

Quark

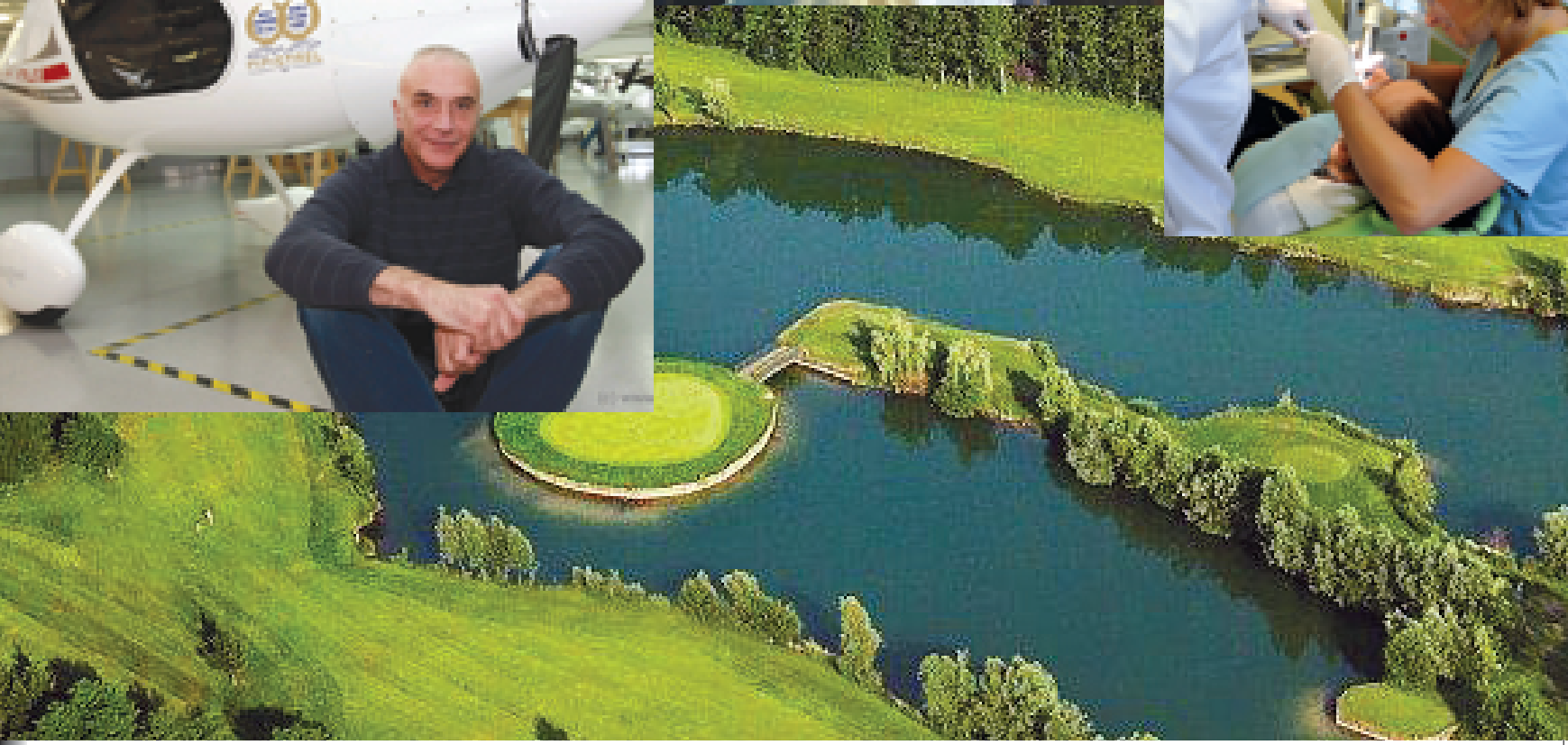
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Research and Development in Slovenia

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Summer 2012

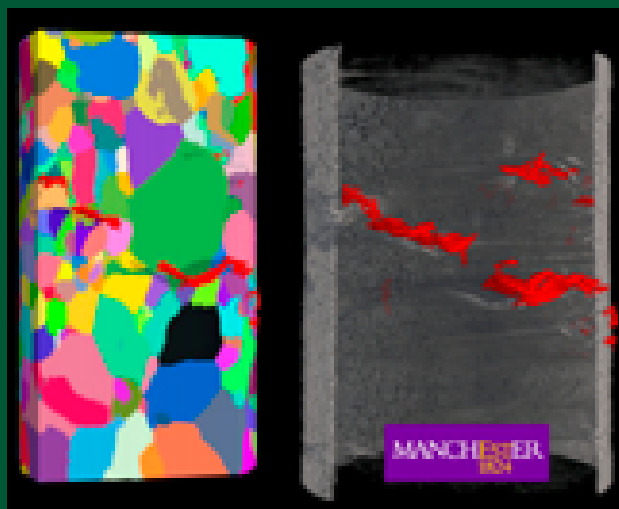
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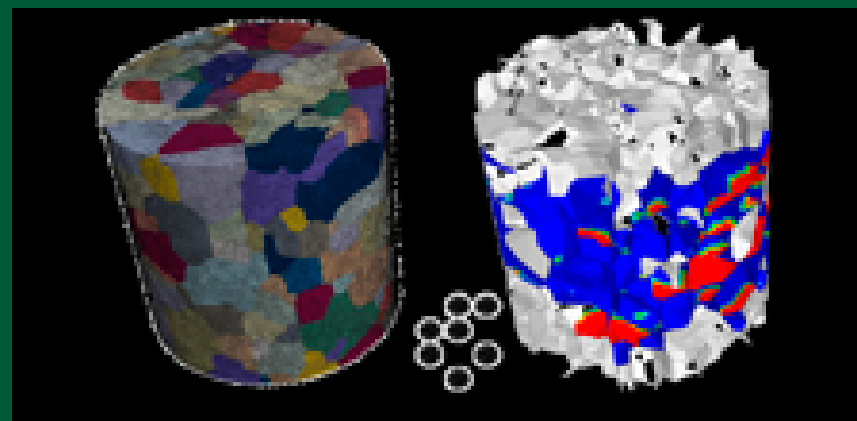
Research for the improved safety of nuclear installations

The worldwide fleet of operating nuclear power plants consists of 436 units. One third of them have been in operation for thirty years or more.

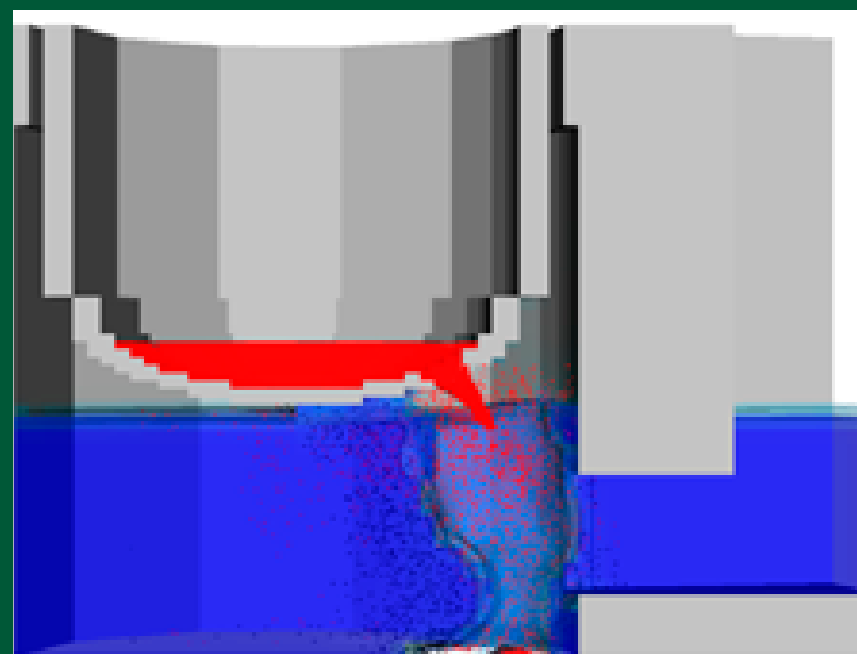
Understanding, predicting and managing the ageing of materials, which constitute the barriers against the release of radioactive materials in those reactors, are among the top priorities in academia and industry. Recent advances in experimental and numerical techniques enable measurements and modelling at various material scales. This includes observation of developing intergranular cracks using 3D X-ray diffraction contrast tomography (University of Manchester) and modelling the developing intergranular cracks with multiscale computational models which incorporate experimentally determined shapes and orientations of crystal grains (Jožef Stefan Institute).



A. King, G. Johnson, D. Engelberg, W. Ludwig, and J. Marrow, "Observations of intergranular stress corrosion cracking in a grain-mapped polycrystal," Science 2008 (321) 382-385



I. Simonovski and L. Cizelj, "Computational multiscale modelling of intergranular cracking," Journal of Nuclear Materials 2011 (414) 243.



M. Uršič, M. Leskovar, B. Mavko, »Improved solidification influence modelling for Eulerian fuel-coolant interaction codes«, Nuclear Engineering and Design 2011 (241) 1206.

Jožef Stefan Institute

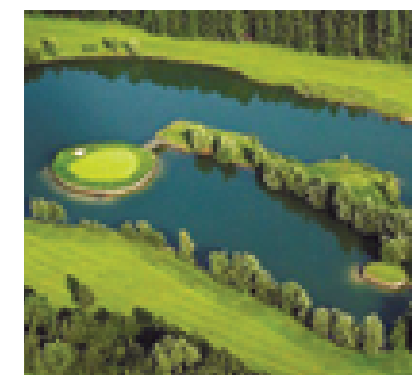
Reactor Engineering Division

Contact: Prof. Dr Leon Cizelj, Leon.Cizelj@ijs.si

Severe accidents are events in nuclear power plants which include the melting of the nuclear fuel. Understanding, predicting and managing such events have been among worldwide research priorities long before the accident in Fukushima Daichi.

Molten fuel (red) could under certain conditions penetrate the reactor pressure vessel (grey) and flow into the cold water (blue) placed below the reactor. A steam explosion might occur. The energy released depends strongly on the fragmentation of the molten fuel, which is controlled by the void build-up and melt solidification. Computational models based on the experimental results (facilities KROTOS, CEA, France, and TROI, KAERI, South Korea) are being developed and validated by the Jožef Stefan Institute within the frame of the European network of excellence SARNET and the project SERENA directed by the OECD/NEA.

Cover photo:



PTUJ - THE OLDEST TOWN IN SLOVENIA
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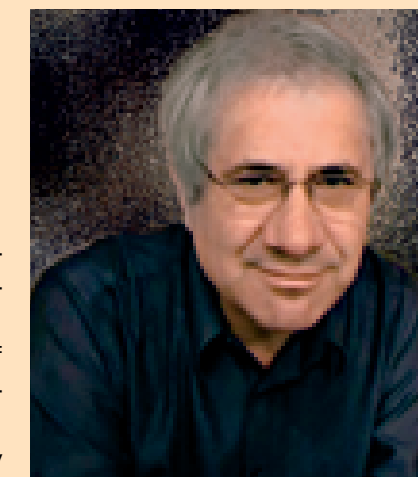
Competency Center for Biomedical Engineering
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The institute-company-university triangle in Slovenia - who is connected, and how?

Companies naturally continue to seek graduates with high quality education. However, demand is continually growing, particularly if we want to establish a form of organisation that would make Slovenia a highly developed country in all senses. In this context, we rapidly encounter a colourful world of all sorts of connections and cooperation required to ensure continual progress. Of interest here are individual trends, for instance in narrower fields, as we rapidly get bogged down in an excessively extensive encyclopedic enumeration. In this issue, we have limited ourselves to increasing the intensity of cooperation among institutes, companies and universities. Centres of excellence have been established, followed by competence centres. They are carefully described in this issue of Quark. It is probably wise to remain moderately cautiously optimistic in assessing their importance. These newly established links will not be very important for all participants, as some companies, particularly large companies, already have long-established cooperation with universities and institutes. The number not in, or not yet established in such centres, is too large to neglect when discussing the importance of the centres. But taken as a whole, it shows that the intensity and quality of cooperation in Slovenia in the institute-company-university triangle has increased, at least in recent years. There are still dark clouds on the horizon, but we hope they will bypass Slovenia.



The establishment of Centres of Excellence and Competence Centres in Slovenia is supported by EU funds.

Editor of Quark Boris Čerin

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CIPKEBIP
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CoE PoliMaT
Our Ambition is to Gain International Recognition, to Forge Strong Links with Industry, and to Create a Path Leading to the Formation of High-tech Companies

CoE NAMASTE
"Materials are conquering the world". News from the Centre of Excellence: Advanced Materials and Technologies for the Future, CoE NAMASTE.

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Community and business meet the Internet of Things

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CC CLASS
KC Class - a Hub of Potential

VITEL 2011
Communications and Computing in Cloud

Development Center for Information and Communications Technologies, Ltd., Kranj, SLOVENIA



European Science Connects: Agencies, Ministries and the European Commission Together on the Future of the European Research Area, in Bled

'Implementing the ERA: Joining Forces at the National and European Level' was the title of a high-level workshop organised in Bled, on 19 and 20 January 2012. The workshop was hosted by the Slovenian Research Agency (ARRS) and the Slovenian ministry responsible for science, and Science Europe, the newly established European association of funding research and performing organisations.



In Bled, over 70 prominent guests from Europe, including four European ministers responsible for science, a strong delegation from the European Commission and over 30 presidents of European research funding and performing agencies discussed possible strategies and mechanisms for fully realising the ERA by 2014.

In addition to hosts Igor Lukšič, then the minister responsible for science, Franci Demšar, the director of ARRS and Prof. Paul Boyle, president of Science Europe, the workshop was attended by ministers of Estonia, Hungary and Bulgaria responsible for research, numerous representatives of national ministries, 30 presidents of European agencies responsible for funding and performing research activities, and representatives of the European Commission, including Waldemar Kutt, Deputy Head of the cabinet of Commissioner Máire Geoghegan-Quinn, and Anneli Pauli, Deputy Director-General of Directo-

rate General for Research and innovation at the European Commission. The aim of the workshop was to bring together the key actors and forces in establishing the European Research Area (ERA), to be established by 2014. Participants discussed the following issues, which are perceived to be central for full realisation of ERA: cross-border collaboration, research careers and mobility, international cooperation, the dissemination, transfer and use of research results including open access and research infrastructures. Suggestions on further utilisation of structural funds for financing research included new approaches to assur-

ing open access to publications and databases and further strengthening of co-operation among European agencies responsible for funding research activities. The Lead Agency Mechanism, presented by Franci Demšar in his introductory presentation, received considerable attention.

BLED



The next high-level Science Europe workshop is planned for January 2013 in Brussels.



Humanoids 2011

11th IEEE-RAS International Conference on Humanoid Robots
Bled, Slovenia, 26–28 October 2011

Aleš Ude and Andrej Gams

The International Conference on Humanoid Robots (Humanoids) is sponsored by the IEEE Robotics and Automation Society, the leading organisation of roboticists in the world. With an international programme committee composed of some of the leading researchers in humanoid robotics, Humanoids 2011 is firmly established as the leading scientific peer-reviewed conference in the field of humanoid robots worldwide. It has been held every year

Aleš Ude

since 2000, alternating between the USA, Asia, and Europe. Previous conferences took place in the world's leading centres for humanoid robotics, including the MIT (Boston), the CMU (Pittsburgh), Waseda University (Tokyo), the AIST (Tsukuba), the KIT (Karlsruhe), and the IIT (Genoa), amongst others. The opportunity to host Humanoids 2011 was awarded to the Jožef Stefan Institute with Dr Aleš Ude as the general chair, placing the Jožef Stefan Institute alongside the world's leading humanoid robotics research centres.

The level of interest in humanoid robotics continues to increase, as evidenced by the record number of papers submitted to this year's conference. With a single-track presentation layout, all the presentations received their fair share of attention and the participants were able to really get a feel of the progress being made in the field. The highest level of quality was ensured with a very competitive paper selection process. Each paper received two or more reviews and the general chair and programme co-chairs had a difficult time selecting the best among them at a two-day meeting. The final programme was complemented by seven workshops and one tutorial. Altogether 117 papers were accepted for presentation at the conference and over 250 researchers attended the event.

Every year the focus of the conference shifts to a particular research subject. In 2011 the theme was "Humanoid Robot Cognition", reflecting the growing need to create robots that can function and help people in natural environments. The introduction of humanoid robots to the household environment is one of the biggest challenges faced by robotics research in the near future. While task-specific robots, such as robotic vacuum cleaners, have been successfully introduced to home environments, the challenges facing humanoid robots are far greater and more complex because humanoid robots need to perform a wide variety of tasks, often in cooperation with humans. It is the duty of the humanoid robotics community to show that humanoid robots are viable as general-purpose home assistants. If successful, the potential market for such robots is vast.

There are still many unresolved research problems in humanoid robotics. These

were reflected in the titles of six sessions (Balance Control, Learning, Human-Robot Interaction, Manipulation, Systems & Sensors, and Locomotion). There were 28 presentations in this session. The rest of the accepted papers

(89) were presented in interactive poster sessions entitled Perception & Human-Robot Interaction, Locomotion & Mechanical Design, and Learning & Cognition.



Organising committee

General chair

Aleš Ude, Jožef Stefan Institute, Slovenia

Conference co-chairs

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Stefan Schaal, University of Southern California, USA

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Jun Morimoto, Advanced Telecommunications Research Institute, Japan

Tamim Asfour, Karlsruhe Institute of Technology, Germany

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The Karlsruhe Institute of Technology, Germany

R. Dillmann and T. Asfour:
<http://his.anthropomatik.kit.edu/english/index.php>

Humanoid robot head

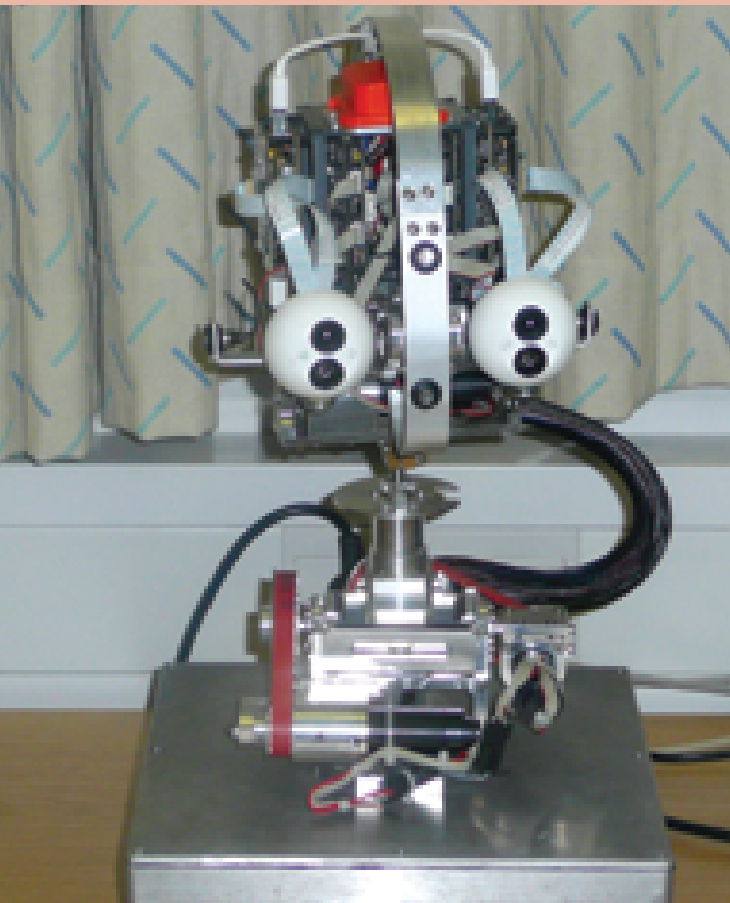
The Karlsruhe humanoid head is the same as that used on the ARMAR-III robot. The head possesses two cameras per eye with a wide-angle lens for peripheral vision and a narrow-angle lens for foveated vision, mimicking human sight. It has 7 degrees (4 in the neck and 3 in the eyes), which allow movement similar to the movement of a human head; six microphones and a 6D inertial sensor are integrated in the head. The version in the picture has been developed for the Jožef Stefan Institute for research into humanoid vision.



Prof. Rüdiger Dillmann, head of the Institute for Anthropomatics, Humanoids and Intelligence Systems Laboratories, Karlsruhe Institute of Technology, Germany.



Dr Tamim Asfour, head of the Humanoids Group in the lab of prof. Dillmann.



ARMAR-III is a fully integrated autonomous humanoid system developed by the Karlsruhe Institute of Technology, Germany. It is designed to closely mimic the sensory and sensorimotor capabilities of humans. The robot is able to deal with household environments and the wide variety of objects and activities encountered therein. It has a total 43 degrees of freedom and is equipped with position, velocity and force-torque sensors. Its upper body has been designed to be modular and light-weight while retaining similar size and proportions as an average person. A mobile platform is employed to increase its mobility.

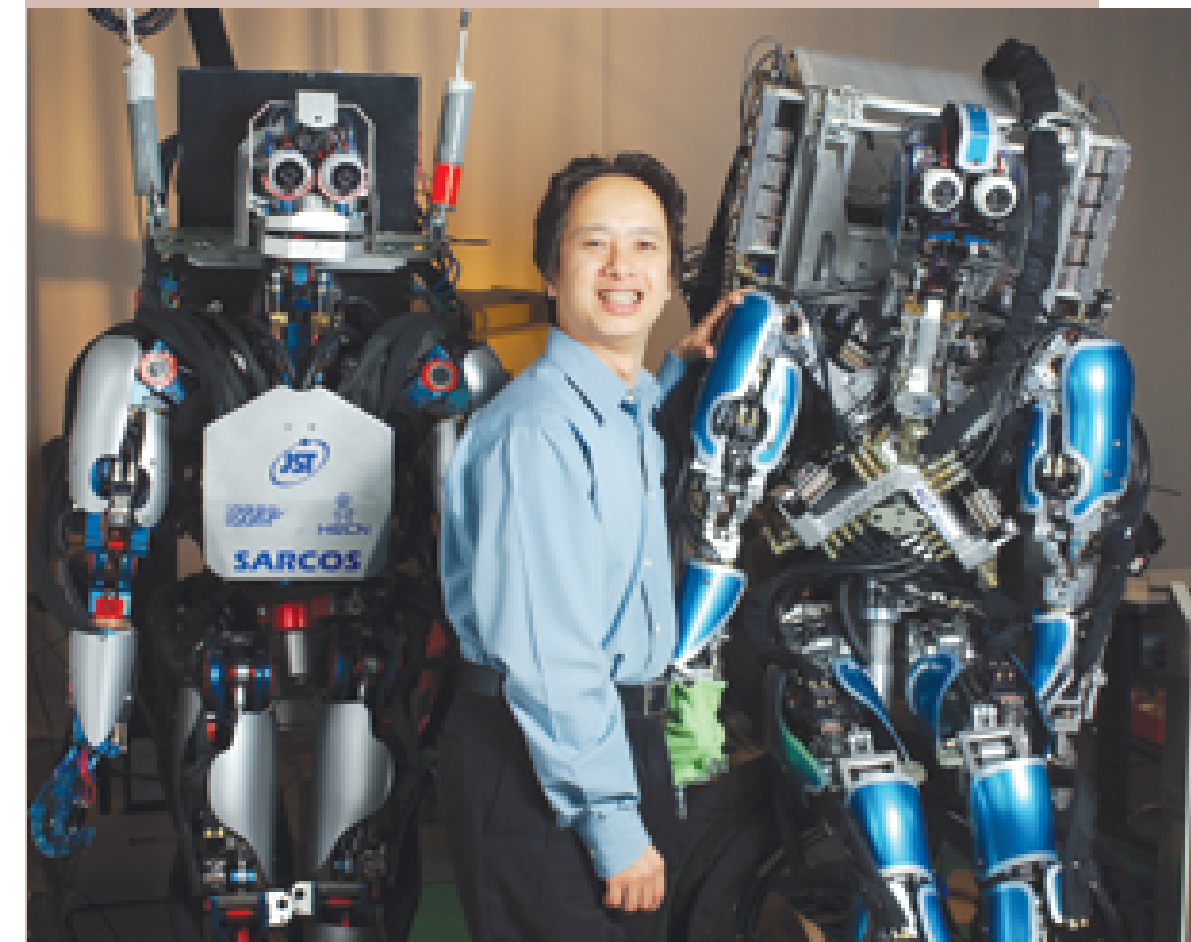


While industrial robotics is firmly established as a branch of industry, companies focused on humanoid robots are relatively young and still emerging. Humanoids 2011 was happy to welcome the founder and manager of Aldebaran Robotics, Dr Bruno Maisonnier, who delivered a plenary lecture at the start of the conference. In his speech Dr Maisonnier presented the development of the small humanoid robotic platform, Nao, which is the most widely used humanoid robot in research and university centres around the world. He focused especially on the possible applications of the Nao platform.

