the difference between life and death. In a further project, VRVis is working on the automatic marking of the spinal column in MRI and CT images. The manual marking of vertebrae is a time-consuming task but necessary for both diagnosis and pre-operative planning. Until now, it could hardly be performed automatically due to a lack of image standardization. As a solution to this problem, VRVis has developed an algorithm that successfully detects vertebrae and intervertebral discs in MRI images and annotates them correctly.

AI is already successfully applied for the automatic segmentation of lung X-rays in the field of tuberculosis detection



Success Story

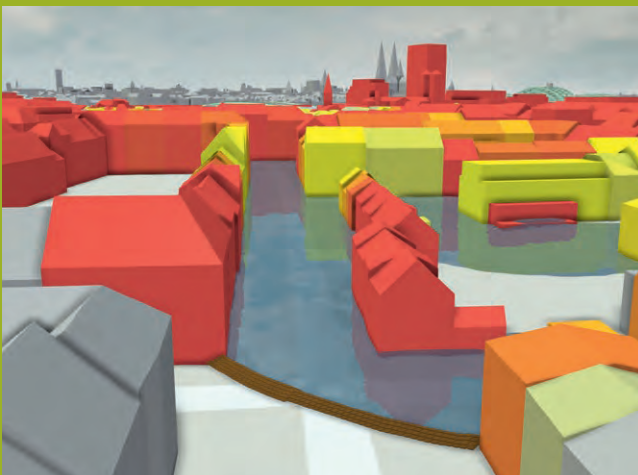
Visual Computing and Simulation for Enhanced Flood Management

Challenge: Due to climate change, extreme weather events such as heavy rainfall or flooding will occur more frequently and more severely in the future. Preventive measures can help protect houses, homes and lives.

Solution: Based on existing geodata, the VRVis research center creates a digital twin of a municipality. With the Visdom software, which combines methods of simulation and visualization, different flood scenarios can be run in order to identify critical infrastructure and endangered buildings. Subsequently, crisis measures and disaster control plans can be prepared. Moreover, the software is an important support tool for first responders in case of an emergency, helping them to quickly find solutions and make decisions.

Contribution: As a result of years of applied research within the COMET program, researchers at VRVis developed Visdom, a decision support tool that already helps Austrian municipalities in protecting themselves against heavy rain and flooding. Once endangered areas are identified, simple structural protection measures often prove to be sufficient, such as mobile water barriers at strategic locations or a road built 20 centimeters higher. In the event of a disaster, the software is also an important support for first responders, who can use it to find solutions faster than in real-time: Visdom calculates where sandbag barriers are needed and how high they have to be, or analyzes how quickly relief forces can reach the scene of a particular emergency.

A sandbag barrier holds back floods. Red buildings are particularly affected, yellow ones less so



Visualization of a flooding river in Tyrol, the local municipalities are affected differently



Interview with Mag. Gerhard Hirczi

CEO of the Vienna Business Agency

The Vienna Business Agency is the city's first point of contact for national and international companies. In an interview with VRVis and SBA Research, Managing Director Gerhard Hirczi gives an insight into the importance of top-level research for Vienna as a world-renowned location for business and innovation.

These two COMET Centers conduct top-level research that helps to position Austria, and especially Vienna, as a trend-setting technological and knowledge-based region in Europe. Do you think that the majority of Austrian companies are open to the innovative research that is happening in these institutions, or are there challenges or even obstacles?

We can see from our research calls that **Viennese companies have a very strong affinity for breaking new ground and also cooperate closely with science and research.** Together, the two COMET Centers have around 120 science and business partners with whom they work and implement innovative projects. This is an area where we can and want to grow.

VRVis and SBA Research are the "oldest" COMET Research Centers in Vienna. How do you see the role of such independent research institutions – which, like the Business Agency itself, see their task in building bridges to industry – for Vienna as a business location?

The "old age" of the two COMET Centers does not show – on the contrary! **Vienna has a very good and comprehensive university research landscape, and the COMET Centers play a relevant role in this by networking science and industry.** The aim is to implement projects at an internationally competitive level. The competition is enormously strong, and excellence is essential to survive.

Research centers as ambassadors for Vienna: Research institutions maintain many international contacts and bring foreign researchers to Vienna – for conferences, cooperation, joint projects. Is this an important contribution to the external perception of Vienna as a business location?

Yes! Our experience as a location agency clearly shows that the best advertising for a location is personal recommendation. This is credible and will be remembered, and therefore has a much more intense effect than conventional marketing measures. Networking and exchange on an international level is therefore an absolute "bringer" in the location competition.

When you think about the cooperation with VRVis and SBA Research so far: What makes you especially proud? What went differently than expected? Where are the challenges?

We have been working together for over a decade now and can point to very successful results. **From a visualization tool for the surface of Mars to flood simulation – there are a number of projects that leave a significant mark.**

Research creates jobs: VRVis and SBA Research together employ around 170 highly qualified people. How can research centers like SBA Research and VRVis together with the Business Agency create even more jobs for Vienna and Austria?

The research institutes are important players for the location, both in their role as employers and as ambassadors on the international market. Through

»Vienna has a very good research landscape, and the COMET Centers play a relevant role in this.«

their work they promote the implementation of projects at an internationally competitive level. By involving small and medium-sized enterprises even more closely in the COMET Centers, we achieve many positive effects for the location, as shown by the projects implemented to date.

Strengthening of human resources and training of specialists at the highest level – research institutions train experts who are well-versed in both the research world and industry and who often transfer to companies. Where do

you see the strengths and weaknesses in contrast to universities/universities of applied sciences?