Among other respected guests at the conference was Prof. Auke Ijspeert from École Polytechnique Fédérale de Lausanne, who gave a detailed lecture on the use of biologically-inspired pattern generators for the control of robot locomotion. The final lecture was delivered by the renowned neuroscience researcher, Prof. Mitsuo Kawato, of the Advanced Telecommunications Research Institute in Kyoto, Japan. His well-received lecture on manipulating neural codes by humanoid robots captured the essence of the research underway in humanoid robotics, which must go hand-in-hand with research on human brain processing in the field of computational neuroscience.

Several events related to humanoid robotics were scheduled to take place in the conference programme, including the panel discussion on the FET flagship candidate "Robot Companion for Citizens". This is currently the biggest initiative in the field of robotics in Europe, which attempts to realise a unique and unforeseen multidisciplinary science and engineering programme supporting a radically new approach towards machines, and how we deploy them in our society. Humanoid robotics is expected to play a major role within this programme. The panel discussion included some of the leading robotics scientists in the world including Prof. P. Dario (Scuola Superiore Sant'Anna), J.-P. Laumond (CNRS), O. Khatib (Stanford University), Y. Nakamura (University of Tokyo), and R. Dillmann (KIT). Among the workshops organised within the conference programme, all of which were proposed by renowned researchers, were "New Bodies for Cognitive Robots", "Advanced bimanual manipulation", "Dynamic modelling and optimal control of humanoid robots", "Human-robot symbiosis: Synergistic creation of human-robot relationships", "Human-

The SARCOS of the USA and the ATR of Japan



Prof. Gordon Cheng formerly of ATR, Japan, now with the Technical University Munich, Germany, and his humanoid robots i-1 and CBI.

G. Cheng:
<http://web.mac.com/gordoncheng/English/Welcome.html>

The CBI is the first full-size bipedal humanoid capable of fast interaction with the environment and humans. It has a wide range of motion which allows it humanlike performance. It has been developed in collaboration between SARCOS of the USA, and the ATR of Japan. With its size and capabilities, it is useful for testing walking and manipulation tasks. It is primarily used to demonstrate the applicability of brain-machine interfaces. Probably the most famous application is bipedal walking synchronised and controlled by a monkey's brain.

Prof. Mitsuo Kawato, Director of ATR Brain Information Communication Research Laboratory Group, ATR, Kyoto, Japan. Prof. Kawato delivered a plenary lecture on manipulating neural codes by humanoid robots on the last day of the conference.



M. Kawato:
<http://www.cns.atr.jp/en/>

oid service robot navigation in human environments”, “Humanoid soccer robots”, and “Evolving morphologies for human-robot symbiotic interaction”.

The conference has garnered support both from public entities (the Slovenian Research Agency and the Second European Network for the Advancement of Artificial Cognitive Systems, Interaction and Robotics) and from industry (Aldebaran Robotics, Barrett Technology & Robotnik, and PAL Robotics), which was of great help in preparing the event. Corporate sponsors also presented their systems at several events held during the course of the conference. Technical support was provided by the Jožef Stefan Institute.

As the largest and most prestigious IEEE Robotics and Automation Society conference organised in Europe this year, Humanoids 2011 has helped promote technical science, and carried the name of the Jožef Stefan Institute and Slovenia to the broadest possible audience of researchers in the field of robotics all over the world. More information on the conference can be found at www.humanoids2011.org.



Prof. Oussama Khatib, Artificial Intelligence Laboratory, Stanford University, USA, visited the conference and gave a talk at one of the workshops. He also participated in the panel discussion on FET flagship candidate “Robot Companion for Citizens”.

O. Khatib: <http://cs.stanford.edu/groups/manips/>

The Aldebaran Robotics’ Nao



Dr Bruno Maissonier, the director of Aldebaran Robotics, France, presenting the Nao robot during his plenary talk.

Aldebaran Robotics’ Nao is a programmable, small-size, general-purpose humanoid robot. It is the best-selling humanoid robot worldwide. It is primarily used in research and education. Owing to its small size, the robot is less useful for manipulation tasks and is therefore often used to demonstrate navigation, vision and artificial intelligence algorithms. The shape, size and interaction capabilities, with its vision and touch, also make the robot useful for human-robot interaction applications, particularly in rehabilitation research and therapy for autistic children.



Tadej Petrič at the Jožef Stefan Institute demonstrating a self-collision avoidance algorithm on two modern KUKA LightWeight Robots.



Prof. Lenarčič (right), Dr. Žlajpah of the Department of Automatics, Biocybernetics and Robotics (left), and Prof. Turk (center), currently the minister of Science in the Slovenian government, visiting the Robotics Laboratory at Jožef Stefan Institute.

In BLED we also talked to Prof. Dr Jadran Lenarčič, Director of the Jožef Stefan Institute and a recognised expert in robotics and automation in Slovenia

Robotics has, for a long time, been an important research area at the Jožef Stefan Institute. A copy of our Quark magazine from 1992, twenty years ago, shows a group photo of the Institute’s researchers and a completed robot. You are also on this picture. Since that time robotics has remained your research area though, being the director of the Institute, the time you can dedicate to your research is rather limited. However, in spite of that, the experiences you have gained as the director of the largest institute in Slovenia allow you to have a broader understanding of this rapidly developing area.

Our Institute first got involved in robotics in the late 1970s. My doctoral thesis was the first to discuss robotics in Slovenia. It is interesting how, over the years, our focus has shifted to different fields within robotics. For example, in the 1980s our wish was to produce, together with various Slovenian companies, like Gorenje, Riko and Iskra, industrial robots that would be for sale. In the 1990s we mainly focused on robot applications for larger industrial lines, such as the production line in Droga. However, in line with trends elsewhere in the developed world, in the past decade, our research was mainly focused on so-called “humanoid robotics”. Before I became the director, I tried hard, in the department I was in charge of, to initiate close cooperation between bio-cybernetics and robotics, as I was convinced that the two could provide a great deal of synergy. And these efforts did lead us to the internationally most exciting area of research. Being the director, I am now, of course, not involved in the laboratory work, but I still chair the most important international conference called Advances in Robot Kinematics, which will take place in Innsbruck

this year. It is also a great pleasure to give lectures at the Faculty of Electrical Engineering in Ljubljana (together with prof. Bajd and some other colleagues, we also wrote a few well-received books), the University of Bologna and partly also at the University of Nova Gorica.

What has robotics development shown us in the past 20 years? Which were the key achievements – more powerful processors or a broader understanding of the environment, allowing the introduction of robotics?

A few months ago I was visited by Oussama Khatib, a professor at Stanford University and one of the most famous researchers in robotics. He told me that since 2005, when I left the laboratory work, no significant change has occurred in robotics. He was referring to the theoretical and conceptual breakthroughs, and there really was a lack of such events in the past decade. In research, progress comes in waves; with theory and technology taking it in turns to lead the development. At the moment some sort of technological revolution is taking place in robotics. The computers, sensors and all the other equipment, as well as the components and tools, are developing rapidly. Let’s take, for example,

stereo computer vision – today it is nothing special, but only a short time ago it was still just a wish. However, it seems to me that no serious progress was made with respect to actuators. In this field, robotics needs a breakthrough in the direction of artificial muscles.

What further development can we expect to see in robotics worldwide and in Slovenia?

When I reported, 25 years ago, about the research into human movement with respect to the development of humanoid robots, several colleagues around the world said that the such efforts did not make much sense, as the robots would always be different from humans and should, therefore, be seen as ordinary mechanical machines. But time has proved me right. However, even today, many people see humanoid robotics as an academic, unrealistic research, not having much in common with industrial practice. It is true that we can't yet find humanoid robots, some sort of androids, in the industrial environment, but the research into humanoid robots and related technologies has already become part of our everyday science. It should also be noted

made to an industrial robot require long procedures and large costs, caused by a necessary halting of production. On the other hand, the teaching-by-showing method that is being developed in humanoid robotics on the basis of our understanding of human learning and auto-learning would allow huge savings and a much more efficient functioning of the robots in industrial processes. Besides, service robotics can find a broad use in households, in medicine and elsewhere.

My long-term vision of robotics includes the use of humanoid robots in the "factory of the future". I see such a factory as a symbiosis of man and machine, and for this reason the similarity between the two is of key importance. Here, I don't refer only to morphological similarity, but also to the intelligence, and the abilities to learn, adapt and communicate.

Japan and the USA are the leading countries in the area of robotics. What about the EU?

With respect to the number of industrial robots in use, Japan is still the world's leader, while the USA and Europe don't differ so much any longer. There are of course other important countries, like Singapore and South Korea. Slovenia is also doing well and the reasons for this are, in my opinion, the fact that we have a lot of industry that favours robotization and also the fact that in Slovenia our robotics experts have always demonstrated impressive expertise.

I would like to point out that Europe strengthened its R&D, so that nobody has doubts today that it actually is the world's leader in those areas. Giant European and large national projects, mainly in Germany, as well as pan-European networking and exchanges, made this development possible.

What are your views on the situation in Slovenia? What is the role of robotics and automation in Slovenian companies?

It is difficult to talk about it in general terms; however, I believe that many Slovenian companies are very well equipped and using cutting-edge technology. These are mainly the companies that are open to cooperation and have excellent research teams that are continually upgrading their technological processes and aiming to increase production efficiency and product quality. Whenever I visit any of these companies, my heart rejoices, as I can see that the dreams the robotics experts had two or three decades ago actually came true. Our country has R&D teams that have traditionally cooperated well with industry. We also have a few very successful companies that have specialised as so-called robotic integra-

tors. In this way our industry has access to a reliable domestic support, should this be required and expected. Unfortunately, however, robotics and automation are expensive technologies; this means that the companies with no quality products and no suitable funds can't afford to introduce robotics and automation, which means that development is then hindered.



Prof. Lenarčič presenting a parallel mechanism, which models the human shoulder, to Janez Potočnik of the EU commission during his visit to the Robotics Laboratory at Jožef Stefan Institute.

that a lot of the research carried out in this area is based on entirely practical industrial challenges.

Let's consider the task of programming industrial robots. The classic methods for such programming are extremely inefficient and slow, as even small changes

Machine vision

has made enormous progress in recent years. Examples of the applications developed include automatic video surveillance, robot self-localisation and mapping, identification and quality inspection in the assembly of parts in industry, automatic car navigation, such as, for example, in the "great desert race" organised as part of DARPA Grand Challenge, data mining in large image databases (particularly the Internet), human body tracking as in Microsoft Kinect used by Xbox 360 video game consoles, amongst others. With the term "machine vision" we normally take this to mean not only the processing of visual information acquired by standard video cameras, but also the processing of information acquired by 3-D scanners and other types of cameras. For example, Microsoft Kinect consists of a colour camera and a depth sensor, which is based on the principle of structured light (a pattern is projected by infrared laser and the depth information is calculated using the position of the projected pattern in a camera image).

However, current machine vision systems are still far less capable than human vision. We still do not fully understand the processing of visual



information in the human brain and the representations and structures formed by the brain. The most successful machine vision approaches are predominantly based on statistical methods that do not require an understanding of general-purpose vision systems such as human vision. As a consequence, such approaches cannot achieve the generality of human vision and often fail if the visual task or environmental conditions change. With such approaches, every new task requires significant additional training. A major challenge for vision research is therefore to create new vision systems based on a better understanding of human visual system, which should result in more general, robust, and versatile machine vision approaches.

Kinect

The Kinect sensor for the Microsoft Xbox gaming console uses an innovative system which detects changes on a projected IR pattern, thereby gaining depth information in a robust manner. While primarily intended for the gaming community, it was immediately picked up by robotics researchers, as it allows quick, easy and inexpensive data acquisition for various applications.

Motion imitation with Kinect



The Kinect sensor, in unison with appropriate software (by Microsoft or another third party), allows for the tracking of the movement of human arms and legs. The movement can be transferred to anthropomorphic robots such as a Kuka LightWeight arm. In the photo, we can see a student at the Jožef Stefan Institute using such a system to test self-collision avoidance algorithms. The views from the sensor's RGB camera and acquired depth information are shown at the bottom of the picture.



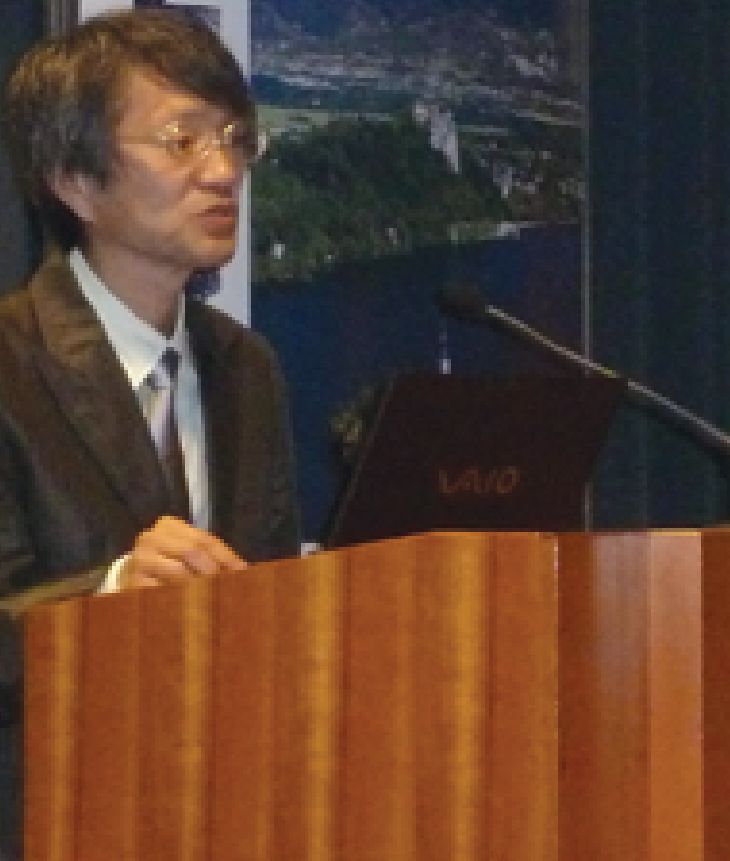
Prof. Paolo Dario of ARTS Lab, Scuola Superiore Sant'Anna, Italy, presenting the FET flagship candidate "Robot Companion for Citizens" (<http://www.robotcompanions.eu>). This is currently the biggest research proposal in Europe in the area of robotics. Prof. Dario is the leading researcher on this project.



Prof. Auke Ijspeert of EPFL, Lausanne, Switzerland, during his plenary lecture on control of locomotion and movements using pattern generators.



Award: Prof. Gordon Cheng and Prof. Kazuhito Yokoi, AIST, Tsukuba, Japan, the award co-chairs during the best paper award ceremony. The best paper award was given to Christian Ott, Maximo A. Roa, and Gerd Hirzinger of DLR, Germany, for their paper titled "Posture and balance control for biped robots based on contact force optimization".



Reem from PAL Robotics

REEM, the humanoid service robot created by PAL Robotics in Spain, can be used in a wide variety of public spaces such as, for example, hotels, museums, trade shows, special events, shopping malls, airports, hospitals and care centres, amongst others. Thanks to its navigation system and voice and face recognition system, REEM can find its way in various surroundings and help or entertain people. Besides helping as a guide or amusing as an entertainer, REEM can also transport small packages, and its dynamic information point can be used with a wide variety of multimedia applications.



C. Atkeson:
<http://www.cs.cmu.edu/~cga/>
<http://www.ri.cmu.edu/>

Prof. Christopher G. Atkeson, Carnegie Mellon University, Pittsburgh, USA, engaged in an intense discussion.

Y. Nakamura:
<http://roboticsnakamura.wordpress.com/>

Prof. Yoshihiko Nakamura of Tokyo University, Japan, presenting his views on the FET flagship candidate "Robot Companion for Citizens".

KEN International Workshop

Boris Šavle



Boris Šavle

On 11 April 2012, the leading Slovenian research establishment, the Jožef Stefan Institute (JSI) from Ljubljana, the Secretariat of Knowledge Economy Network: the Slovenian Business & Research Association from Brussels, and the Secretariat of Central European Initiative (CEI) from Trieste, organised an international workshop in Ljubljana, under the title of "European Growth: Building Knowledge Society and Economy through Effective Business - Academia Partnerships". At the end of the event, the participants adopted the Stefan Declaration on Business - Academia Partnerships for Reviving European growth, as well as the proposal of KEN Recommendations.

conditions leading to enhanced and improved business, and collaborations and partnerships within the world of academia, so as to make economies more competitive, and also to achieve a more favourable position in the global "brain circulation". Attention was also paid to RTD systems and the challenges of their synchronised performance, by focusing on perceptions



Photo: Marjan Smrke, JSI.

First row: Prof. Dr Jadran Lenarčič, Director of the Jožef Stefan Institute, (right) B.Kalchbrenner, Director, Tibora International d.o.o. and Dr Janez Podobnik, ICPE, Acting Director

The international workshop was organised in collaboration with three Slovenian public universities (Ljubljana, Maribor and Primorska). It was convened on an invitation-only basis, with high-level participants from all

four domains of knowledge society: academia, business, authorities, and NGOs. The workshop raised the key issues of how to properly mobilise all resources to accelerate the development of

of the benefits of business-academia partnerships, policy and regulatory frameworks with motivation & support mechanisms, the role of associations and networks linking business and research, synergies between industry-

driven research and university curricula, and last but not least, the issues of innovation funding, including venture capital. Participants were also familiarised with some successful approaches and policies adopted and implemented productively in some environments (good practice) in Europe and in North America (USA and Canada). At the end of the workshop the participants adopted the "Stefan Declaration", which summarises the main

positions and ideas discussed during the international workshop. As it is stated in the declaration, key problems and underlying causes in Europe have long been identified, but it seems that the entire economic and socio-political environment remains insufficiently adjusted to the requirements of a modern knowledge economy. Unless all intellectual potential and political influence is mobilized to accelerate growth of knowledge econ-

omy - and being fully utilised, including the enormous potential of business-academia partnerships - it is difficult to be optimistic about a European future. Europe is adjusting too slowly, and increasingly faces a deep structural, economic and political crisis. Recently, knowledge economy has become the priority of EU institutions, but for implementing these initiatives into real life in many member states the political will is still insufficient. Europe needs a second

As Dr Žiga Turk, the Slovenian Minister for Education, Science, Culture and Sport stressed in his opening speech, it is particularly in the time of crisis that political decision-makers rarely consider the long term causes and roots of problems. They tend to primarily address the acute and politically most sensitive problems, thereby limiting the effect of the adopted long term measures. Relating to the present situation in Slovenia, he mentioned some acute problems: Slovenia borrows 20c for every EUR 1 that it spends in the budget, as well as borrowing EUR 1000 per person, per year. For the last three years Slovenia has had less than 1% growth and pays + 6% interest rate, which is not sustainable in the long term.

Defending the necessity of austerity measures to be adopted in Slovenia, he also advocated the need for adequate macro-economic measures that would stimulate dynamic public and private investment in innovations. Innovations can significantly contribute to growth through closer business-academia collaboration.

The Minister also presented several pieces of statistical data concerning the scientific situation in Slovenia, which has been marked by various positive indicators (such as many scientific articles, a relatively large number of talented individuals with a doctoral degree, including in the field of engineering), but also some negative ones (for instance the restricted mobility of Slovenian scientists, a low volume of exports in high-tech products and services). Therefore according to Dr Turk, the Government and the more developed market of knowledge

(of course, not limited to scientific publications), supported by closer links between academic and business spheres, could contribute towards overcoming this situation.



Dr Žiga Turk, the Slovenian Minister for Education, Science, Culture and Sport

Photo: Marjan Smrke, JSI.

renaissance by which creative, bold intellectual initiatives will be welcomed for finding solutions to the accumulated problems, and in activating and mobilising the creative human capital. Besides the stronger initiative at each and every institute and factory floor, at the local, regional and national level, more leadership and action is needed also at a European level.

Recalling the business-academia partnership in particular, the declaration underlines that nowadays, companies that do not innovate and permanently

Prof. Dr. Boris Cizelj, President of the Board of SBRA, Brussels, and Chairman of the Knowledge Economy Network (KEN),

New dimensions of contemporary challenges, by which academia-business cooperation is confronted nowadays, were presented by Dr. Anders Flodstrom, Vice-Chairman of the European Institute of Innovation & Technology (EIT). First of all, a new way of thinking is necessary: it is no longer scientific or technological challenges that need to be solved, but problems created by us. If we wish for accelerated development and a faster solving of problems, today's grand challenges should not be reduced only to certain aspects – for example demographic trends used only to process ageing and longevity, or the learning and enhancing of human potential only by teaching (there are neurology, computer science and nanotechnology, too, all which are integrated). He warned that Europe is becoming older and older, not only from the point of its demographic structure (compared to the Middle East, Africa, India and Pakistan), but also relating to the structure of its business companies (in comparison with the USA, China and India). He took the example of biotechnology to demonstrate that the EU has strong assets to support a solid entrepreneurially driven industry and should capitalise on them, thus more efficiently exploiting its chances. A new innovation/business infrastructure for Europe – not a new research or higher education infrastructure – as well investing and not funding, were some of Dr. Flodstrom's final thoughts, after he had explained the role of EIT in future stakeholders integration.



Prof. Dr. Boris Cizelj, President of the Board of SBRA, Brussels, and Chairman of the Knowledge Economy Network (KEN), outlined the fact that after combining five country rankings (based on more than two hundred and fifty indicators) Slovenia remains 26th on this composite ranking. This proves that there is important potential for qualitative development, which should be better mobilised. During the current period of crisis we all must do more, not conditioning our activities by public financing, which would simply be unrealistic.

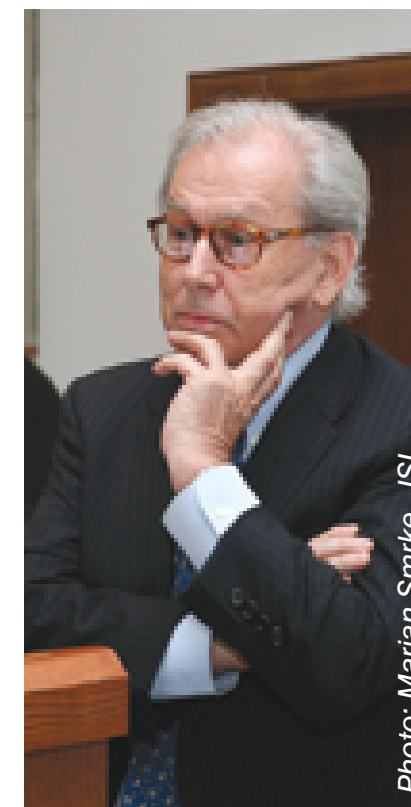
Dr. Cizelj then elaborated on the issue of overcoming the so-called “cultural gap” between academic and business spheres, deeply rooted in historical and already outdated attitudes and views on both sides. New conditions should be created in which innovative enterprises would be awarded by the market, that

would lead to their increased investment in R&D, and the engagement of researchers who work outside the business sector. At the same time, society must encourage researchers to pay more attention to issues which are vitally significant for the development of the economy which, utilising these research achievements, would become more competitive and profitable, and consequently become ready to invest more in R&D and innovations. The most developed countries, among them the Nordics, have recognised this a long time ago, and therefore their partnerships between academia and business spheres are very productive. Although each of the two spheres have their own logic and modus operandi, they have been able to find and accept a common denominator and benefit from these partnerships. At the same time, with such an attitude, they both contribute to the international competitiveness of their economies, which are amongst the very highest in the world rankings.



A European Commission representative, Dr Peter Fisch (Head of Unit, DG Research and Innovation) presented those aspects of the 7th FP and Horizon 2020 which were relevant for the topics of the workshop, and underlined the importance of a full realisation of a European Research Area. He also mentioned the lack of a driving force from the European research programmes industry sector.

Dr Peter Fisch (Head of Unit, DG Research and Innovation)



Ambassador Gerhard Pfanzelter, the CEI Secretary General

This European macro-region dimension was further elaborated upon by Ambassador Gerhard Pfanzelter, the CEI Secretary General, who stressed the importance of various networks within the CEI framework, among them Networking Knowledge Centres in the region of Central Europe, which promote a knowledge-based economy aimed at achieving smart, sustainable and inclusive growth, in accordance with the EU 2020 Strategy. In this context, he also mentioned the Science & Technology network, whose mission is to strengthen scientific and technological cooperation across the CEI area. The CEI Secretary General also spoke about various projects promoted by CEI (for example CERES), as well as about the University Network and the fruitful partnership between CEI and EBRD.



Dr Žiga Turk, the Slovenian Minister for Education, Science, Culture and Sport (left) and Prof. Dr Jadran Lenarčič, Director of the Jožef Stefan Institute (right), second row: Dr Franci Demšar, Director of the Slovenian Research Agency (ARRS).



Dr. Lubomir Faltan, Vice-President of the Slovak Academy of Sciences

Dr. Lubomir Faltan, Vice-President of the Slovak Academy of Sciences, drew attention to similar problems in the Danube macro-region. The Danube region consists of fourteen countries and is a regional grouping of various economic, infrastructural and social qualities. From the point of view of the relationship between research and business, a typical feature of post-socialist countries in the region is that during the privatisation process, the former public sector has undergone structural changes whereby many companies disappeared or became part of multinational corporations. According to Dr. Faltan, foreign investors made a strong position for themselves. To a large extent, this has also led to a weakening of domestic scientific and research potential, as multinational companies and corporations based, and still base, innovative plans on scientific research at parent headquarters. As Dr. Faltan said, therein lies one of the reasons that the share of the private sector in supporting science and research is still insufficient in these countries.



B. Kalchbrenner, Director, Tibora International d.o.o. and Dr. Janez Podobnik, ICPE, Acting Director

seek new ideas and practical solutions through their own researchers and developers, and do not collaborate with academia, cannot avoid becoming uncompetitive. On the other hand, academics who live in their isolated ivory tower, and who do not bother to check their discoveries and theories in the real world, can hardly avoid becoming irrelevant. The efforts for bridging the "two cultures" are therefore not so much an attempt to "bring them closer to one another", but rather to modernise both, and creating a platform at which they will identify and experience

the urge not only to collaborate occasionally, but to build close and lasting, mutually enriching partnerships.

The Declaration is going to be disseminated to many RTDI and business stakeholders around the globe, including regional players, as well as among European and some international media. Specific recommendations based on this declaration are accessible on the Knowledge Economy Network (KEN) website (www.knowledge-economy.net).



Photo: Marjan Smrke, JSI.



Dr. Miroslav Vesković, Rector of the University of Novi Sad

Besides Slovenian and EU views, aspects of issues relating to the European macro regions were also elaborated upon. Dr. Miroslav Vesković, Rector of the University of Novi Sad, stated that big differences still exist among several parts of the Danube macro-region, comparing, for example Bavaria Federal State in Germany with Moldavia. Therefore, also taking into account the intellectual potential of three million students in Europe, he outlined the importance of "brain circulation" in Europe in general and in particular within the Danube macro-region. He also confirmed the importance of enhanced cooperation amongst the universities in this macro-region as well as establishing the Danube Fund for Research and Innovation.



Prof. Dr. Howard Alper, Chair of the Canadian Research, Technology and Innovation Council (STIC)

The organisers of the KEN international workshop in Ljubljana did not want the presentations and discussion to remain, vis-à-vis global environment, within some kind of "European Ghetto". Prof. Dr. Howard Alper, Chair of the Canadian Research, Technology and Innovation Council (STIC), who presented North American experiences, highly contributed to this benchmark attempt. The question of how businesses and universities interact, and how the Canadian government supports these interactions, as well the reasons and interests for collaboration between businesses and universities, were among his key topics. Then he briefly elaborated on the barriers that stand in the way of this collaboration and talked about the best practices in terms of managing intellectual property (IP), the activity of technology transfer offices (TTOs), and building relationships and developing necessary skills. The last part of his presentation was devoted to the question of how knowledge transfer and receptor capacity in businesses could be enhanced, citing two successful cases (Pennsylvania State University, Dow Chemical Co.).



Prof. Dr. Dragan Mihalovič and Dr Žiga Turk, the Slovenian Minister for Education, Science, Culture and Sport.

Photo: Marjan Smrke, JSI.

Synthetic Biology from Nanoscale to the Molecular Assembly Line

Roman Jerala, Rok Gaber, Jerneja Mori, Jernej Turnšek

Synthetic biology can be described as the implementation of engineering principles into life sciences, where we want to modify the biological systems so that they adopt new useful properties that can be used to improve the quality of life. This interdisciplinary area can be used to solve many challenges of the humanity, such as in the areas of health, environment, energy but also information processing and new materials. Slovenian researchers carved their name in synthetic biology primarily through the success at the international competitions of student research projects with an acronym iGEM that takes place each November at the world renowned university MIT. This competition gathers each year more than 100 teams from the world's best universities, where the students and their mentors invent new exciting applications of synthetic biology, which are also experimentally tested using demanding experiments using techniques of the genetic engineering. Teams from Slovenia perform their research at the Department of Biotechnology of the National institute of Chemistry, where the students typically spend about 4-5 months in the lab in order to get their projects ready for the scrutiny of the judges at the competition.

Slovenian iGEM 2010 project

Living organisms synthesize many useful compounds. These natural molecules can be used as drugs, food supplements, fragrances, biofuels and more. Production of such substances imposes a metabolic burden on the producing organism. Industrial biotechnology seeks to

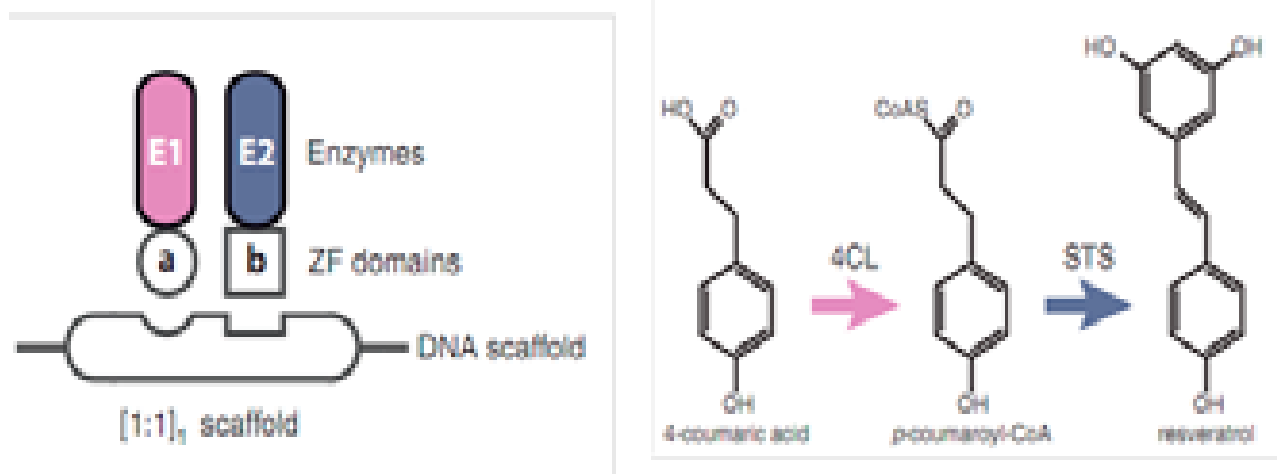


Figure 1: (Left) Schematic depiction of the DNA-based assembly line, where the order of the biosynthetic enzymes E1 and E2 is defined by the binding domains a and b that bind to their target sites on the DNA scaffold. (Right) Resveratrol 2-step biosynthetic pathway. Resveratrol is a natural antioxidant also found in red wine.

develop special strains of organism that can produce as large amount of the desired substance as possible in the shortest time and with minimal costs. One such example would be to reengineer the natural antibiotic producer in order to foster its production capacity. Unfortunately, this is not an easy task. Classical biotechnological approaches such as random mutagenesis are often not sufficiently effective to turn the wild type organism into a cost effective industrial producer.

In essence, microbiological production of a biologically active compound is not very different from the production of a car in a modern factory. In both cases the end product gradually arises from the initial chassis that is modified several times. In a modern car factory all work is automatized and emerging product travels along an assembly line from one worker or robot to another. Production pathways in natural organisms that lead to industrially interesting chemicals are usually much less organized than assembly lines in modern factories. Biological counterparts of workers in living cells are enzymes. They usually diffuse around the cytoplasm of a host cell and from time to time accidentally find the appropriate substrate molecule. Such encounters result in the transformation of a substrate molecule to

another molecule which becomes a substrate for the next enzyme in a biosynthetic pathway and so on to the final product. Because interactions among appropriate substrate and enzyme molecules are random, the overall reaction rate is usually slow and ineffective.

In our iGEM 2010 project we introduced the concept of a DNA-guided assembly line into the microorganism producing industrially important chemical compound - resveratrol. In such a way we organized the biosynthetic pathway enzymes into a desired order.

We genetically fused the biosynthetic enzymes with the DNA interacting domains which specifically bind to

Grand Prize

Slovenia



Figure 2: Slovenian team winning the Grand Prize at the iGEM competition 2010 in the Kresge auditorium of the MIT.

Second row: Rok Gaber, Jerneja Mori, prof. Dr Roman Jerala, Jure Bordon, Matej Žnidarič, Mattia Petroni, Rok Črešnovar, Rok Pustoslemšek, Jernej Turnšek, Dr Matjaž Polak.

First row: Dr Monika Avbelj, Tjaša Stošički, Nejc Tomšič, Tina Lebar, Tina Ilc, Miha Moškon, Dr Tomaž Koprivnjak.

another molecule which becomes a substrate for the next enzyme in a biosynthetic pathway and so on to the final product. Because interactions among appropriate substrate and enzyme molecules are random, the overall reaction rate is usually slow and ineffective.

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We genetically fused the biosynthetic enzymes with the DNA interacting domains which specifically bind to

the predefined nucleotide sequences. Next we introduced the DNA scaffold molecule composed of the ordered target DNA sequences into the microorganism. In such system DNA interacting domains position the enzymes in the correct place within the DNA scaffold molecule so that the evolving product can travel much faster from one enzyme to another than in the wild type strain. We observed the production of food supplement resveratrol was 6 times higher in comparison with the strain where DNA scaffold was not present.

The idea of DNA guided assembly line for biotechnological production of useful compounds was demonstrated by 10 students and their mentors on the International Genetically Engi-

Mentors that didn't take part at the competition are:
Dr Irena Vovk, Vesna Glavnik, prof. Gregor Anderluh, prof. Miha Mraz and prof. Nikolaj Zimic.

neered Machine (iGEM) competition in 2010. iGEM competition took place at the Massachusetts Institute of Technology in Cambridge, USA, every year since 2004 with teams from some of the most prestigious universities in the world. The student team from the Laboratory of Biotechnology at the National Institute of Chemistry won the overall Grand Prize for this project. This was the third victory of Slovenian student teams on iGEM after joining the competition in 2006.

<http://www.youtube.com/watch?v=zpa1YJXFAuk>.

BIOMOD 2011: "DNA-protein marriage"

Nanotechnology studies of manipulation and engineering of a matter at an atomic and molecular scale. Generally, it develops new materials, devices or other structures possessing at least one dimension sized from 1 to 100 nanometres, which is a few thousand times less than the width of an average human hair. Or another way of putting it: a nanometer is the amount an average man's beard grows in the time it takes him to raise the razor to his face. Over the past few years, nanotechnology has grown into one of the most promising and rapidly evolving scientific fields with the leading world economies investing large efforts into its development.

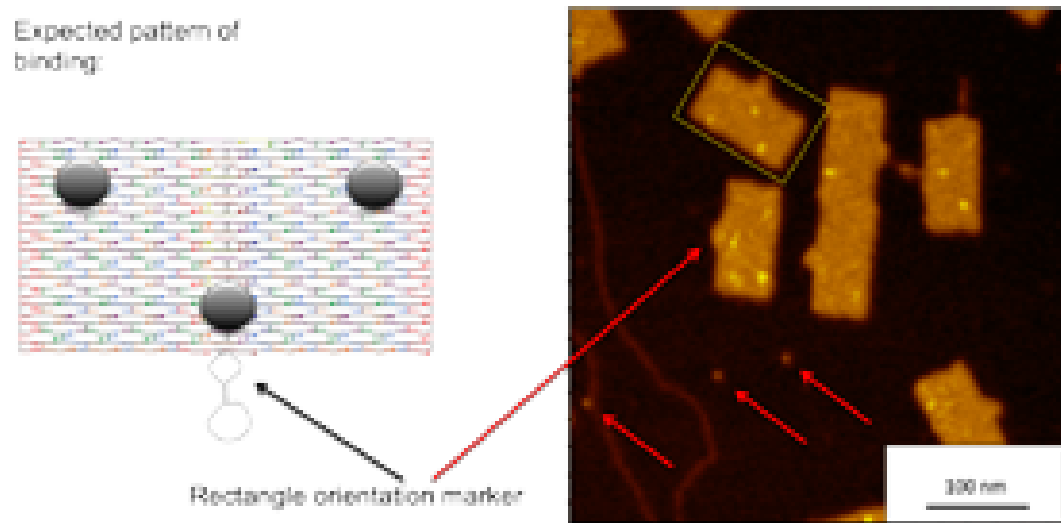


Figure 3: (Left) The expected binding pattern. (Right) The observed binding pattern under the atomic force microscope (AFM). A yellow rectangle marks the DNA origami with all of the three binding sites occupied. Red arrows indicate unbound protein adsorbed to mica. Furthermore, we also prepared stacks of two DNA origami rectangles on top of each other which offers some exciting possibilities in the field of nanoelectronics.

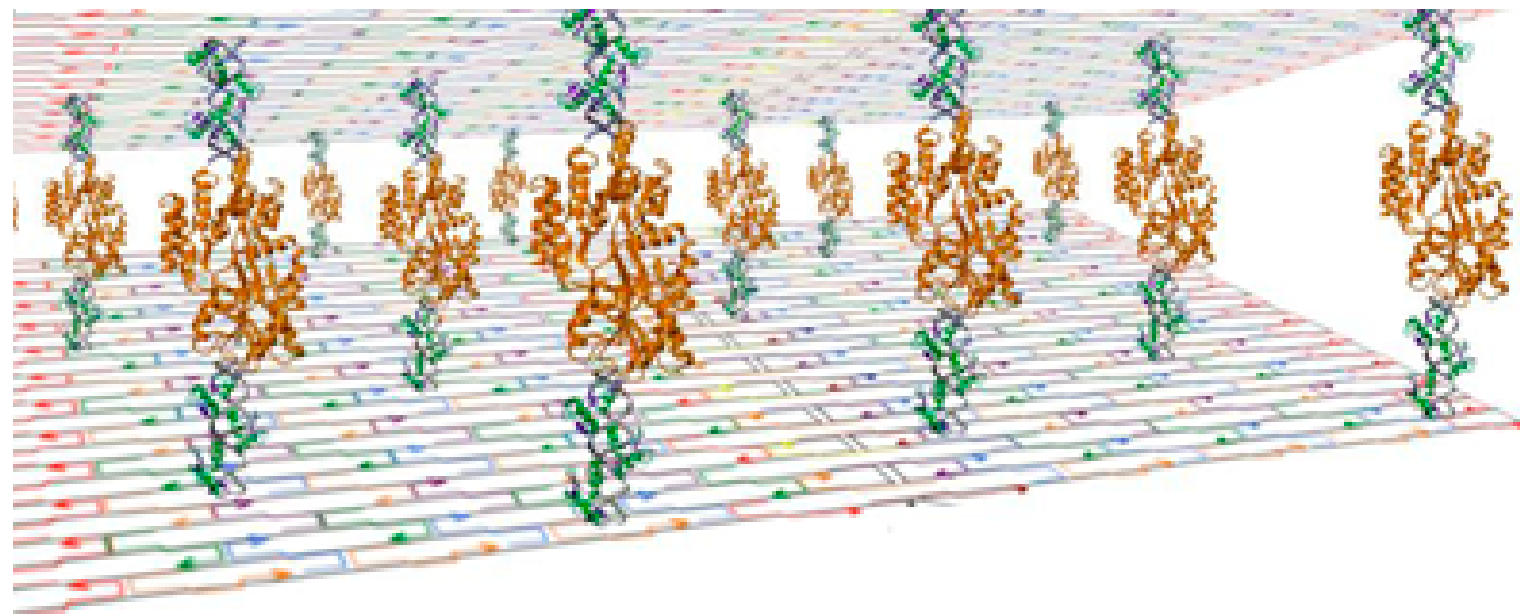


Figure 4: Two or more layers of DNA origami can be arranged by the bivalent DNA binding proteins that tether the DNA layers into a precisely defined separation that could serve for the construction of nanocapacitors or nanobatteries.

One of the most promising branches of nanotechnology is bionanotechnology. As the name implies, it utilizes biological components in the molecular design process such as for example DNA where Watson-Crick base pairing is exploited to form complex 2- and 3-dimensional nanosized shapes and objects. This subfield of bionanotechnology is referred to as DNA nanotechnology. Its roots reach back to the early '80s to the seminal work by Ned Seeman, but the real push forward within happened in 2006 when a computer scientist from CALTECH, Paul W. K. Rothemund, introduced the DNA origami technique which allows us to fold the roughly 7000 bases long stretch of a single-stranded DNA from the M13 bacteriophage into a desired shape.

DNA origami shapes are of relatively little use on their own unless they have some functional properties. There have already been some early attempts into this direction and here is also where our BIOMOD 2011 project comes in. We have demonstrated the proof-of-principle for DNA origami functionalization with proteins. Why proteins in the first place? They are the most versatile molecules in the nature performing a wide variety of complex functions such as binding to DNA, catalysis of chemical reactions, detection of environmental signals, cutting and ligating DNA, emitting light etc. With recombinant DNA technology one can combine these functions at will leading to bi- or even multifunctional protein

chimeras. We fused the DNA binding protein (ZFP - zinc finger protein) with another functional protein domain (GST - glutathione S-transferase) and visualized the attachment of such chimeric protein to the DNA origami rectangle by using atomic force microscope (AFM). What is really elegant is the fact that the nature of DNA origami enables one to target such proteins to completely arbitrary locations with nanometric precision.

The functionalized biomolecular breadboards might lead to new applications in the fields of medical diagnostics, biosensors, nanoelectronics and biosynthetic pathway engineering. They could advance lab-on-a-(nano)chip technologies as well.

This project was presented at the first BIOMOD - International Biomolecular Design Competition - which was held at the Wyss Institute for Biologically Inspired Engineering, Harvard University, Boston, USA, in November 2011 and had been carried out in the Department of Biotechnology at the National Institute of Chemistry by the three students and their three mentors during the summer of 2011. The idea behind the BIOMOD is to advance the burgeoning field of bionanotechnology and bring it closer to the public. In the spirit of this aim we also had to prepared a YouTube video summarizing our achievements: <http://www.youtube.com/watch?v=zpa1YJXFAuk>.

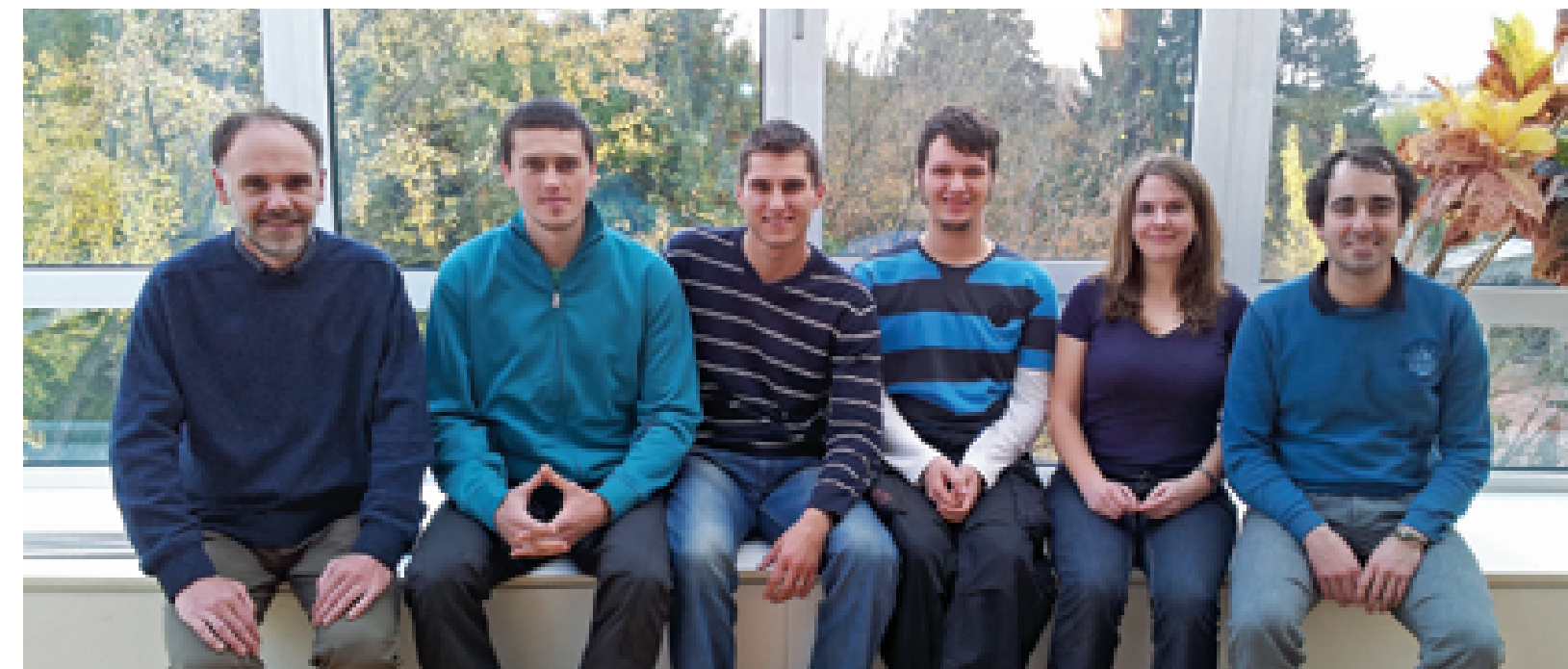


Figure 6: Slovenian BIOMOD 2011 team. From left to right: prof. Dr Roman Jerala (mentor, leader of the project), Jernej Turnšek, Vid Kočar, Marko Verce (students), Dr Iva Hafner Bratkovič and Rok Gaber (both mentors).