The location needs top people. And everything that helps to increase quality and also quantity helps to strengthen Vienna. That is why both academic education and the training of specialists for the business world must work together extremely well and complement each other.

In addition to their core competence in research, research centers are of course also committed to science communication and contribute to the dialogue with the public, for example by participating in the Vienna Research Festival, which lasts several days, or the Vienna Daughters' Day. What impact has the direct communication of innovation by research institutes and who can be reached by that? How could the Vienna Business Agency or the City of Vienna further support research institutions in this respect?

If it is done wisely – and if many participate – we could possibly jointly contribute to getting more young people enthusiastic about science and research and to encourage them to take up future professions instead of following traditional career paths. With formats such as the Vienna Research Festival or the many, many workshops for children and young people, we are directly addressing the generation who will shape our city tomorrow and beyond. Global developments clearly show how important it is to win over as many young people as possible to make tomorrow's world worth living in.



Success Story

Secure Software through Combinatorial Security Testing

Challenge:

In our networked world, software security plays an immensely important role. Computers and smart devices increasingly control critical areas of life, are therefore constantly online and thus under threat: blackmail trojans, botnets, hacker attacks and security vulnerabilities endanger economy, society, privacy and data protection. Classical methods in testing security reach their limits and many threats are not detected.

Solution:

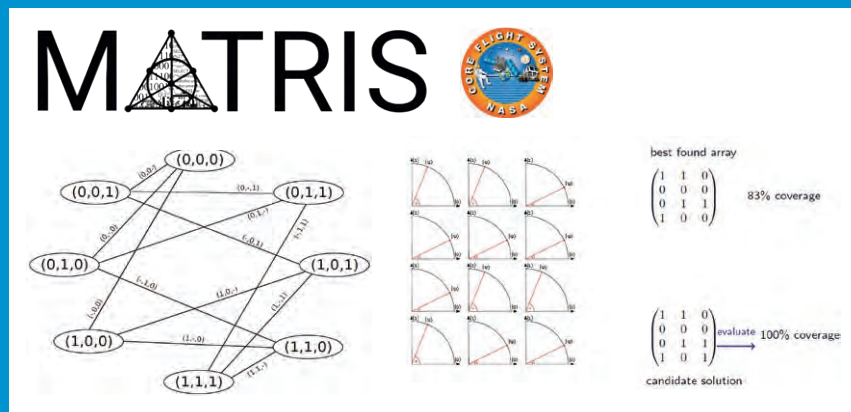
Combinatorial Security Testing (CST) creates a minimal number of test cases that can automatically detect hard-to-recognize errors, providing a completely new approach: CST has the potential to find bugs or security vulnerabilities that are almost impossible to identify when using traditional testing methods.

Contribution:

Within the framework of COMET and externally funded projects, SBA Research has been investigating new fields of application of Combinatorial Security Testing in information security for several years. The ambitious research cooperation of the MaTRIS research group of SBA Research (SBA-K1, Area 4), NIST and Adobe has already resulted in concrete successes: Through combinatorial testing, potential vulnerabilities were found in popular software products that previously could not be identified, despite extensive "traditional" testing. NIST in particular is interested in using this technology in high-risk areas – e.g., critical infrastructure, aviation or (semi-) autonomous vehicles – where software failure can lead to disasters. Combinatorial Security Testing is currently still a basic research field in which the MaTRIS group is leading internationally; it has great potential to become an important tool to make software more reliable and secure in the near future.

MaTRIS technology for the creation of highly optimized test sets, using quantum and neural computation concepts

Dimitris Simos (key researcher, SBA Research) with Raghu Kacker (senior scientist, US NIST) on the NIST campus



Success Story

sec4dev – Security as an Integral Part of Software Development

Challenge: There is hardly any activity in the 21st century that is not supported or made possible in the first place by software. However, there is currently a lack of experts who can cope with the challenges of ever-increasing software complexity. Hacking attacks widely reported in the media repeatedly show that in Austria the gap between the development and the security of software is still large.

Solution: Secure Software Development is central to the protection of companies, public institutions and private individuals. Secure software is feasible, but the Austrian software and security communities are hardly connected, if at all; the transfer of know-how often only takes place through commercial services. In order to sustainably increase the quality of software products, security-specific training for software developers and a continuous exchange of knowledge are needed.

Contribution: Imparting knowledge, creating awareness, forming communities and facilitating exchange – these are fundamental technical and societal tasks of a COMET Center. With the appropriate know-how, secure software is feasible. That is why SBA Research launched sec4dev Conference & Bootcamp in 2019, the first and only platform in Austria that builds a bridge between software development and -security. Highly specialized bootcamps (two days), followed by a two-day single-track conference, allow participants to learn how hackers think, to become familiar with security basics and technical details, and to exchange ideas with like-minded people. Security is a driving force for the quality of software products – a fact that needs to find its way into the mindset of companies and developers. Through sec4dev and regular Security Meetups, SBA Research creates and promotes a steadily growing community that to date includes more than 600 software developers. The mission: Making security a first-class citizen in software development!

sec4dev Conference & Bootcamp



In highly specialized hands-on bootcamps, expert knowledge from practice is conveyed





IMPRESSIONS OF TOP-LEVEL RESEARCH
VRVIS ZENTRUM FÜR VIRTUAL REALITY UND VISUALISIERUNG



IMPRESSIONS OF TOP-LEVEL RESEARCH
SBA RESEARCH

Bundesministerium
Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie

Bundesministerium
Digitalisierung und
Wirtschaftsstandort



FWF
Der Wissenschaftsfonds.

Christian Doppler
Forschungsgesellschaft



Das Land
Steiermark
→ Wirtschaft und Innovation



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