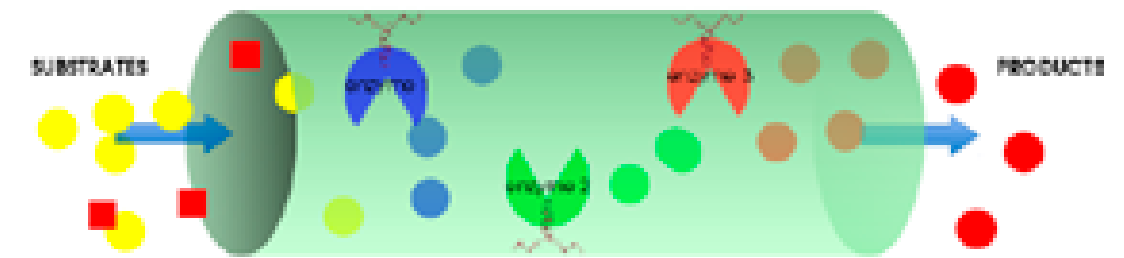


Figure 5: One among the other possible future applications of functionalized DNA origami shapes is this cylindrical biosynthetic nanoreactor with binding staple oligonucleotides protruding into the interior of the compartment to anchor enzyme-DNA binding protein chimeras in place thereby promoting the metabolite channeling and speeding up the transformation of substrates into products.

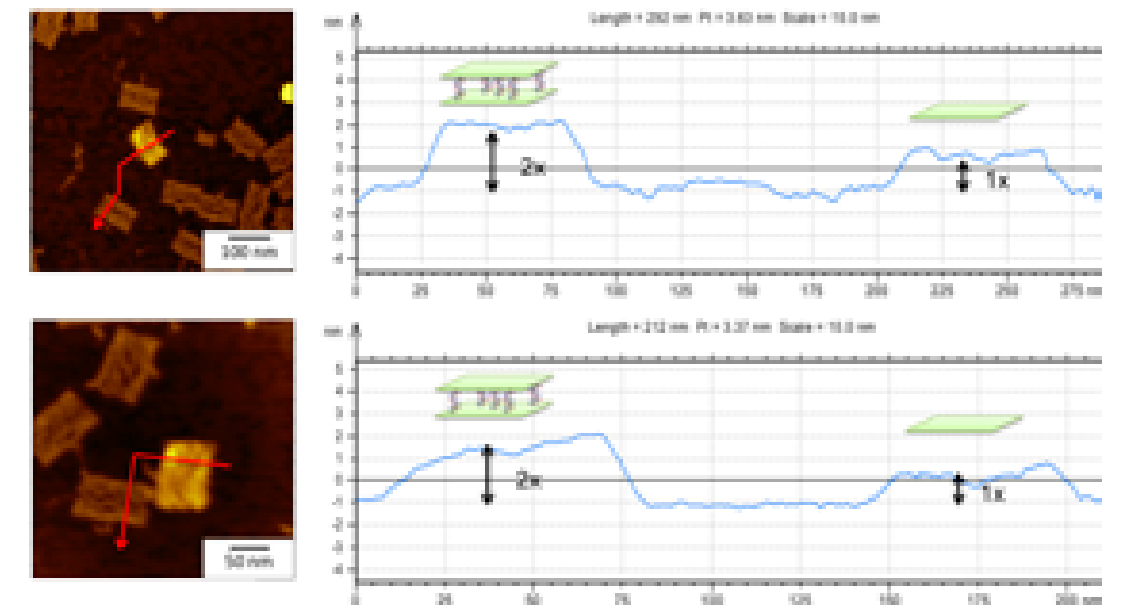
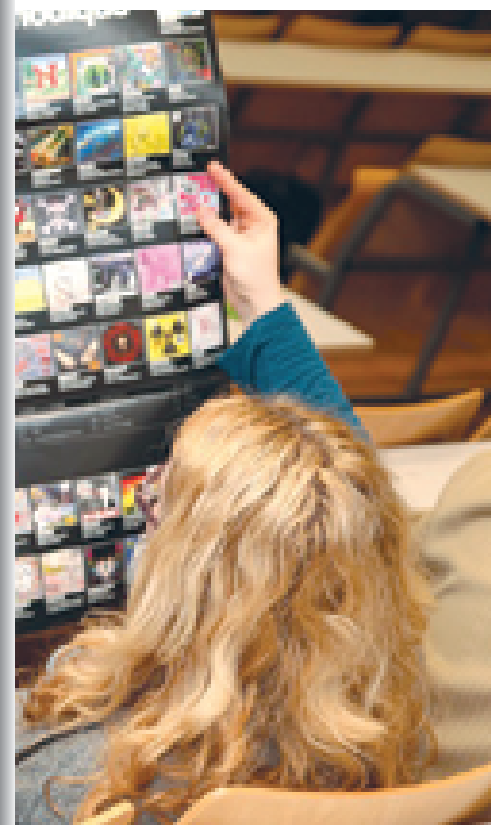


Figure 4: (Left) Red arrows indicating the zigzag path of the profile extraction using a special AFM software. (Right) Profile clearly depicts that the height of stacks is double in size of the non-stacked DNA origami rectangles.

Chemistry for Today and Tomorrow

Edvard Kopal
and
Venčeslav
Kaučič

The perception and understanding of chemistry among the people is very important for every society. The year 2011, International Year of Chemistry (IYC 2011) was an outstanding opportunity for chemists in knowledge institutions, for chemical engineers in companies and public institutions and for the teachers of chemistry-related educational programs to think well about the standard ways of knowledge transfer and to innovate every aspect that has



At the 17th Slovenian Chemistry Days in September, the Slovenian Chemical Society held a working celebration of its 60th anniversary.

The high-ranking guests included Prof Dr Ulrich Schubert, President of EuChemS, and Prof Dr Leiv Sydness, former President of IUPAC. At far right in the photograph is Prof Dr Venčeslav Kaučič, President of the Slovenian Chemical Society.

not, so far, resulted in appropriate results. All the efforts in this special year, which was officially ended in Slovenia on January 26, 2012 in Maribor, the European Capital of Culture, represent a valuable investment for the future.

The organiser of the national program for the celebration of this special year was the Slovenian Chemical Society, and the honourable sponsor was Dr Danilo Türk, the President of the Republic of Slovenia.

The United Nations endorsed a petition, originated by UNESCO and IUPAC, and proclaimed the year 2011 as the International Year of Chemistry. The reason for the special year, devoted to chemistry, was the 100th anniversary of the Nobel Prize in Chemistry awarded for the first time to a female scientist, Mme. Marie Curie, née Maria Skłodowska (1867 – 1934). The role of women in chemistry thus came into focus both within the framework of scientific and research fields as well as in educational processes. The important aspects of an educational process are the creation of interest among the young generation towards chemistry and the ability to provide the inspiration to male and female students to creatively pursue their careers in chemistry.

Partners in organising activities and encouraging events worldwide were

UNESCO and IUPAC. In Slovenia the role of organiser was logically taken over by the Slovenian Chemical Society. The program of celebration under the global theme 'Chemistry – Our Life, Our Future' also included the celebration of the 130th anniversary of the birth of Maks Samec (1881 – 1964), the pioneer of modern chemical investigation and education, as well as the celebration of the 60th anniversary of the Slovenian Chemical Society foundation.

In November 2009, the Slovenian Chemical Society established a special committee consisting of experts from various national organisations – the National Institute of Chemistry, the Jožef Stefan Institute, the University of Ljubljana, the University of Maribor, the University of Nova Gorica, the Slovenian Science Foundation and the Association for Technical Culture of Slovenia – that prepared the program and monitored its progress. The committee addressed the Slovenian chemists to present interesting and important themes from chemistry and related fields with a special emphasis on natural and technical sciences. Schools were particularly encouraged to actively participate, and for them the Slovenian Science Foundation prepared several all-Slovenian projects and acted as the Slovenian coordinator for the cooperation in some global-scale projects. All these activities were



carried out with a purpose to improve the understanding of chemistry and emphasise its evolutionary role in modern national, European and global society.

The program of celebration was carried out on local, national and global levels. The activities on a local level were organised by individual primary and middle schools, by the members of professional associations and societies and visiting male and female chemists from central knowledge institutions.

The conference featured talks by top Slovenian chemists, including Prof Dr Marija Kosec from the Jožef Stefan Institute in Ljubljana



In cooperation with the Chemistry Industry Association at the Slovenian Chamber of Commerce, in May 2011 Ljubljana hosted a national conference on communicating chemistry. Photographed: Srečko Štanič, Dr Jean-Marie Lehn, Dr Edvard Kopal and Marko Vresk MSc.

Two Nobel Prize in Chemistry winners, Jean-Marie Lehn from France and Harold Kroto from Great Britain, also participated in the program. The committee arranged and prepared at least one national event each month. Let us mention just a few: a consultation about water at the National Council (in March), the European Day of Science for the Young (in April), a national conference on communicating chemistry (in May), the celebration of the 130th anniversary of the birthday of Slovenian chemist Maks Samec, the discussion on the relationship between chemistry and art (in July) and the 17th Slovenian Science Festival 'Planetary Challenge of Time' with international attendance (in October).

In the IYC 2011 the Slovenian Chemical Society celebrated the 60th anniversary of its foundation. The central celebration ceremony took place within the event 'Slovenian Chemical Days 2011' which was organised at the Grand Hotel Bernardin in Portorož from September 14 to 16, 2011.

The Slovenian Chemical Days 2011 were organised for the 17th consecutive year and for the first time in Portorož. All previous ones took place in Maribor, except for 2007 when they were organised in cooperation with the Austrian Chemical Society and held in Klagenfurt, Austria.

Because of the Society's 60th anniversary, the Chemical Days were organised more ceremoniously and somewhat differently. They lasted for 3 days and six plenary lecturers were invited, three from Slovenia (acad. Prof. Branko Stanovnik, Prof. Miran Gaberšček and



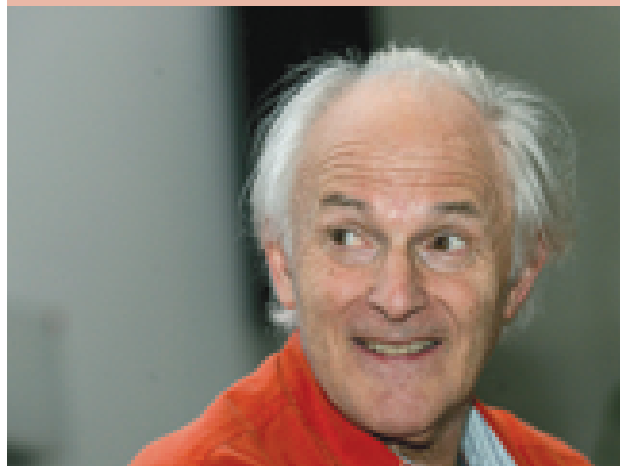
Prof. Dr. Danijel Rebolj, Vice Chancellor



The closing event was at the seat of the University of Maribor on 26 January 2011. Participants were greeted by Prof. Dr. Danijel Rebolj, Vice Chancellor, and Prof. Dr. Željko Knez, Dean of the Faculty of Chemistry and Chemical Technology, and young chemists from Slovenian primary and secondary schools also appeared at the event.

Prof. Dr. Željko Knez, Dean of the Faculty of Chemistry and Chemical Technology

In the summer of 2011, the Jožef Stefan Institute hosted Sir Harold Kroto, winner of the Nobel Prize in Chemistry



Prof. Miha Drogenik) and three from abroad (Prof. Garry Schrobilgen from Canada, Prof. Christian Slugovc from Austria and Prof. Jiří Klemes from Hungary). Three parallel sections ran simultaneously and a poster section was organised for the first time. The ceremony on the 60th anniversary of the foundation of Slovenian Chemical Society was attended by numerous guests and also by EuChemS president Prof. Ulrich Schubert, the former IUPAC president Prof. Leiv Sydnes and by presidents or their representatives of chemical societies from several countries (Austria, Germany, Czech

Sir Harold Kroto, winner of the Nobel Prize in Chemistry



The largest number of events during the year was aimed at young chemistry enthusiasts. The high point of the celebrations was at the 17th Slovenian Festival of Science in October 2011



The keynote address at the conference was entrusted to Dr Jean – Marie Lehn, winner of the Nobel Prize in Chemistry



Dr Jean – Marie Lehn, winner of the Nobel Prize in Chemistry

Republic, Slovakia, Hungary, Poland and Croatia). The Slovenian Chemical Society awarded the acknowledgments to some institutions and individ-

uals in recognition of their past support and successful cooperation. All national events were carefully planned and carried out in the best possible way with available funds. Several chemical and pharmaceutical industrial organisations, gold and other precious metals trading companies, knowledge institutions, the Slovenian Chemical Society and Slovenia's National Commission for UNESCO all showed understanding for the support of IYC 2011 events. Individual events



were also supported by citizens; more than 140 of them supported the central event of the celebration of IYC – the 17th Slovenian Science Festival.



The patron of the celebrations for the International Year of Chemistry in Slovenia was Dr Danilo Türk, the Slovenian President



Dr Danilo Türk, the Slovenian President

The National Institute of Biology Celebrated the 50th Anniversary of its Work

In order to honour the 50th anniversary of the establishment of the National Institute of Biology, we organised an event under the honourable patronage and with honourable guests.

Mr Borut Pahor, solemnly greeted the guests. He began his speech by emphasising that time is evolving rapidly and that if we do not cope with these quick changes, others will decide about our future. He continued that “we shall stay and survive only with the help of our knowledge, since Slovenia does not have military power, rich natural sources and it is not an economic force. We have people. And if we will know how to evolve our talents – regardless of social and other differences – which live on among our children, we shall have the future of great nations”. The 21st century will be demanding and full of changes led by scientific currents. “We cannot be the leading scientific force of the world, most certainly not in all areas; however, there are niches where we can be the first and so we must always strive for excellence.” He also emphasised that training of young researchers and experts as well as utilising the know-how in practice is crucial. This is also the goal of the Slovenian

The first award winners, who were selected by the NIB Scientific Council, are: Prof. Kristina Gruden, PhD, and Prof. Gregor Anderluh, PhD, who received the Miroslav Zei Award for special achievements in the field of the institute's research activity, and Prof. Boris Sket, PhD who received the Miroslav Zei Grand Awards for research work in the field of life and environmental sciences.

government, which is reflected in the National Higher Education Programme and Slovenia's Research and Innovation Strategy, which the government plans for a long-term until 2020.

For the first time in the history of the NIB, we also granted **Prof. Miroslav Zei, PhD, awards and recognitions.**

Miroslav Zei, PhD was also one of the founders of NIB. For his 90th birthday, he was awarded the Golden Order of the Republic of Slovenia for his life work and contribution to the Slovenian biology science and its reputation in the international scope. He also received numerous Slovenian and international awards. Prof. Miroslav Zei, PhD, awards and recognitions will be granted to individuals for their exceptional achievements in the area of fundamental and applied research in the field of life science and realisation of the vision and mission of NIB.

Prof. Miroslav Zei, PhD, fell in love with the sea already as a young boy while living during the WWI on the coast of the Gulf of Trieste. This Slovenian biologist, ichthyologist and oceanologist has remained

loyal to the sea all his life. The sea presented an inexhaustible source of research – for him, the sea was also the cradle of numerous myths. In decades following WWII he was the director of the Institute of Maritime Biology at the Yugoslav Academy of Science and Art in Rovinj, the chairman of the Zoology Institute at the Faculty of Nature Science and Maths of the University of Ljubljana, for thirteen years he was an expert and director of UN fishing and oceanographic projects in Ghana, Tunisia and the eastern tropic Atlantic Ocean, chairman of the Maritime Biology Station in Piran; the member of international intergovernmental committees for researching the Mediterranean, hosting professor at various universities in Europe and Africa, mentor to young Slovenian biologists and a passionate researcher. He has written over a dozen expert monographic works and numerous expert articles. He gained special recognition in the world of science by discovering the sex change in bony fish.

Coincidentally, his surname Zei is related to the Zeiformes sea fish order, the word itself means “similar to Zei”. These fish also include a well known fish called John Dory. The main characteristic of this type of fish is a large dark spot on its side, which according to the legend, emerged when St Peter held the fish with dirty hands. Since this type of fish was the only one in Peter's hand, he threw it back and left a dark spot for all descendants of this fish. Therefore, John Dory is the motif printed on the documents of Miroslav Zei, thus presenting the work of this great maritime biologist. The plaques were designed by an academic sculpture, Mrs Vladimira Štoviček.

This event was also the occasion, where we declared two NIB honourable members – the authors of the first Slovenian schoolbook on ecology,

Word of the Director, Prof. Dr Tamara Lah Turnšek, on the Occasion of the 50th Anniversary of the National Institute of Biology

“We are such stuff as dreams are made of”, said Shakespeare. I want to say “We are such stuff as knowledge is made of” ... Revelation is a thought caught on the fly, a butterfly caught in a net and realised in our scientific experiments. Then it gets established and becomes reality. We put knowledge into context, like a stone into a mosaic, where it perhaps doesn't belong at all, and yet, sooner or later, it integrates where it really belongs. Or it does not! Where will our thoughts belong tomorrow, when the fluid mosaic of our perception of everything that is around us and of what we do,

will appear different? We do not know ...! Will we ever be given a chance to get to know a human being, the web of our neurons? Whether we will have this opportunity or not is very difficult to say, since one human life is too short for this. We are born and we die in a state of incomplete understanding. This is how I see my work. This is how we, scientists, see living creatures and the surrounding nature – “biology”. Today's scientific film that we have created will show us more about this and in more depth, so enough for the moment!

Today requires even more from us, more than just philosophy or science – we have to spread this knowledge among people – it needs, in particular, to be given to the young, who are like fragile flowers seeking for the morning dew of knowledge – but they are also demanding, merciless, shameless and exhausting. The education of budding researchers, who we at NIB help to become equipped with new skills and knowledge, so that they will be prepared to deal with the challenges of society – human, environmental, economic, and so on – is an important mission of NIB. These new doctors of science, brought up in the context of our research, form the basis of a very much needed driving force of innovative development in Slovenia.

Prof. Dr Tamara Lah Turnšek

But today also demands that knowledge is turned into gold. Unfortunately, we are not alchemists, and there are many steps between knowledge and economic wellbeing that we cannot influence. There are many other elements and supporting systems which science and scientists themselves cannot do much about, but we can help build the steps up to a point where the fusion between knowledge and technology can result in real success. But this cannot be achieved overnight.

When I look back in our history, I realise that we used to be on the right path. We knew how to sacrifice and to seek higher goals. Science learnt how to walk and the growing industry of the 1970s – 1980s knew how to reach out for science. But those were other times; what happened then is too much for today's day of celebration.

Those were the times when NIB was born: the vision of **Prof. Miroslav Zei, a marine biologist** and the initiator of our Institute, has today become a reality. NIB was thus not born out of politics, unlike the majority of natural science and technical institutes founded prior to ours, and which are still getting stronger state support. NIB grew as a plant that grows on its own which has strengthened us for survival and for the days to come.

Today therefore, because of its strong scientific reputation and competent researchers, the new technological awareness is taking NIB as an important partner in development. Over the last decade in particular, we can recognise great improvements in the scientific work, with increasing and better publications, not to mention in the prestigious journal *Nature*, as well as in the development and application areas.

In the 1970s, the Marine Biology Station Piran (MBP) became part of the Institute, and their thinking has made a very considerable contribution to already existing research areas, such as plant physiology, entomology and, in particular, ecosystems research. MBP has already extended its exploratory research on marine biology to broader research on the coastal zone, the development of its management, and the exploitation of its resources. Today NIB is the most sought after partner of various ministerial sectors and agencies, particularly in the fields of environment, agriculture and health. We have become, and remain, an indispensable source of services and consultancy on the government's development planning policy, not to mention the much needed synchronisation with European policy and directives.

During the last decade we have succeeded, with the help of the Ministry of Higher Education, Science and Technology, in restructuring MBP, so that today, this is the most advanced infrastructure on and around the Adriatic Sea. We are expecting soon to achieve a new infrastructure in Ljubljana, based on the existing Biological Centre. It is only twenty years since we moved into the Centre, and yet it has already become too small, particularly due to the influx of young scientists joining NIB, including increasing numbers from other countries.

Here, I have to stress that today biology is one of the fastest growing disciplines and is involved in many of the new technologies, from classical biotechnology to nanotechnology and even space technology – although we are still insufficiently aware of this fact. We are trying to collaborate with the business sector, either through partnerships with Centres of Excellence and Centres of Competence, or by direct partnership with industries at home and abroad. We are trying...

In my opinion, however, it would be by far the best for us to establish our own spin-off companies. The first fruit of this strategy is the founding, on our 50th anniversary, of Biosistemika. This company grew out of our own research on systems biology.

The subjects of our research are rather diversified – from bacteria to human beings and their environment. The bottom line is, however, the preservation of a healthy environment for a healthy humanity as the essential basis for the highest quality of life.

Let me stop here. I wish you all an enjoyable afternoon, in which you will feel biology and thus feel yourself as a living being that is only part of nature and nothing more – yet nothing less.



From the left: Prof. Dr Boris Sket, Prof. Dr Kazimir Tarman, Prof. Dr Guy Van Den Eede, Prof. Dr Kristina Gruden and Prof. Dr Gregor Anderluh.

Prof. Kazimir Tarman, PhD and Guy Van Den Eede, PhD from the Ispra European joint research centre which assisted NIB in establishing the national reference laboratory for genetically modified food and feeding stuffs, as well as for genetically modified organisms.

The event also premiered the **www.h documentary on the significance of biology and our work for the environment and health**, which also provides answers to other existence-related issues of the modern world, wrapped between technological developments and maintaining the balance in life.

The **www.h documentary** is a combination of scientific thought and visual communication. The provocative approach forces us to deliberate on our existence and conduct, on our goals and role, which should be awarded to the science in the society. The modern way of life that imposes constant haste on us requires answers; however, at the same time it does not allow us to set the fundamental ques-

tions **Why, Where, When and How?** This is also the title of the film, dedicated to the global audience and titled in a web-like way, namely Why Where When and How. The message of the film: only when the answers in science as well as of every individual will present the crops of real questions, we can hope that our life will lead in the right direction.

The authors of the film, Prof. Dr Bojan Sedmak (concept and text), **Tomaž Letnar** (script and text), **Rado Likon** (photography director), **Jasna Hribernik** (director) and **Prof. Dr Tamara Lah Turnšek** (producer) merged the relentless logic of scientific thought with the sensibility of art. Today, we created the world and life. We also design our future, every individual and everyone together! Although many people think that we are only chess pieces on the board of nature and the secret forces that lead us, this film teaches about quite the opposite – we create our happiness and faith – to a much greater extent than we are allowed to. Does this not present a sufficient reason that requires deep thought about how to act?



The authors of the film **www.h**, from the left: Rado Likon, Jasna Hribernik, Tomaž Letnar in Prof. Dr Bojan Sedmak.

AWARDS CEREMONY OF THE NATIONAL INSTITUTE OF BIOLOGY

On Monday, November 7, 2011, a second official awards ceremony of the National Institute of Biology was held at the Biological Centre on Večna pot 111 in Ljubljana.

National Institute of Biology (NIB) for the first time in its history gave awards in honour of Prof. Dr Miroslav Zei to individuals for their extraordinary achievements in fundamental and applicable research in the field of life sciences and in the field of realising the vision and mission of NIB.

The ceremony was also attended by the Minister of Agriculture, Forestry and Food, Dejan Židan, M.Sc. In his ceremonial address, he exposed the global importance of food sources and especially safe food due to the increasing population of our planet. Safe food is also one of important fields in which the NIB co-operates with the Ministry of Food. The term healthy food has many underlying activities. The cases of genetically modified organisms (GMO) are widely known and the NIB is very active in developing know-how and technologies used in detecting undesired GMOs and in helping the Ministry of Agriculture, Forestry and Food in preparing measures and directives for co-existence and food control. A no less important aspect of healthy food is care for drinking water, which extends from knowing the eco-systems from which it originates, through discovering poisons, mutagens and various microorganisms harmful to humans and plants, to developing the methods of cleaning. New commercial ways and climatic changes cause a quick introduction of new pathogens and destroy the balance in ecosystems. The minister thanked the associates of the NIB for their co-operation in the past and asked them for further assistance in critical and acute issues in the country, like the threatening epidemic of grapevine yellows, mass bee deaths, fireblight etc., which present a threat to the Slovene economy as well.



Minister Dejan Židan, M.Sc.

Minister

The Grand Award of Miroslav Zei for research work in the field of life and environmental sciences was received by Prof. Dr Alenka Malej.

Prof. Dr Alenka Malej is head researcher in the field of ecology of littoral waters and sea biology. Her basic research activity concerns sea plankton with orientation to ecology and biology of gelatinous plankton. The results of her scientific studies were published in scientific articles that were quoted more than 700 times. As Head of the Marine Biology Station Piran of the National Institute of Biology she has co-ordinated multidisciplinary work of the group for over twenty years and has managed as many as 23 international projects in the field of sea research and monitoring. She has been a national co-ordinator of the Mediterranean Action Plan programme at the Environmental Programme of the United Nations for years and the President of the National Committee of the Intergovernmental Oceanographic Commission of UNESCO. Since 1985, she has been a member of numerous co-ordinating committees for the protection and monitoring of the Adriatic and Mediterranean Sea and was appointed to an expert group in 2010 for the preparation of paragraph 180 for the resolution of the General Assembly of UNO on oceans and maritime law. She was a visiting researcher and teacher at respected maritime institutions and international schools. She participated in numerous international scientific meetings as an invited lecturer or organiser. She played a decisive role in signing a co-operation agreement between the National Institute of Biology and the leading French research and medical university Pierre et Marie Curie. She was awarded a medal of the mentioned university for her contribution to the signing of the agreement. Together with her colleagues Dr Jadran Faganeli and Dr Neda Fanuko, Professor Malej received an award from the Boris Kidrič fund. This fund is now called the Zois Awards for Scientific Achievements.



Prof. Dr Alenka Malej

At the ceremony, all young researchers of the NIB who obtained PhD titles in the period from January 1, 2010 to September 30, 2011 were presented:

From the left: Dr Branko Bogunović, Dr Irena Bertonec, Dr Tomaž Rijavec, Dr Alenka Žunič, Dr Urška Čepin, Dr Mateja Grego, Dr Maarten De Groot, Dr Urška Koce, Dr Polona Kogovšek, Dr Franja Pajk, Dr Saša Kenig, Dr Manca Pirc, Dr Ana Rotter and Dr Jana Petković;



The prize of Miroslav Zei for extraordinary achievements in the field of research activity of the institute was given to Prof. Dr Jurij Piškur and Assistant Prof. Dr Rade Injac.



Prof. Dr Jurij Piškur

The main research fields of Prof. Dr Jurij Piškur, full professor of molecular genetics at the Department of Biology at the University of Lund in Sweden cover the metabolism of nucleic acid precursors, genetic treatment, comparative genomics and the molecular evolution of yeasts. In the past 5 years Prof. Piškur has published 46 articles out of a total of more than 120, many of which were also publications in the most respected scientific journals. Some of his discoveries were patented, he is co-author of three books and is co-founder of three spin-off biotechnological companies. A special acknowledgement of his research achievements is his 2005 election to the Royal Fisiographic Society in Lund, one of the Swedish royal academies. Although Professor Piškur has lived and scientifically worked abroad for over 25 years, he has maintained professional and personal contacts with his home country. Since 2010, he has been active in the Committee for Science of the Council for Slovenes Abroad as a consulting body of the Government of the Republic of Slovenia. Since 2009, he has been co-operating with the laboratory for microbiology of the Maritime Biology Station of the National Institute of Biology in the field of research of maritime microorganisms in adapting to modified environmental factors.

With his innovative scientific approach and use of the latest pharmacological and analysis methods assistant professor Dr Rade Injac managed to prove a potential use of fuller-enol as an organ-protective agent in the therapy of cancer diseases with doxyrubicine. His work has set foundations for numerous further research of pharmacological applicability of fullerenols and made an important step towards the implementation of active ingredients of this type in medical practice. His scientific research is excellent, which is shown in 34 scientific articles in the past five years, which have been quoted more than 240 times. His knowledge of pharmaceutical technology is reflected in four international patent applications.



Assistant Prof. Dr Rade Injac



From the left: Prof. Dr. Tamara Lah Turnšek, Minister Dejan Židan, M.Sc., Mr Matjaž Kočar, Dr Stojan Sorčan, Prof. Dr Radovan Stanislav Pejovnik

The award of the National Institute of Biology for an extraordinary doctoral thesis in the field of research activities of the Institute was given to Dr Jana Petković.

For the first time in the history, the National Institute of Biology awarded a prize for an extraordinary doctoral thesis defended in the past academic year. This year's award was given to Dr Jana Petković. The results of her doctoral thesis with the title Mechanisms of Toxic and Genotoxic Activity of Titanium Oxide Nanoparticles were published in five scientific articles and a chapter in a book published by an international publishing house. She was the first author of three articles and the aforementioned chapter. Two articles were published in the most eminent journals from this field. Jana Petković was also awarded a Krka Prize for her doctoral thesis.



Dr Jana Petković



Systems Biology Tools Development for Cell Therapy and Drug Development - SYSTHER

The Concept

Germany and Slovenia have been cooperating in molecular life sciences for many years many years within the frame of several research activities, including the ERASYSBIO and PathoG-enoMiks ERA NETs. The announcement of the “**Industrially Relevant Molecular Life Sciences**” (INREMOS) framework in 2005 resulted from the effort to strengthen the transfer of technology and to encourage spin-off companies in this field of biotechnology. The selection of the project on “**Systems Biology Tools development for Cell Therapy and Drug Development**”- SYSTHER - as a **Slovenian-German Virtual Research Institute** was also aimed at fostering translational research in cancer with the strong emphasis on new aspect in therapy - personalised medicine. Such an aspect can only be approached by the new tools **provided by systems biology and bioinformatics**. The Project has joined several research and clinical groups in Germany and in Slovenia. The project was financed by the Slovenian Ministry of Higher Education, Science and Technology and the German Ministry for Education and Research.

In Slovenia the lead partner was the National Institute of Biology with the two strong teams in the field of cancer biology and systems biology, lead by Prof. **Tamara Lah Turnšek** (with Dr **Helena Motaln**) and Prof. **Maja Ravnikar** (with Prof. **Kristina Gruden**), respectively, who also cooperated with the team of Prof. **Nada Lavrač** at the Josef Stefan Institute. The link between stem cell research and clinical application in Slovenia

The Structure

Duration: 5 years (2006-2011)
Total finances: 5.6 mio EUR;
Slovenia: 1.6 mio EUR and
Germany: 4 mio EUR (25% co-financing by partners)

Institutions:
Slovenia: 2 Public research institutes, 2 Public health institutions, 1 New private company

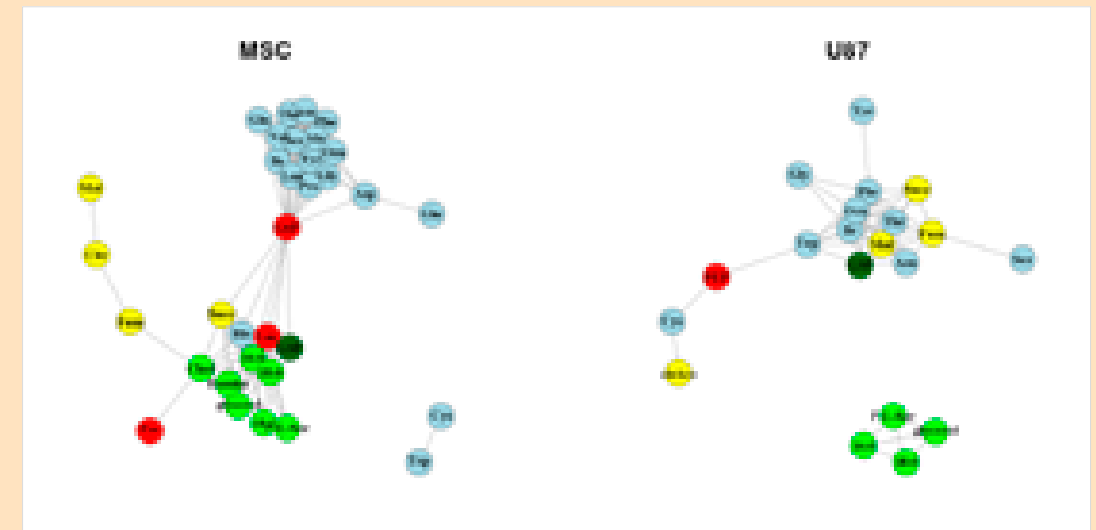
Germany: 2 Universities, 1 Public health institution, 1 Private company

The Key Players

The coordination and management was divided between two coordinators:
Prof. Joachim Selbig and **Assist. Prof. Miomir Knežević**.

was established via Profs. **Matjaž Jeras** and **Primož Rožman** from the Blood

Transfusion Centre and clinicians from University Medical Centre in Ljubljana. **In Germany**, the coordinator Prof. **Selbig** (with Dr **Kathrin Juerchott**) from University of Potsdam (Max Planck Institute for Plant Physiology, Potsdam-Golm), provided strong expertise in systems biology, matched by **Michal Or-Guil** at the Humboldt University in Berlin. The cancer research and clinics were lead by Prof. **Joerg Tonn** and Dr **Christian Schichor** from Grosshadern Clinic of Ludwig Maximilian University in Munich. **The bidirectional technology transfer** was supported by Dr **Johannes Schuchhardt** in Germany (Microdiscovery GmbH) and in Slovenia, the new biotech company BioSistemika was established by young entrepreneur and researcher **Klemen Zupančič** and partners (<http://www.biosistemika.com>). This spin-out company of the NIB represents the transfer of knowledge from research into application.



The contacts:
 tajnistvo@nib.si ;
 Selbig@mpimp-golm.mpg.de and
 miomir.knezevic@nib.si

SYSTHER-Booklet3

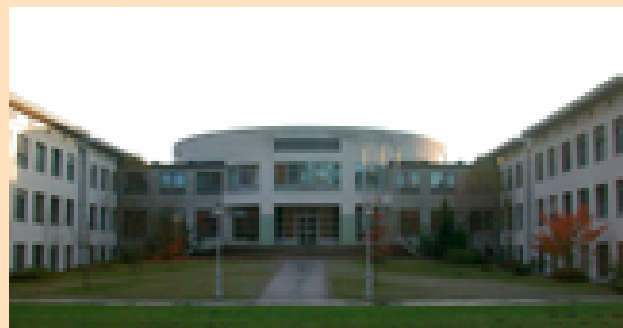
(I) Define cancer cell and normal mesenchymal stem cells (MSC) interactions at the transcriptomic, proteomic and metabolomic (“omics”) levels and the integration of these data using system biology approach.

The Task of the Virtual Institute

was to prove the validity of systems biology-approach, using bioinformatics and mathematical

(II) Design of new experimental approaches and protocols for the improvement of cancer

The content is available on:
<http://www.svsther.eu> and
<http://svsther.biologie.hu-berlin.de>



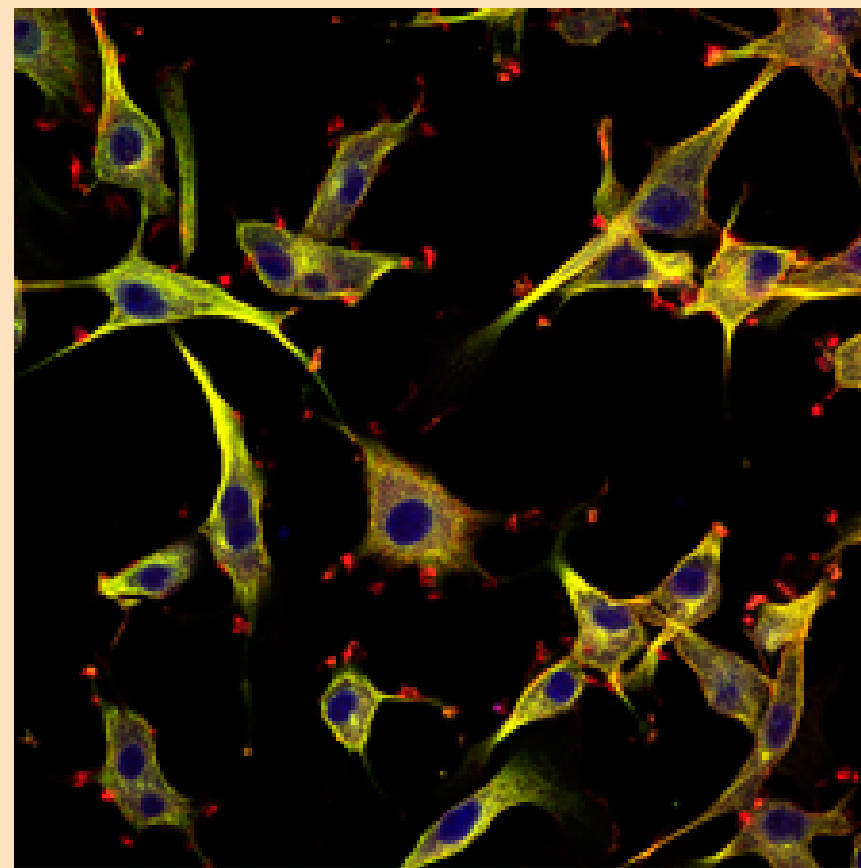
National-institute-of Biology



University of Potsdam



Ludwig Maximilians University Munich



Glioblastoma cells moving



diagnosis by following the pattern of blood markers, focusing on immune related potential, starting with:

- Normal framework of omics data & data analyses using novel mathematical modelling tools on healthy volunteers.
- Data acquisition and management tools for complex data, related to diagnosis, prediction and therapeutic application in cancer.

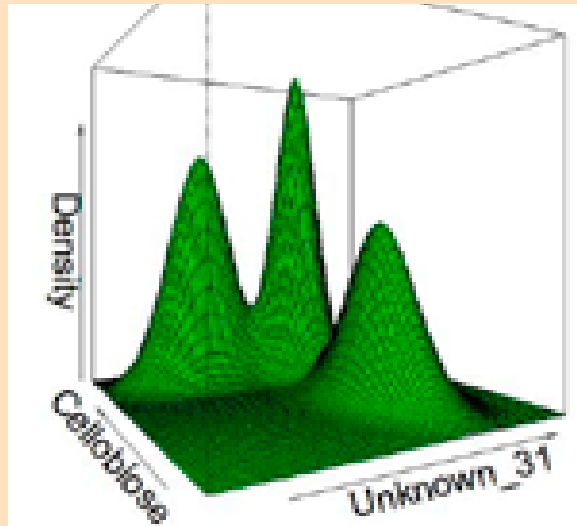


Dr Christian Schichor

(III) **Establish** the biotechnology company for exploiting the research results.

The Achievements

(I) Despite modern treatment concepts, prognosis of patients harbouring a brain tumour is still dismal. **Stem cell therapy** could only be based on improved knowledge of differential gene expression and protein signalling pathways in normal **bone marrow derived stem cells**, which are recruited by the tumour. In the SYSTHER project, we proved that newly developed bioinformatics' tools could well explain the observed phenotype of cellular interactions, resulting in significant effects of normal mesenchymal stem cells (MSC) to impair the proliferation and invasion of the brain tumour - glioblastoma cell (U87MG) in vitro. By metabolomics, we proved that these two cell lines do, and how, they significantly differ in their metabolism. We also pointed on relatively higher genetic stability of normal MSC than previously thought, as we were the first to prove that the spontaneous malignant transformation of normal MSC in vitro was due to the contamination with tumour cells. This



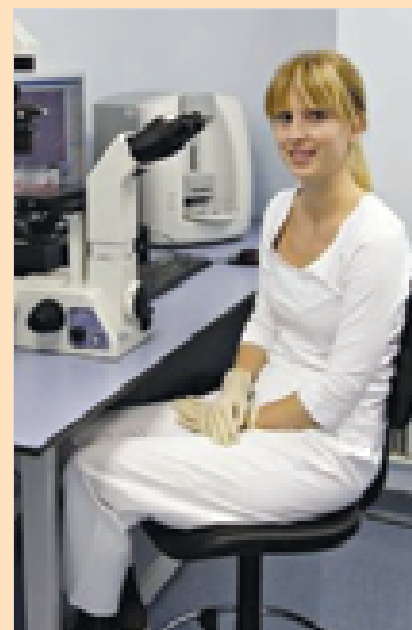
Metabolite profiling



Dr Michal Or-Guil



Dr Helena Motaln



Students at work
UrškaTajnssek

data provides the needed molecular basis for future use of the stem cells alone and/or as vectors for cell therapy of glioblastoma and other tumours. Also, the amount and type of recruited stem cells in the tumour can be used as a diagnostic tool, and to estimate prognosis in adjuvant treatment plans.

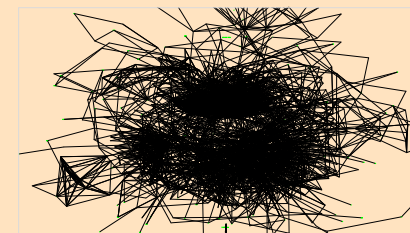
(II) To assess the **clinical significance** of SYSTHER findings, translational studies were aimed at investigate whether there is a response to malignancy in the blood of tumour patients that could be used for diagnostic purposes. We are testing an interesting concept that also brain tumours - GBMs - leave a fingerprint in the blood-borne antibody repertoire, although they rarely metastasise. However, to establish base line levels, we finished the first clinical studies in healthy individuals, focusing on

serum metabolites, peptide-antibody profiles and miRNA, as well as and on the transcriptome profiles of white blood cells. The investigation of the impact of a single dose of dexamethasone, a part of standard therapy for glioblastoma patients, and other treatments is still in progress, leading to possible predictions of therapy response. Here we expect significant variations among patients, as were found in healthy individuals, so each patient would respond differently. All this data justify the personalised medical treatment, based on gathering sufficient molecular information, clustered and sorted by systems biology tools, to choose the most efficient and least harmful treatment.

(III) The final results of in vitro analyses and translational studies of SYSTHER will be validated for their potential to be translated into **clinical practice and management** of tumour patients. New systems biology based approaches applied in our biological systems can easily be transferred to study other pathological conditions. **The dissemination and commercialisation** of the knowledge and expertise will be achieved by newly established biotech company BioSistemika, acting alone and in cooperation with other SYSTHER partners worldwide.

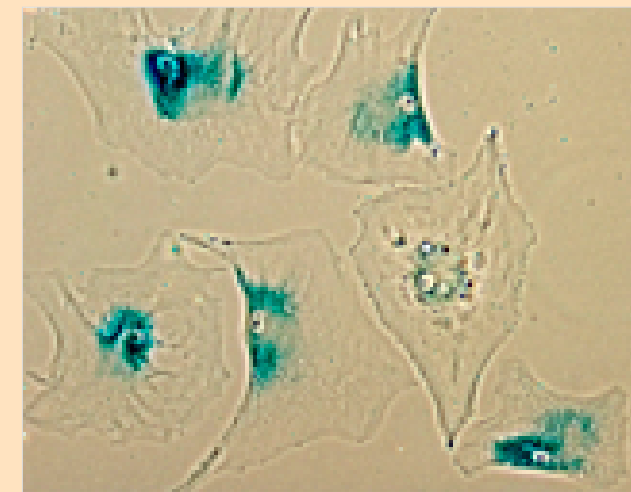
Significance

SCIENCE Systher team published over 30 original articles, and 10 more are expected in the near future based on joint research. At least ten of them appeared in the journals with highest impact in the field. Many lectures and seminars were given, all over the world, increasing the visibility of the novel findings.



Biomine search for tumour upregulated genes

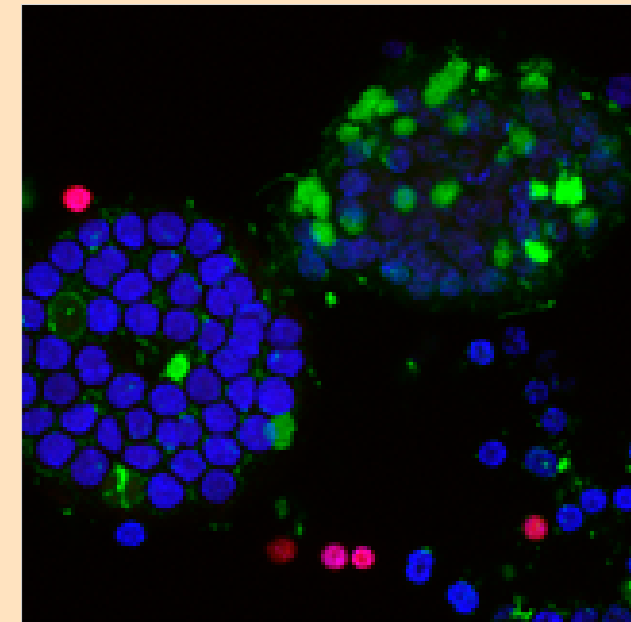
PATIENTS Anti-malignant cancer effects of normal adult - mesenchymal stem cells promise that the cell therapy as a part of advanced therapies, will be a realistic option for adjuvant treatment in resistant tumours.



Senescent mesenchymal stem cells



Assist. Prof. Miomir Knežević and Prof. Tamara Lah Turnšek



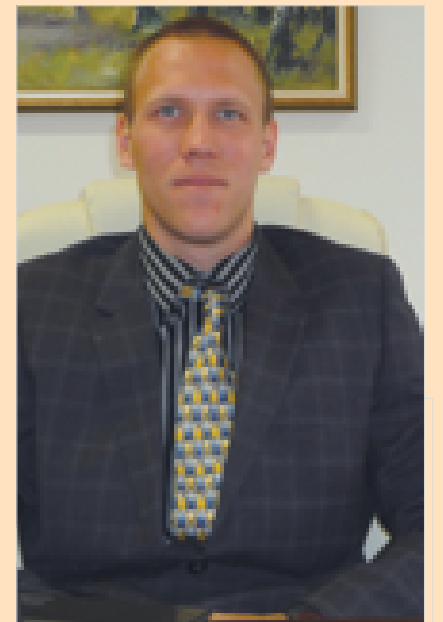
Cellular Cross talk



Dr Joachim Selbig

HEALTH CARE SYSTEM Personalized medicine - multiple molecular testing of patients, by the systems biology tools will rescue from harmful side effects and high costs of unnecessary treatments, and on the other hand justify the expenses for the most efficient patient-tailored therapy.

BUSINESS SECTOR New services, provided by systems biology application, assisting complex diagnosis, prognosis and prediction of tumour therapy response will become more easily available for numerous customers. Personalised molecular networks will be used to structure an individual portfolio for specific treatment of cancer patients.



Klemen Zupančič

Communication Challenges in the High Technology Sector

Sandra Stermšek, Franc Gider

High-tech companies face challenges in communication regarding high-technology products and services. Most texts about high technology are professionally technical and contain data that the general public find hard to understand.

Media communications, B2B communication and presentations to investors



Sandra Stermšek



nalists and editors decide to publish commercialised high-technology stories, in which a mass of professional and technical data is “translated” into popular language and the content of the story is wrapped in “commercial paper”.

In B2B (Business to Business) communication with the aim of establishing business partnerships or presentations to investors, communication must be simplified and always understandable, since in most cases it does not involve communication with specialist experts in individual fields. Communication experts believe that there is no technology that cannot be presented in a simplified and understandable manner. It is important to stress that the simplicity of communication does not reduce the value/credibility of high technology.

In our experience, over time the marketing departments of high-tech companies often lose a sense of understanding of content from an outside perspective – they no longer see through the eyes of an outside observer or user of their products/services. To them, technical information and professional data become self-evident and understandable, while to the target public they remain unclear and questionable.

Some see a solution in working with classic marketing agencies, although this is not an optimal solution as most of them are unfamiliar with the specific features of communication in the



Dr Franc Gider

high-tech sector. Classic marketing approaches are neither suitable nor effective in the case of high technology, as it is initially necessary to prevent noise in communication on the level of understanding professional terms, content, concepts, technical data, descriptions, information, etc. Furthermore, effective communication in the area of innovation and high technology cannot be transferred into practice overnight. In the experience of TIA, and in the opinion of communications experts in the technology sector, this is a process. Composing texts requires a certain talent and con-

siderable training, which also provides theoretical knowledge. In fact, it could be asserted that good writing can be infectious. The word “infectious” here

is particularly appropriate. The process is a little slow and is not like flu, which can infect people in passing.

Part of the process can involve reading existing published technical, research and innovation texts as examples of good practice, where the articles should

META Group d.o.o.

“META Group has been operating on the Slovene market since 2005, and what we can see is a change in young Slovene companies and would-be entrepreneurs, who are becoming more ambitious, dynamic and less risk-averse. This is a significant change that also needs to affect the public sector and other service providers, given that government funding is shifting from grants to loans. To attract a venture capital-investor requires ambition, global orientation and a commitment to success. An ability to communicate these characteristics and present your business proposal with passion and coherence, and demonstrating the ability to deliver high goals is even more crucial. Nevertheless, the most important ingredient is a committed and balanced entrepreneurial team, followed by a clear market opportunity.

At META Group, our added value is international in character. Our mission is to make the knowledge to market route efficient and profitable, and we provide our clients with a wide portfolio of services and tools, ranging from strategic advice for local development initiatives, and specialized services for knowledge-based start-ups to access global markets and dedicated finance (seed-funds), to management of seed funds (more than 80m under management). We have considerable experience working with talents, helping them to exploit research results, turning their knowledge into marketable solutions. We believe in people: as can be seen from our approach, this has been recognized by the Kaufmann Foundation, the most important foundation dealing with enterprise, which chose us to deliver their Fasttrac® courses in Europe.



Nina Mazgan

Our vision is to create a supportive environment in Slovenia for sound growth and development of knowledge-intensive companies, and convey the need for a less risk-averse culture, thereby boosting the creation of globally oriented companies.”

Together with Zernike Group Holding Bv, META Group manages seed funds and start-up funds with the aim of supporting the creation, promotion and high-growth potential of SMEs. Building on experience gained internationally by the two partners, around 180m has so far been managed and invested in more than 400 start-ups in different sectors across Europe, mainly in Italy and in future also in Slovenia. It is clear from this that communication is a matter not so much of technical detail as of simplicity and presenting the investment potential.

Meta Group, in conjunction with the Public Agency for Technological Development of RS and the Ministry of the Economy, through the “Promoting the knowledge-transfer process – VALOR 2010” public tender, provided training in the area of effective presentations to investors for six selected young high technology companies, which then had the opportunity to present their business ideas to respected foreign venture-capital investors as part of the Investment Forum event.



Statement by Bio-Sistemika d.o.o.

“Under the aegis of TIA, which together with Meta Group organised various education programmes and workshops, we at BioSistemika have a positive view, as the events were organised professionally. We gained much new knowledge and, most importantly, we received feedback on our progress after certain steps. We were very satisfied with the closing event, as they invited foreign investors and business angels. We would like to stress that as a young company, international investors are important because we want to break into foreign markets, and their experience can help us achieve much more, so that we can stand alongside a global company. We would be delighted to work with TIA and Meta Group again.”

not be read too quickly and certainly not passively. We should take enough time to try to connect the information acquired and research the structure of the article. This way, the virus of beautiful and clear expression can soon infect us. Or, as the Latin saying says, "POETA NASCITUR, ORATOR FIT" - "Poets are born, orators made" - in this case in written and spoken words.

Such techniques to develop communications excellence make a decisive contribution in for instance media communications. The research, development, technology and innovation sector comprises thousands - or rather, tens of thousands - of professional fields, and journalists cannot be expected to "translate" professional texts into more popular content themselves, as they do not have the professional background. In the first instance we must then start with ourselves and begin to build flexibility of expression.



Good practice and golden rules of communication in the high technology sector

Generally speaking, there is a lack of knowledge in society in the area of communication of high technology, but some companies understand "the rules of the game", and their communications strategies could be examples of excellence.

One golden rule worth following is that high technology is "packaged" in a product, where what you make, and not how you make it, needs to be presented. The identity of some successful trademarks is thus based entirely on the identification of their activities

(e.g. producing lights, boats, aircraft, etc.). Their successful communications strategy is geared towards presenting the advantages of individual innovative solutions, and not towards presenting the technical advantages of such solutions. It is thus necessary to communicate what technology can offer, what problems it solves, what advantages it has over competing technologies, etc. Pitches (brief presentations to investors at matchmaking or brokerage events) should be prepared in two steps: first present the existing problem - a need in the marketplace - and then show the solution to the problem. Once again, it is necessary to present the advantages and benefits of the solution, and not the technical specifications of the product or service. In addition, investors must be convinced in a very short time (3-5 minutes) why our company/product or service is the best investment or partnership in terms of profitability.

This can result in asymmetric expectations, as companies view their innovations as "the best ideas in the world" and are very familiar with their product or service, while investors are also interested in other parameters (e.g. return on investment, level of investment required, control of business risks, intellectual property, dedication to success, professional qualifications of the team, business model, identification of competition, etc.)

In the case of individual innovators, communications and entrepreneurial skills are very important: independent innovators, as part of a national system of innovation, are only important in terms of innovation potential once their innovations are successful in the market.

Public presentation of results of development-investment and research projects cofinanced through public tenders

Through RIP, SRRP, VALOR and INO public tenders from 2008 to 2010, published by the Public Agency for Technology of the Republic of Slovenia (TIA) in conjunction with the Ministry of the Economy and the Ministry of Higher Education, Science and Technology, with partial cofinancing from European Structural Funds (European Regional

Development Fund and European Social Fund), approximately 180 million Euros was awarded, with around 150 development-innovation projects underway in various programmes. Most of these projects end in 2011: for companies, this marks the start of the marketing phase for project results. At the TIA, we have noticed that companies implement the projects excellently, but are unable to communicate project results effectively enough. As a result, in cooperation with TIA, subsidy recipients will have the opportunity to publicly present their project results in the form of events, press conferences, public announcements, articles and interviews published in the media. The agency undertakes these activities as part of the "VTIS of communication". VTIS is a Slovene word meaning "impression", since the purpose of all communication is to create an impres-

Intra lighting d.o.o.

Intra lighting is a specialised **manufacturer of architectural luminaires and lighting systems** for:

- business premises and administrative buildings;
- retail stores and shopping centres;
- schools, hospitals and other public buildings;
- industry and logistics centres.

We have been providing lighting solutions for 22 years. Today, we are an international company with a global presence. We operate production facilities in three countries, have representative offices in 12 countries, and export our products to more than 40 countries. Our good reputation and references extend even further. Every day, over 300 people work to develop new products, ensure quality, and create lighting solutions, and are happy to do everything for the visible satisfaction of our customers.

Our attitude is development-oriented. We focus on technological innovation and design, research the impact of lighting on how people feel in a room, and continually think about saving energy. Top quality manufacturing, attention to detail and use of the best available materials are our imperatives. We manage our projects responsibly in search of optimal investment costs and in providing optimal service.

The company's business is B2B, with our main target customers being investors, architects, light designers,

intra lighting
all visible



project engineers, contractors and wholesalers. We try to get involved in the earliest stage of the project by offering clients support in planning and creating optimal lighting solutions.

In 2010 the company's founders were awarded with the title of 2010 Entrepreneurs of the Year, resulting in much media attention. The main events are presentations at the EuroLuce and Light & Building global lighting fairs. This year for the first time Intra lighting attended the Euroshop specialised fair for shops and shopping centres, and the American LFI (Light Fair International), at which our product Deux pieces was among the most innovative products in its category.

Intra lighting systematically strives for top quality products and services. This was the reason for investing in a new photometric laboratory for lighting technology, which is the only of its kind in south-eastern Europe. At the same time, alongside our unconditional 2-year guarantee, we decided to offer our customers an optional 5-year warranty across our full range of products.

sion, and this is particularly important in the area of innovation and high technology.

The objective of shared activities is for companies – through public presentations – to justify their receipt of state and European aid, and to obtain additional publicity in the media and public recognition. For the programme provider (TIA), presentations of results achieved in development-innovation projects are very important, as they provide the public with the opportunity to learn detailed results achieved through state and European funds: an increase in value added in companies, more quality jobs (with higher educational requirements), reduced environmental impact of business, etc. Last but not least, at the TIA we hope that the presentations of results of successfully completed development-innovation projects will also influence future decisions by politicians, who must devote greater attention to such activities (and allocate greater budget funding).

PIPISTREL d.o.o.



*Ivo Boscarol,
General manager
and founder*

Ivo Boscarol:

On quality and motivation:

If the worker is satisfied, the product is a high-quality one. If the worker is motivated, the product is innovative.

The main foundations of Pipistrel's success are:

- ◇ Powerful vision – anticipating trends in the global economy
- ◇ In-house development (we invest all available resources in research and development – between 20 and 30% of turnover each year)
- ◇ Proprietary high-technology product

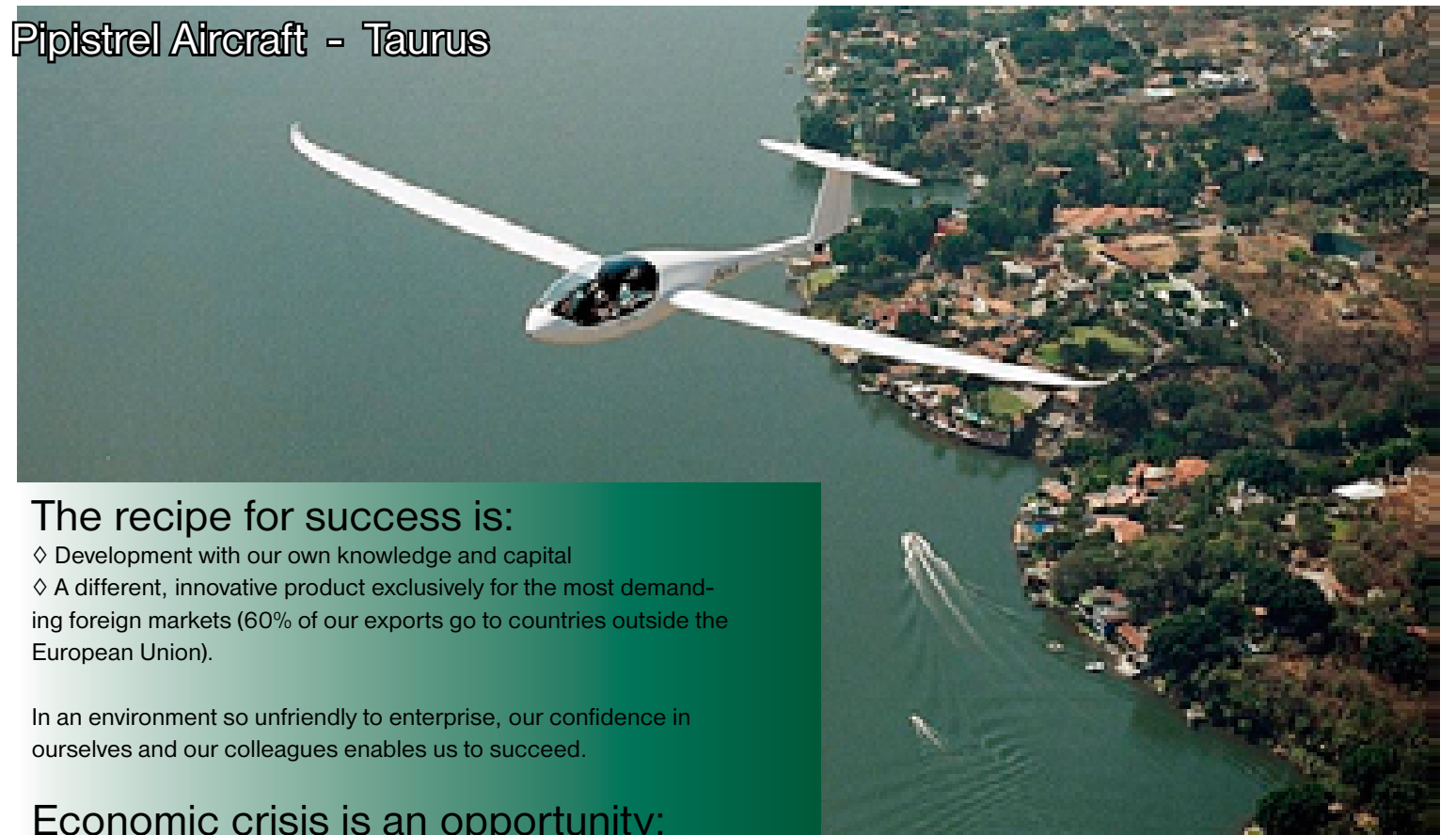
- ◇ Innovation – we encourage it at every step, including through a system of rewards for employee innovations, which results in a highly motivated team
- ◇ Own trademark, increasing the value of our product
- ◇ Rigorous quality control at every step ensures that each product is technically perfect.
- ◇ High added value for our products
- ◇ Environmentally friendly production and rational energy consumption
- ◇ Own market – a 100% market share for our unique products and global market presence

As soon as you're satisfied with lesser objectives than these, you're adrift in a sea of averageness, which means collapse.

Pipistrel Aircraft - UL 3-Axis AIRCRAFT - Taurus



Pipistrel Aircraft - Taurus



The recipe for success is:

- ◇ Development with our own knowledge and capital
- ◇ A different, innovative product exclusively for the most demanding foreign markets (60% of our exports go to countries outside the European Union).

In an environment so unfriendly to enterprise, our confidence in ourselves and our colleagues enables us to succeed.

Economic crisis is an opportunity:

Economic crises are just another opportunity for companies and individuals who know how to anticipate and use them: crises force us to innovate and discover hidden reserves in companies. You must take advantage of the impact of the crisis by emerging from it as a winner with competitive advantages.

Customer trust:

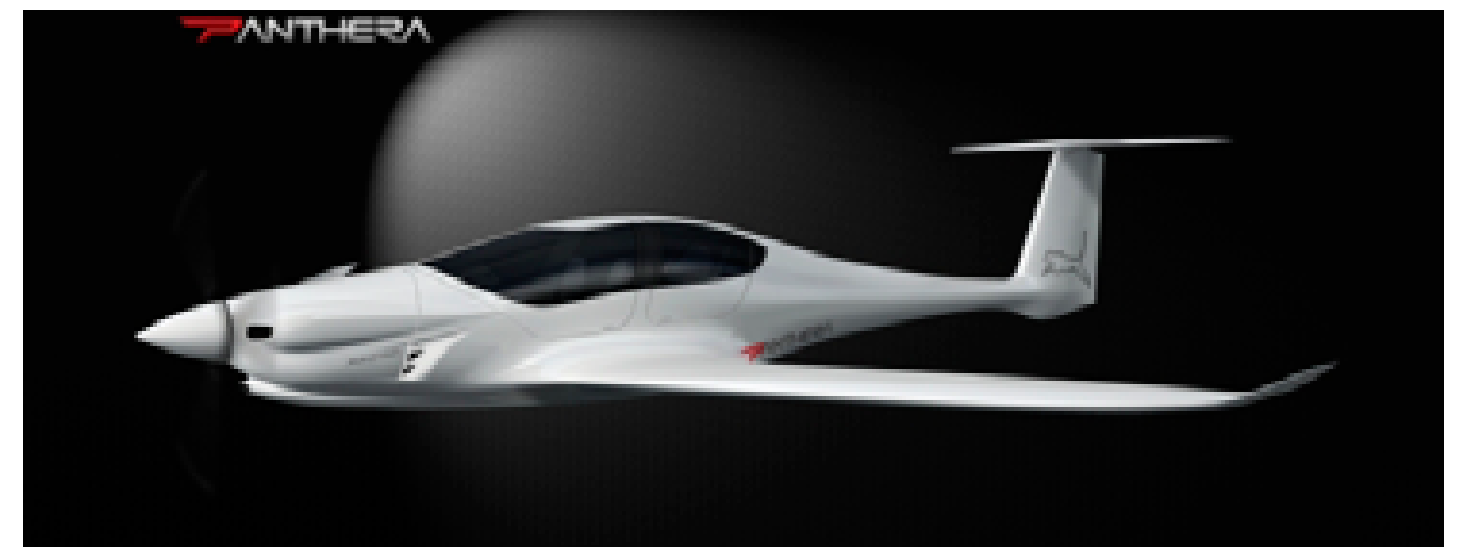
By setting very high objectives, the most stringent criteria and the highest standards, especially for ourselves, we can gain the trust of customers. This is reflected in the fact that, our customers are prepared to make a 100% advance payment on aircraft orders and then wait for delivery, while some have even ordered the new aircraft we are developing, even though the first prototype has yet to fly.

Goals and success:

Under global competition, setting goals TOO high is the only way to succeed.

In personal and business life, there is only one key dilemma: Succeed, or to be a loser!

There is thus no alternative – we have to dedicate our lives to success. Success must be our life goal. We achieve it through innovation and belief in ourselves. We must set goals high enough to break down barriers globally – and then must have full belief that we can achieve them. There are no limits – obstacles exist only in our heads!





Jasna Kontler Salamon
DELO

Interview with: Janko Jamnik, PhD, Director of the National Institute of Chemistry of Slovenia

A winning formula: a public institution based on the model of US universities

It is probably hard to find many Slovenian managers and directors who are happy with their business results at the moment. Among the few, we find Professor Janko Jamnik, PhD, Director of one of Slovenia's leading research institutions, the National Institute of Chemistry in Ljubljana.

We will deliberately start with the same question as in our interview from March last year. It has been over a year since then, and you were doing well at the time; is this still the case?

I'll give you a similar answer as last year. I can still gladly say that we are doing very well. And I'm not just saying that off the top of my head; this is shown by indicators. Last year, in a recession year, we experienced an increase of the influx of funding from the economy by one quarter. We are truly very proud of that.

What does that mean in figures?

Last year, our institute received more than 3 million euros in funding from the economy for the first time since its founding. The year before that we managed to obtain around 2.7 million euros. In addition, we tripled our income from the sales of patents compared to 2009. I believe we ranked first in terms of the number of patents sold among the research institutions in Slovenia.

Did any changes in your policy regarding intellectual property con-

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giving us results. We give the developers a third of the sum for the patent, a third goes to the department and a third is reserved for the Institute. We copied this scheme from MIT, and we will definitely keep it, as it has performed beautifully.

Does this system ever cause envy on the part of those who do not develop patents and do not partake in such incomes?

I think there is less and less envy. Last year, there was certainly more of it. In my opinion, this is the result of our policy to consciously highlight success. Precisely so as to make people think of success as something positive and desirable. It is also very important to stay realistic and acknowledge as a success only what really is one. By all standards. For example, a patent that is successfully commercialised.

Do you stimulate your innovators in other fields besides technical and natural sciences; fields where there are usually no patents, although these kinds of innovations bring better business practices and savings, e.g. in administration?

It is true that there are no palpable incentives there. We have actually only begun to take stock of the fact that these are innovations as well. We will definitely try to implement an appropriate rewarding scheme in these fields.

When listing your last year's achievements, surely the publications in various research journals cannot be missed?

Indeed. Last year, our researchers managed to get two articles published in the Nature Materials Journal. That is the equivalent of all of the publications we had in previous years in the Nature Journal. I think it is important to highlight all aspects of our success, as they are all very interconnected.

Are you also making progress in founding spin-off companies?

We are still lagging behind in this area, but the cause for this is primarily the obsolete national regulations. Slovenian legislation still does not allow a firm to found a spin-off company based on a patent. We have succeeded in founding a few companies, but because of the aforementioned reasons, we call them "spin out" companies.

The legislation you mention has already been successfully circumvented by some...

True. But we want a systemic solution for this issue. There have been a number of discussions on this topic, but there are still no results. Currently, we have such conditions in our country, such a depressed atmosphere, that many are probably not very comfortable with the idea of starting a new company. Some of the blame for the falling behind in this area is certainly on us. We should have arranged a lot of things differently. The problem is also in the fact that many a researcher would gladly have a company if he could concurrently stay employed at the Institute. Because of the security, few are willing to take the risk and give up an indefinite duration contract – such jobs are getting scarce.

Have you ever considered an entrepreneurial path?

No, I'll admit, I never have. I think it's because I'm too interested in science to have the time to spare for other matters.

Two years ago, when you first publicly praised the business results of your Institute, you have, as you later told us, received negative reactions as well. Aren't you concerned that this year, since most firms are doing even worse, that you will receive even more of these reactions?

What can I say? I think that persistence matters in times of crisis. In everything. That includes a frank discussion of one's results and not changing course at the first sign of trouble from the environment.

It is also true that you are a public institution, and for that fact alone, you would have difficulty in hiding anything. Success included. Private firms are another matter. Can you

Janko Jamnik, 47 year old physicist, graduated and also completed his master's degree and doctorate at the Ljubljana Faculty of Mathematics and Physics. He spent more than five years in research positions abroad, mostly at the Max Planck Institute in Stuttgart and also at Cornell University in the USA. He is employed at the Slovenian National Institute of Chemistry since 1988. From 2000 until two years ago, he was head of the Laboratory for the Materials Electrochemistry, and for the last two years, he has been Director of the Institute.

Janko Jamnik, PhD, Director of the National Institute of Chemistry of Slovenia

confirm from your experience with business that we have quite a few very successful companies in Slovenia, which for various reasons keep their success from public view?

This is true to a certain extent. Most of the companies we work with are very good, and it is also true that not many of them appear in the media. As for why, that is for you to discover. In professional circles, there is of course no withholding; we all know how successful they are.

You and some others have recently answered our question about the initiative for a closer cooperation of the University of Ljubljana and Slovenia's four leading public research institutes. You were also the only one that expressed your support for the integration with the Ljubljana University, even before the announced joint statement. Is the content of the statement announced by Dr Oto Luthar clear by now? What reactions did your statements encounter within the Institute and elsewhere?

No, the joint statement has still to come, but we are working on it. As for the reactions to my statement, they were mixed. My colleagues already knew my opinion, but for others, it may have been a surprise. Why do I support this initiative? Above all, because I think that Slovenian higher education urgently needs improvements. We would without a doubt be able to achieve a better rank in the Shanghai and other classifications with this merger. Many serious researchers and university professors around the world and in Slovenia don't really pay any attention to these, but they are very important for students, especially Asian ones, and the recruitment of foreign students is a very important thing for any university. The Institute would also like to have the possibility for international exchanges.



Your incorporation with the university would probably be conditioned on financial and other types of autonomy?

I'd like to emphasise the fact that it is all still in the phase of suggestions and discussion; there have been no decisions yet. We also haven't yet started negotiating with the university. All the relevant details will be, if we so decide, outlined in the framework of the manoeuvring room of the merger. For now, everything is still on the table, and it is still possible that there will be other forms of integration – among the institutes themselves or the institutes and some other university.

Is it possible that with this integration, you would somehow transfer your successful practices to other institutes and the university? Or would you conversely risk becoming less successful yourselves?

I have no illusions regarding this. A former president of the Slovenian Academy of Science and Arts, the now Minister Boštjan Žekš, said that when he became academy president that in science it is like in a classroom. If the majority has excellent grades, they will pull the bad students along with them. And if there are more bad students, the opposite will happen.

In your opinion, who is in the majority within the very large and heterogeneous University of Ljubljana University? Considering you support the merger, you probably think it is the good students?

Unfortunately, I do not believe so. The faculties are very different. Some have a majority of excellent students, other have a lower average. But the greatest threat I see is the way the university operates, its rigidity. The university would probably not adopt the agility of the Institute. More likely, the Institute would drown in its rigidity. This is why we need very clearly defined safeguards. In Germany, for instance, where there was a conjoining of a university and an institute in Karlsruhe, things were different. They were two institutions that were similar in size and organisation.

The initiative for the discussed integration comes from the proposal for the Slovene Research and Innovation Strategy (RISS). You took part in the recent public debate about this document and the proposal



The Grand Prize went to Prof. Dr Milan Randić

The Pregl Awards of the National Institute of Chemistry

Prof. Dr Jure Zupan received the title of Researcher Emeritus of the Institute of Chemistry

for the National Higher Education Programme (NPVŠ). The latter generated a lot more discussion than the research and innovation strategy. Has this surprised you?

No, because there are many more stakeholders in higher education than there are in research. Also, in higher education there is quite a divide between public and private institutions. These have very different opinions and needs. In addition, students have a substantial say in higher education. For all these reasons, the preparation and review of the national higher education programme is a lot more complex and demanding than is the case with the research and innovation strategy.

What do you think of the Slovenian research and innovation strategy?

I think the document is not bad. It includes many things that are relevant, well thought out and would be beneficial for science and education in our country. It predisposes more competences for stakeholders and with them more responsibilities. This is the right approach for all of society, not just the research community.

The merger of agencies that support technical innovation and research was also announced. Do you support this?

We are definitely in favour of merging TIA (Slovenian Technology Agency) and JAPTI (Public Agency of the Republic of Slovenia for Entrepreneurship and Foreign investment). There is a great deal of redundancy there at the moment.

And how do you view the proposed possibility of the exclusion of your employees from the public employees system?

I think it's a great idea, because we would be able to pay the best performers better than we can now. For instance, heads of successful departments. On the other hand, this would mean much more work for us. In any case, I'm in favour of letting people decide for themselves whether they want to stay with the old system or not. There shouldn't be any compulsion here. It's also interesting that some people who were previously not happy with their public employee status now cling to it...



2011 Pregl Awards Ceremony

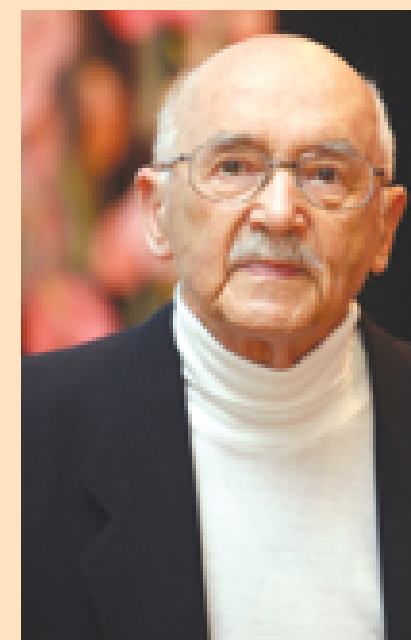
Ljubljana, 20 June 2011

In this International Year of Chemistry, the Pregl Awards of the National Institute of Chemistry, whose purpose is to encourage innovation and excellence in scientific work, were awarded at the Grand Hotel Union in Ljubljana.



Prof. Dr Alexandru T. Balaban gave a speech regarding Prof. Randić's award

Cizelj also took part in the ceremony, and in her address, she emphasised the importance of science for future



Acad. Prof. Dr Dušan Hadži



Dr Romana Jordan Cizelj, Slovenian Euro-MP

The Grand Prize for Research Work was awarded to Professor Milan Randić, world renowned computational chemist, professor emeritus at the Drake University of Iowa and honorary member of the Slovenian National Institute of Chemistry in Ljubljana.

The Pregl Award for Exceptional Achievements was awarded to Professor Radmila Milačič for her important scientific contributions in the field of speciation of elements.

The title of "Researcher Emeritus of the Institute of Chemistry" was awarded to Professors Dr Dušan Hadži and Dr Jure Zupan for exceptional achievements in scientific research and their invaluable contribution to the development and reputation of the Institute of Chemistry and Slovenian science at home and abroad.

Slovenian Euro-MP Dr Romana Jordan

Prof. Dr Radmila Milačič, recipient of the Pregl Award for Exceptional Achievements

development: "The formulation of a scientific research policy unites us on the level of principle within the Euro-

development of new materials, information technologies, satellite technology and the understanding of life down to the very atom. Also, there are the fields of nanotechnology and biotechnology and the challenges of providing healthy, safe and sufficient food, the challenges of an aging population ..."



The History of Funding Research & Development in Slovenia

Polona Novak and Franci Demšar

Abstract

In this study we give a historical overview of developments in the field of financing research and development activities in Slovenia. Historical overview of developments in that area starting with the establishment of the Fund Boris Kidrič in the 1953. The Fund's task was to decide independently, separately from the government mechanisms, on awards to the excellent and scholarships to the most promising researchers through its management board consisting of renowned researchers. The government later transferred powers in funding research to the Fund. The Fund's effect on the development of science in Slovenia kept growing until it became the only funder of research in Slovenia oriented towards long-term and common objectives of the development of Slovenian society, when federal funds were abolished in 1971. The Research Community of Slovenia established in 1971 provided through its expert bodies the base for the Management Board of the Fund to implement the research policy on which funding decisions were founded. The Ministry of Science and Technology and later the Science Office of the Ministry of Education, Science and Sports continued to formulate the research funding policy in independent Slovenia. The Slovenian Research Agency has been funding with government budget funds a major part of research since 2004, in accordance with the interests and policy of the Ministry of Higher Education, Science and Technology.

The paper presents data for 1954-2010 on funding of research obtained from annual reports of institutions responsible for research in Slovenia.

Introduction

The first part gives a historical overview of funding research in Slovenia between 1954 and the disintegration of Yugoslavia. The crucial events and turning points on which the competent persons for research policy reported and informed the public are listed.

This is followed by a presentation of R&D funding between 1954 and 2010, as reported annually by the research funding institutions.

Publicity of the work

The Boris Kidrič Fund paid great attention to the publicity of its work. In addition to regular annual public meetings of the Management Board, the Fund

published annual reports containing all information necessary to keep the public informed. The first volume contains the report for 1954-58, the second for 1958-59 and the third for 1960-61. The reports have been issued annually from 1962 to the present with all legal successors having the main task of funding research from the government (of the republic and the country) budget maintaining the tradition. With the development of IT, the emphasis has been increasingly given to the Internet and the reports on the work in Slovenian are available on <http://www.arrs.gov.si/sl/finan/letpor/>.

The issued and publicly available reports on funding research place Slovenia side by side with the US National Science Foundation, which issued its first report for 1950-51 (First Annual Report of the National Science Foundation 1950-51, http://www.nsf.gov/about/history/ann_report_first.pdf).

The main source of this paper and the analyses were the annual reports. The presented funds were mostly those of the following legal entities:

- Boris Kidrič Fund (BKF), established in 1953 and distributing the first funds in 1954;
- Research Community of Slovenia (RCS), starting to operate in 1971;
- Ministry of Science and Technology (MST), established in 1991;
- Ministry of Education, Science and Sports, Science Office (SO MESS), continuing the work of the MST since 2001;
- Slovenian Research Agency (Agency), beginning its work on 1 October 2004.

The term "the beginning" in this paper relates to the beginning of operations of the Boris Kidrič Fund as a legal predecessor of the Slovenian Research Agency. The science policy and systematic funding of Slovenian science was first established in the mid-fifties of the previous century (more by Aleš Gabrič in *Znanstvena politika v Sloveniji po drugi svetovni vojni in vloga Antona Peterlina – The Science Policy in Slovenia after the Second World War and the Role of Anton Peterlin*).

The beginnings

The People's Assembly of the People's Republic of Slovenia (PA PRS) adopted the law on the Boris Kidrič Fund in 1953, a year after Boris Kidrič died. Giving the fund the name of Boris Kidrič was a result of his great support to the development of science and to general progress. Several methods for participating in promotion of scientific research had been formed upon the Fund's establishment, mostly granting awards and training. The statute regulating the Fund's work was adopted in 1955. The statute of the fund was supplemented and the Fund's tasks expanded a year later due to a law amending and supplementing the law establishing the Boris Kidrič Fund. The Fund's tasks mostly comprised the following:

- 1.) giving Kidrič Awards for the best original scientific work published in the preceding year;

- 2.) giving awards for theoretical and applicative theoretical papers put forward on the basis of a call specifying the topics of the awards;
- 3.) giving awards for technical inventions and improvements;
- 4.) granting scholarships;
- 5.) funding basic and applied research;
- 6.) added later: granting loans for research equipment.

The first Kidrič Awards for scientific work were given in 1957. The Kidrič Awards were given for high quality original scientific research work in economics, and social and natural sciences published in the preceding year; One first award and not more than three second awards could be given each year. The main criteria were the scientific and expert value of the published work and its recognition among scientists. An award for life accomplishments could be given to scientists exceptionally.

The awards for successfully discussing predetermined topics were given for the first time in 1955. Eleven topics were selected in 1955-57, all of which concerned economically or technically significant issues. Five topics were prescribed in 1958.

A competition for technical inventions and upgrades established in practice was published in 1956. The first such award was given in 1957.

The decision to grant the first scholarships for expert training in the country or abroad was taken in 1954. Scholarships were granted in the initial period to candidates who were already employed. Full-time secondary school and university students received the scholarships only exceptionally. The Boris Kidrič Fund granted the first five multiyear scholarships for domestic educational institutions, two once-off grants for expert training and study trips in Yugoslavia, and five scholarships for specialization studies abroad in 1954. The same number of scholarships was granted in the following years with an increase in scholarships for multi-year studies in domestic schools. The number of candidates being granted scholarships for studies at home and for expert training abroad by 1958 was 34 and 21, respectively.

In 1956 and 1957, the Fund financed 19 scientific research projects with the results directly benefiting the Slovenian

economy. The Fund expanded this activity in 1958. The Fund took over the management of all budget funds earmarked by the republic for scientific research.

The Fund's statute stipulated that its "aim was to promote theoretical and practical research work in economics, and social and natural sciences as well as in all other fields directly assisting the development of the socialist economy". The Act amending and supplementing the Boris Kidrič Fund Act adopted in 1961 extended the Fund's activities to scientific research in all fields of social activities. The new task of the Fund was to promote and support theoretical and practical research in all scientific fields by: (1) funding scientific research, (2) giving awards, and (3) granting scholarships. The new law stipulated that the Fund may finance purchases of equipment needed for scientific research. The first modest funding of research equipment was granted in 1962.

The federal scientific fund and the scientific funds of republics were established in 1961. Their core task was to link scientific institutions and the users of scientific findings and achievements. A general principle was adopted of co-funding only scientific research for which funding is also provided by scientific institutes, businesses and other organisations. The funds would only exceptionally fully finance any scientific work. The Boris Kidrič Fund took over those tasks in full in the People's Republic of Slovenia.

The Management Board of the Fund found in 1962 that the main issue in Slovenia was not underdevelopment but insufficiently modernised production, reflected in low labour productivity, poor quality and choice of products, high costs, lack of adaptation to the market and low exports, in short, lagging behind in the global division of labour with regard to techniques, technology and organisation of production. The Management Board thus made an effort to fully include science in production. Science was becoming a responsibility of businesses but only few of them in Slovenia were aware of the matter's urgency. Some data had already foretold a change: the year-end accounts of 17 scientific research institutions in technical sciences show that the share of research funding provided by businesses and by the funds of the federation and the republics in the

preceding year was 85 % and 15 %, respectively.

Funding research from the budget

The Management Board of the Fund was developing all forms of assistance to scientific research based on calls for proposals (except for the Kidrič Awards and the Fund's awards) with participation of over 200 renowned scientists and experts. Great emphasis was given to co-funding research as that multiplies the funding of science and in particular gives a better guarantee that the research will be performed efficiently and effectively as well as that it will receive a proper assessment.

The Fund's work increased significantly in 1963. The budgeted revenue was 1,800 million dinars, almost matching the entire amount available to the Fund since 1954, the year its work began. The Fund's budget was growing and stabilised at a percentage, which was 5.6 % of the budget of the republic. Thus, the funding of research grew in line with the rising income in the republic. The Fund managed most of the budget funds earmarked by the republic for research. Gradually, that included funds previously earmarked for research in other funds, e.g. the School Fund, or directly in the government budget. That was implementation of the principle that research institutions receive no grants with their activity being financed instead. Research units at universities began to receive funding according to that principle as well that year.

The Fund's aim was always to attract funding from as many users of research as possible. The users contributed 42 % of research funding as early as in 1961. A year later their share rose to 48 %. In 1963, it climbed to 54 %.

The efforts aimed at improving efficiency and effectiveness of research were intensified. Participation of users in funding of research provides a certain guarantee that the funds will be soundly invested and the research aim achieved. Financial participation of users was growing into guiding and planning research work. The users found out that individual projects proposed by researchers were necessary but meaningless on their own. They gained sense only when they were linked together. The Fund took the ini-

tiative to improve the organisation and planning of research. The discussion included representatives of research organisations and businesses, the Science Council and the Chamber of Economics and formed the initial draft of the methodology of planning and organising research, and introduced grouping, coordinating and guiding towards solutions of certain problems in handling of research topics.

Scholarships were an important area of the Fund's activities. The Management Board of the Fund more than doubled the amount for scholarships in 1964 because only adequate human resources can perform increasingly complex tasks.

The Management Board reported in 1965 on the enhanced development of the society in all fields. Growth in the number of research staff, the number of publications, etc., shows that the volume of research doubles every 12 years. Funding of research grew faster than the economy, meaning that research began to encompass increasingly wide areas of activities. The Management Board strictly applied the policy of co-funding by interested organisations, primarily in R&D. Co-funding by interested organisations reached 50 % for technical sciences and 38 % for biotechnology in 1964. The share was 30 % even for medicine and social sciences. In conjunction with the co-funding policy, lending for research tasks (notably in technical sciences) was becoming increasingly common. It rose from 10.5 million in 1962 to 110 million a year later and 265 million dinars in 1964. Loans for additional equipment of research organisations rose as well, in particular for funding semi-industrial devices as a necessary link between laboratory results and industrial production. The loans grew from 18 million in 1963 to 230 million dinars in 1964. The Management Board noted a particular problem, i.e. publication of achieved research results and found that a number of research findings had not been published in research literature, had not become available to researchers and experts and thus could not be subject to an extensive qualitative assessment.

The Fund's financing from the government budget of the republic had been increasing until 1964. The growth stopped in 1965. Although the Fund was merged with the Geological Research Fund that year, the combined funding of the two funds fell below the

1964 level after the adopted amended budget of the republic. The Fund raised a short-term loan to offset the lower than planned budget funds but its repayment was fully debited to the next year's budget of the Fund. This had an effect on funding of research projects in 1966, although the funds from the budget of the republic were higher in 1966 than in 1964.

The Federal Commission for Nuclear Energy significantly reduced the funding of all three nuclear institutes and research in nuclear materials in 1967, shifting a part of the financial burden to the republics. The new obligations placed a burden on the Fund that prevented it from increasing funding of research projects and tasks in other fields.

The structure of the Fund's funding of individual fields was relatively stable (source: Poročilo o delu, 1968, p. 7).

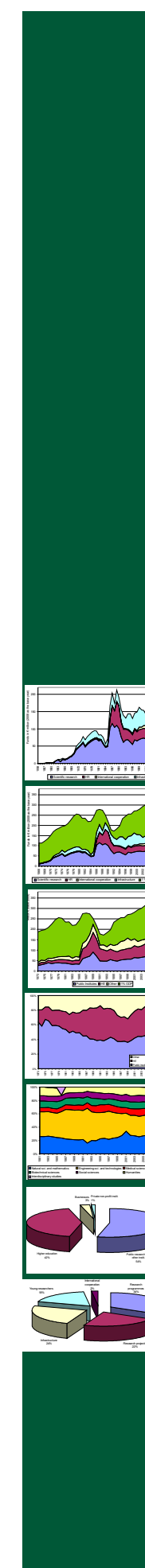
Technical sciences	46 %
Geological research	21 %
Biotechnology	14 %
Medicine	6 %
Social sciences	13 %

A large share of funds was earmarked for geological research aimed at searching for domestic energy sources.

Co-financers paid 53 % of the total cost on average for the tasks co-funded by the Fund. Businesses contributed 48 % on average, the Federal Fund for Financing Research and Geological Research 34 % on average and the remaining funds were own funds of institutes and those paid by other interested parties.

The Act on Permanent Funding of Research adopted at the end of 1968 stipulated a slightly higher growth in the Fund's budget than the forecasted domestic product growth until 1973.

An imbalance between the budget of the federal fund and the funds of republics for research funding was reported in 1969. The Federal Fund received nearly 60 % of all research funding from the federal budget, while all the funds of republics received only slightly over 40 %. Federal projects were not always aligned with interests of the republics, but the republics were nevertheless forced to co-fund such programmes if they wanted to receive co-funding from the Federal Fund for their research institutions.



The Federal Fund for Financing Research was abolished in 1970. The federation waived the part of personal income tax from which the federal fund was financed. The republics earmarked the released funds for the same purpose and transferred them to their research funds, thus providing for continuity of funding.

The Fund received a substantial boost in funding, which provided it with a new quality. The bulk of the new funding was used in the first years for the assumed obligations of the Federal Fund.

The Research Community of Slovenia (RCS) began its work in 1971. The focus of activities of the RCS was on guiding the development, and organisation and coordination of research, while the Fund implemented the policy by funding research programmes, projects and by lending for equipment and development research. The decisions on funding were transferred to a wide circle of researchers organised in sections to assess the scientific and social value of proposals. The principle of public panel discussions in approval of research programmes and publication of all data was applied. The Raziskovalec (Researcher) bulletin was first issued that year, regularly publishing information and new developments in Slovenian science and scientific institutions. Activities of the RCS extended to parallel activities, such as IT, scientific journals and international cooperation.

The Constitution of the Socialist Federal Republic of Yugoslavia was adopted in 1974. Adoption of a new constitution of the republic followed, which introduced self-management agreements and establishing self-management interest communities. The Research and Research Communities Act adopted in December 1974 placed the responsibility for programming, developing and research funding on workers joined in new self-management interest communities. A new research community was established a year later as the community of researchers and users of research, which ended the transition from a period when only the government cared for the development of science to a period when full responsibility was placed on the directly interested workers joined in self-management interest communities.

The self-management agreement on the establishment of municipal and regional research communities and the research community of the republic was adopted in 1976. The research policy was within that framework formulated more under the influence of researchers than on the basis of recognised and evaluated needs of the society. Research projects and programmes had a well-established role and interest of researchers and a poorly defined role of users. The Agreement on the Foundations of the Social Plan of the Socialist Republic of Slovenia 1981-85 was adopted to resolve the issue. The planned objective of spending 2 % of the domestic product (DP) on research was set. All forms of interest associations were established: municipal research communities (in 54 municipalities), special research communities (12), units of the research community (the unit for discovering and researching raw materials of general significance was included in the RCS) and the joint research programme within the RCS.

Declining trends in Slovenian science after 1980 resulted in a decrease of new doctors and masters of sciences, and a reduction in R&D units in business sector. There was an economic crisis in the country and abroad, stagnation (though the economy kept expanding), real personal income was falling, social standard stagnated, high inflation undermined many efforts to improve the economic outlook and foreign debt was high. A system of solidarity caused irrationalities.

Importing of scientific equipment was liberalised in 1985 and the imports of foreign scientific and expert literature stopped falling. The medium-term plan and the annual implementing resolutions specified an increase in the share of funds for basic research, all forms of postgraduate education, linking with the world and for innovative joint research projects.

The improved social conditions resulted in doubling the funding of research. The 1987 report stated that the funding more than doubled in 1986 compared to the year before: the nominal increase was from 6 billion to 24 billion dinars and in real terms it grew from 0.35 % of the domestic product to 0.72 %. Funds for promoting training of young researchers were specifically earmarked that year.

A graphic presentation of funding research & development

The presentation uses 2009 as the base year for calculating the funds. Retail price indices were used in the calculation for the years until 1998 and consumer prices indices for the years

ing also the cost of invited foreign scientists;

- infrastructure comprising the following items: scientific and popular science publications, scientific meetings, information & documenting activity/INDOK, ARNES, research equipment, capital investments, research infrastructure, innovations fund, building investments/investments of national importance, Academy of Science and Arts, founder's obligations,

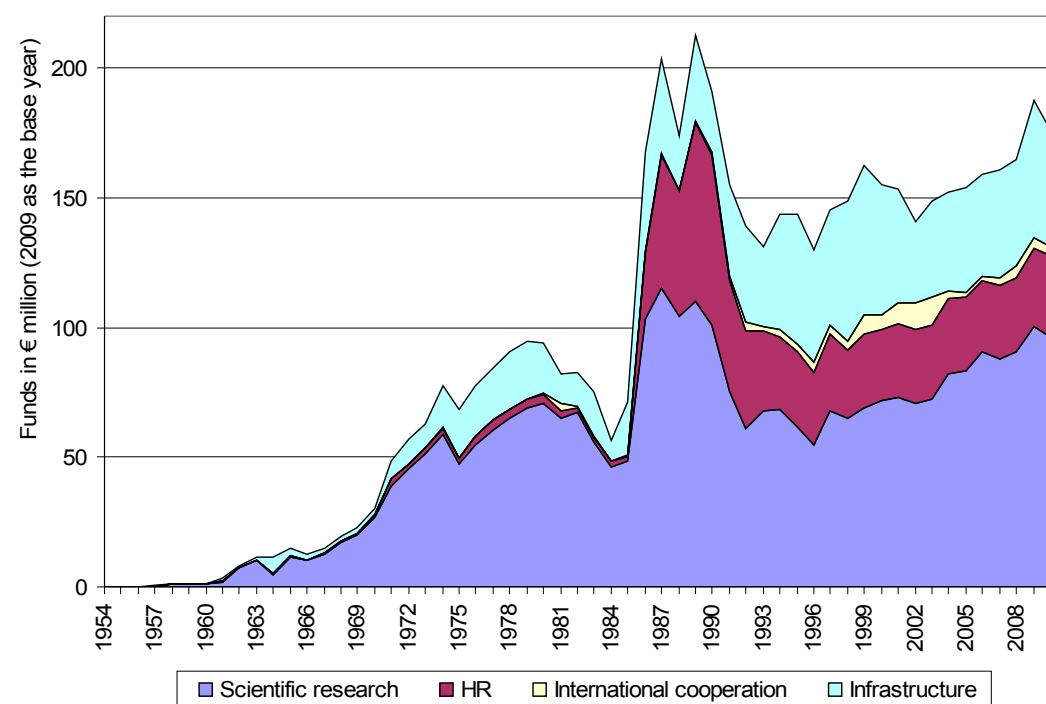


Figure 1: Funding of research & development by set

thereafter (source: Statistical Office of the Republic of Slovenia).

The figure presents funding between 1954 and 2010. They were combined into four sets for improved transparency:

- scientific research comprising the following items: scientific research (until 1980), research programmes of the RCS and the PoRS/GRP (guided research programmes), the programme for discovering and researching raw materials/unit, basic, applicative and R&D projects, targeted research programmes, research programmes and technological development;
- human resources comprising scholarships and training of young researchers;
- international cooperation compris-

awards, promotions, the expert system, operating costs of research organisations (acquisition of fixed assets, wages and salaries, and costs of material).

The figure presents only the funds of the ministry responsible for science after 1991 and only the funds of the Agency after 2004.

The figure above shows a distinct rise in funding until 1971, when the Fund began to manage all funding of research and development of the republic. The funding then experienced increases and decreases reflecting on the one hand the level of support to research and on the other the socio-economic situation described in the first part of the paper.

The next figure adds a dimension of domestic product and gross domestic product to the funding of research and development (presented in Figure 1). It presents the funding since 1966.

and falling DP/GDP had an effect of reducing funding of R&D. There was a lag in falling of the funding of R&D, thus the funding of R&D was the closest to 1 % of DP/GDP, when a crisis

struck or towards its end. It is a reflection of the awareness on the importance of investing in R&D (in particular when times are tough) and a decision to maintain for as long as possible the same share of R&D funding in the government budget.

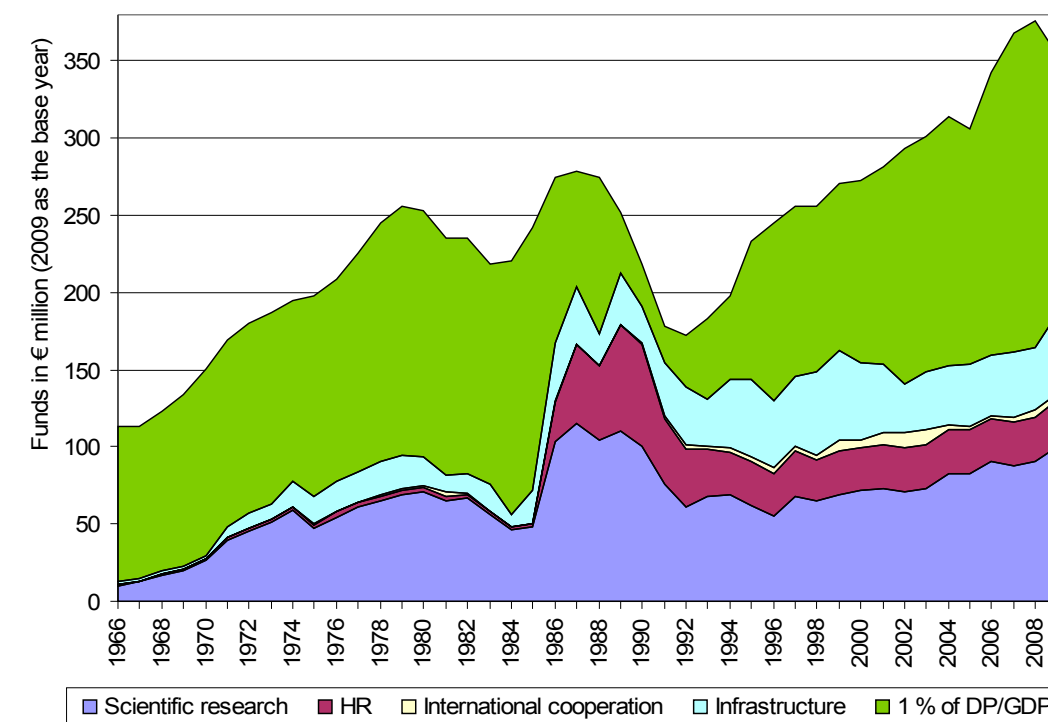


Figure 2: Funding of research and development by set and 1 % of domestic product (DP) or 1 % of gross domestic product (GDP)

Below is a presentation of R&D funding from 1973 onwards by recipient type. Recipient types have been combined into three groups with regard to the sectors of performance. The first group comprises organisations having the status of a public research institute (PRI) since 1991. The term "national institutes" was used for them before 1991 and now they are often known as the government sector. The second group comprises universities and their members (schools, academies and higher education institutes) and independent higher education institutions. The third group includes all other organisations (legal and natural persons) not classified into any of the previous two groups: institutes (public and private), businesses (Ltd, Plc, etc.), sole proprietors, private researchers, agencies, societies, international organisations, etc.

The organisations and their legal predecessors are classified into groups with regard to their current legal and organisational status.

The figure above shows data on the DP until 1979 and on the GDP since 1980. The source is the Statistical Office of the Republic of Slovenia, which collected data on the DP. The comparable data for the GDP are available from 1980 onwards (<http://www.stat.si/indikatorji.asp?id=20>, http://www.stat.si/letopis/1990/1990_07.pdf). The presented changes in the DP and the GDP reflect three crises: the oil crisis in the eighties, the disintegration of Yugoslavia in the nineties and the recent financial crisis.

Recalculating money to a common denominator is tricky for periods of high inflation and major fiscal changes or measures. We have used the same indices for recalculation of funding of research and development and for the DP and GDP and we therefore assume the data to be comparable. The figure shows a similarity between funding of R&D and the DP/GDP. Growing DP/GDP resulted in rising funding of R&D

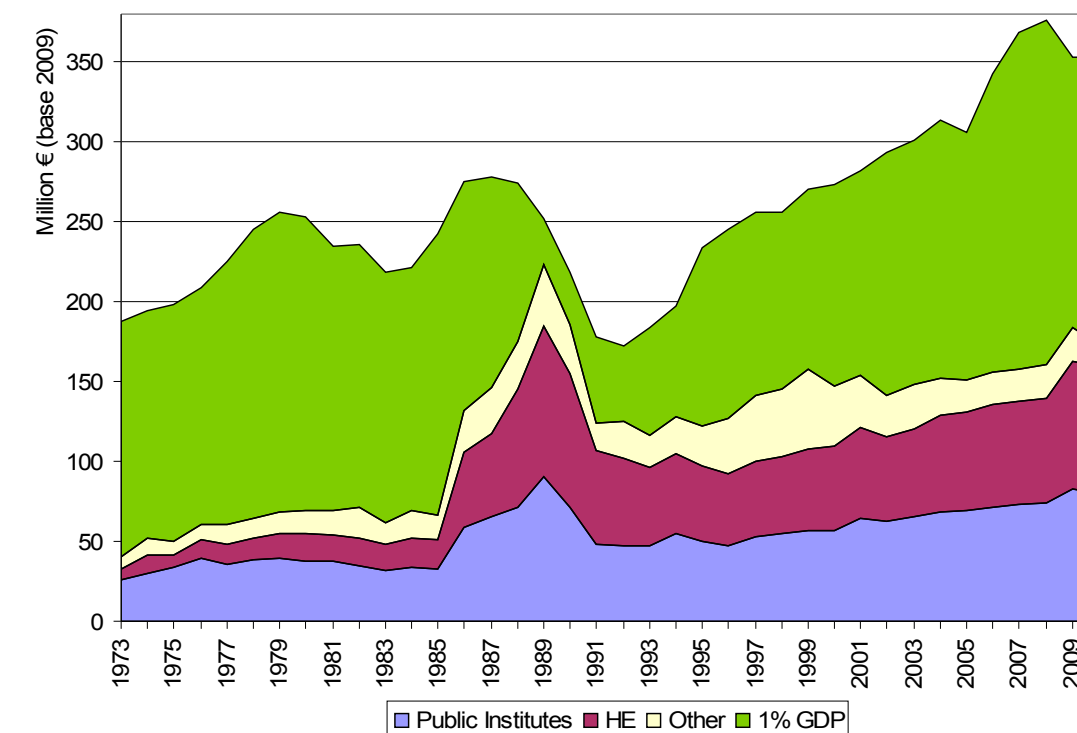


Figure 3: Funding of research and development by activity sector of the fund recipients and 1 % of DP/GDP

Until 1994, the reports on the work specified data only for fund recipients that we now know as "research organisations", i.e. organisations (including natural persons) entered in the register of providers of research and development. The same category includes researchers entered in the register of private researchers. The data for all recipients of R&D funds have been available since 1995, which is why there is a noticeable relative increase in the funding provided to that group of recipients.

The R&D funding by sectors of performance is more stable and fluctuates less than the total R&D funding. The funds were relatively stable until 1985 and were not significantly affected by the crisis around 1980. The funds began to grow after 1985. A distinct fall was recorded in 1990 and 1991. It was followed by relatively stable slight increases.

Below is a presentation of R&D funding by fund recipient with regard to the sectors of performance. Funding provided to the government sector (i.e. the PRI) had been falling in the observed period from more than 60 % to less than 50 % until 1990, after which the share remained virtually the same. In the period when the PRI were losing funding, the relative winners were "university" recipients - a result of establishing research institutes at universities and thus enhancing the R&D activity in the sector. "Other" recipients had

had a relatively stable share of funding until 1994 with an increase following thereafter. The increase was due to changed disclosure of data in the annual reports, as the funding has been presented for all recipients (and not just for the "research organisations") since 1995. Funding of other recipients has been falling since 2000, which is due to the transfer of "technology" (funding of training of young researchers from businesses and funding to promote technological and other development, comprising: grants for technological development in businesses, grants

to technological parks, grants for the operation of infrastructure development centres, grants for the development of patented prototypes and grants for EUREKA projects) from the Ministry of Science and Technology to the Ministry of the Economy.

The figure above presents R&D funding by fields of science from 1981 onwards. Funding of the following areas has been distributed by fields of science: joint programme of the RCS, GRP, scientific research (basic and applicative) projects, postdoctoral

Figure 5: Funding of research and development by fields of science

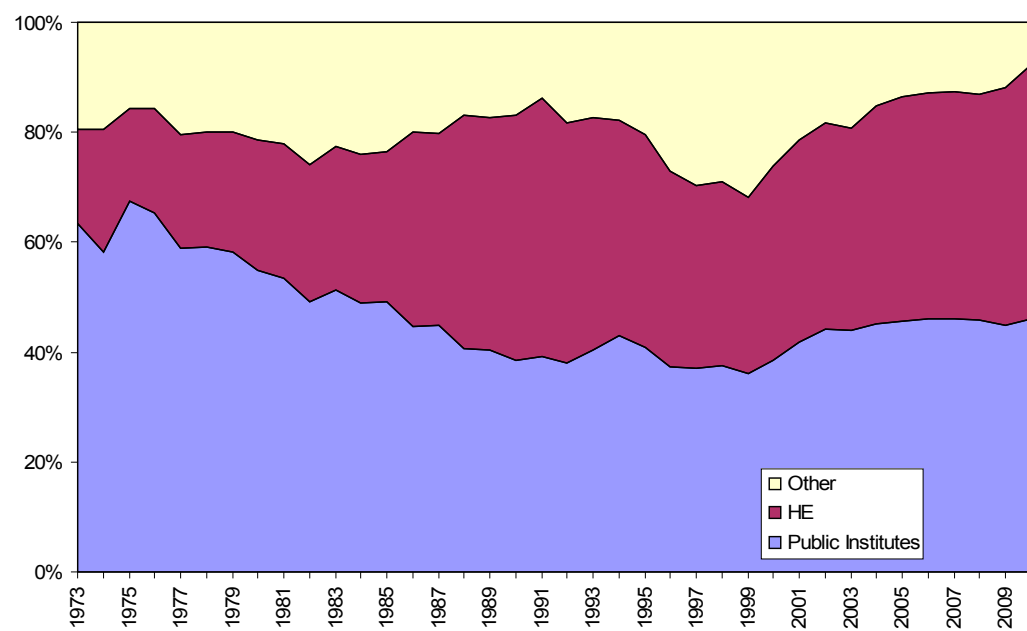
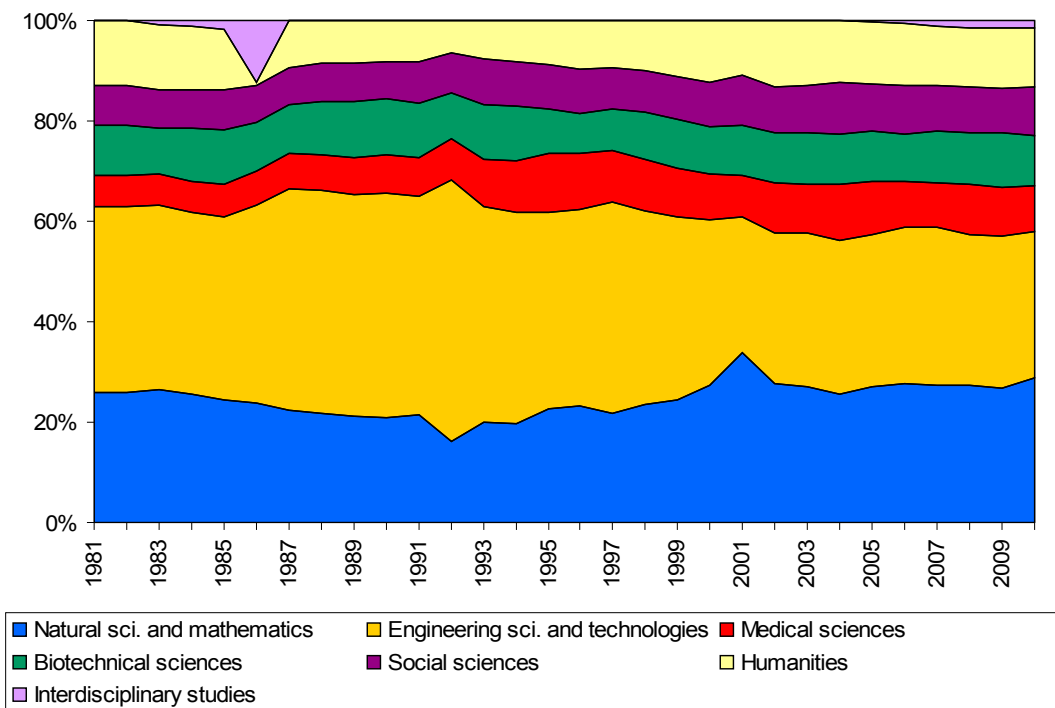


Figure 4: The share of funding of research and development by sectors of performance of the fund recipients

research, R&D projects, technological development, young researchers, postgraduate studies, scholarships, target research programmes, scientific and expert meetings and publications, research equipment and founder's obligations.

The figure shows that the share of funding of technical sciences had been falling until 2001 when "technology" was transferred away from the Ministry of Science and Technology. Natural sciences and mathematics had been gaining until 2001. The absolute amount for natural sciences and mathematics exceeded that for technical sciences for the first time in 2001 and such (comparative) situation has remained the same to the day. The stable relation stems from the policy of stable funding.

Conclusion

Funding of research in Slovenia has more or less followed the changes in the DP and the GDP since 1954. The latter were strongly influenced by the global economic situation. In addition to economic growth and recessions,

was distinctly falling in the first years of Slovenian independence. R&D funding has been growing slower than the GDP since 1996.

The paper presents only the funds of the ministry responsible for science after 1991 and only the funds of the Agency after 2004. To obtain a com-

our estimate, based on partial collected data, R&D funding of other recipients of funds from the national budget nearly matches the funds of the Agency. Consequently, the budget funds for R&D came very close to 1 % of GDP in 2010.

In conclusion, we present the budget funding of the Agency by sectors of performance and by instrument of funding. The Agency gives more than a half of its funds to public research and other institutions followed by higher education with 42 %. Businesses and private non-profit organisations jointly receive merely 4 % of funds.

By instrument of funding, the Agency earmarks more than a half of funds to research programmes and research projects. They are followed by infrastructure with 24 % and training of young researchers with 18 %.

Figure 6: Share of budget funding from the Agency by sectors of performance in 2010

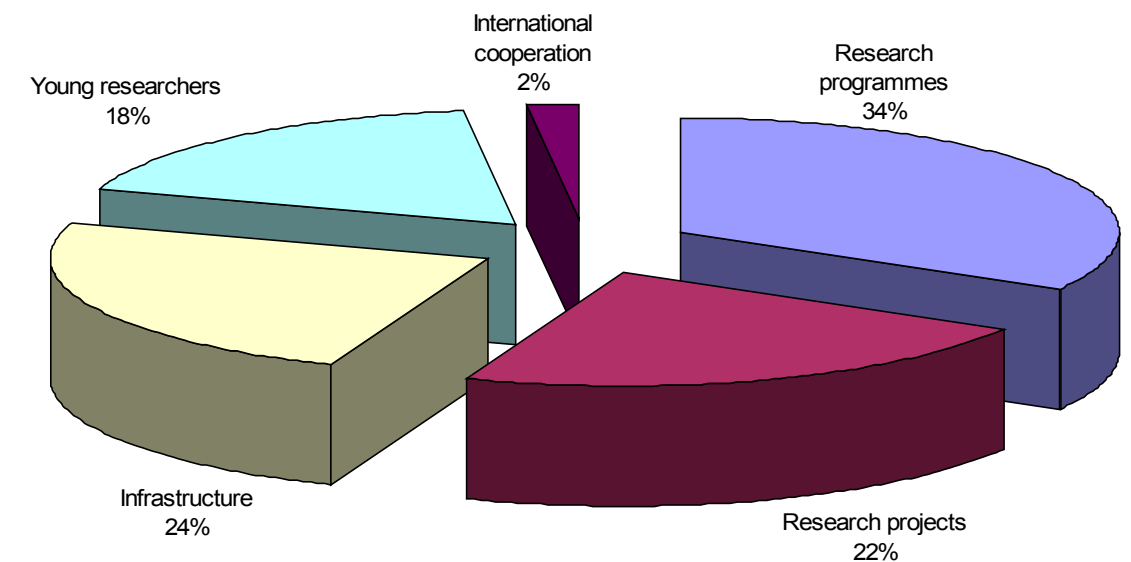
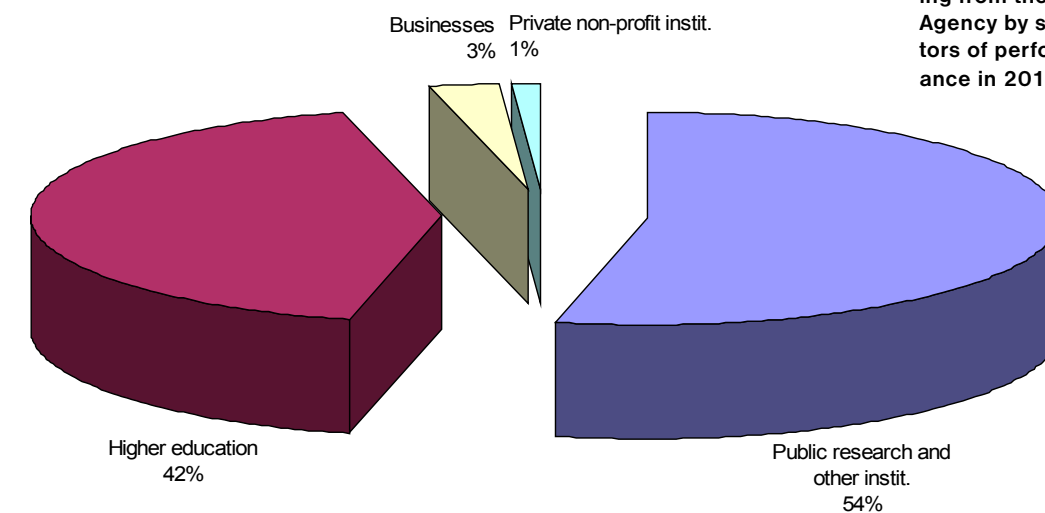


Figure 7: Share of budget funding from the Agency by instrument of funding in 2010

R&D funding in Slovenia was affected by changes in the socioeconomic and political system, at the national level and at the level of the research activity. R&D funding came the closest to 1 % of GDP in 1990, just before the disintegration of Yugoslavia. The share of R&D funding compared to the GDP

preprehensive picture on changes in R&D funding, these data should be supplemented with the entire funds from the government budget spent on R&D. Unfortunately, we have not managed to obtain that information. The Agency's funds amounted to roughly 0.5 % of GDP in 2010. In

Acknowledgment: I would like to thank to Dr Aleš Gabrič for his expert opinion and proposed improvements.

Research, Education and Knowledge Management: Essential Prerequisites for Safe Utilization of Nuclear Energy

Leon Cizelj, Anže Barle

Slovenia is the smallest amongst the 30 countries with operating nuclear power plants. The single nuclear unit at Krško contributes about 40% of the electricity produced in Slovenia. This is consistent with the energy mix of the rest of the European Union, which depends on a nuclear contribution of about 30%. Nuclear energy provides 15% of the global consumption of electric power.

Research based education and knowledge management are fundamental to the successful development and implementation of nuclear power. The responsibility to organize and sustain appropriate research and education was recognized in the early days of commercial nuclear power and is now-

Figure 1 Map of the current research activities with respect to the generation of the NPP

adays clearly set forward in the UN International Atomic Energy Agency (IAEA) Nuclear Safety Convention and in the EURATOM Treaty. The primary responsibility for safe operation rests with the plant operator. Substantial efforts devoted to research and education during the development

Thermal hydraulics safety analyses	Research Tech. support	Research Tech. support	Research Tech. support	Research	Research
Ageing and integrity of the reactor pressure boundary	Research Tech. support	Research Tech. support	Research Tech. support	Research	Research
Probabilistic safety analyses	Research Tech. support	Research Tech. support	Research Tech. support		
Severe Accidents	Research Tech. support	Research Tech. support	Research Tech. support		

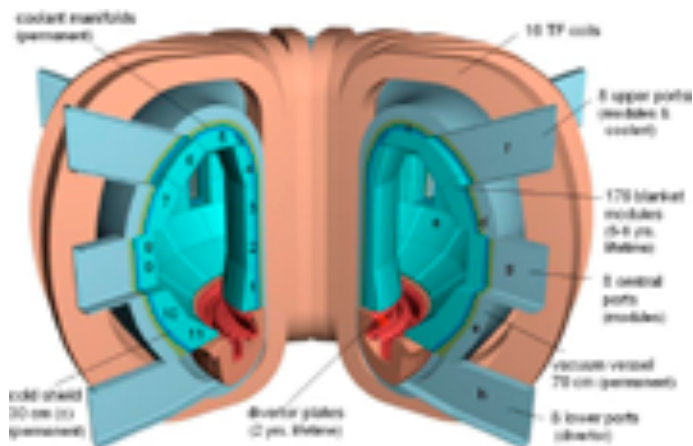
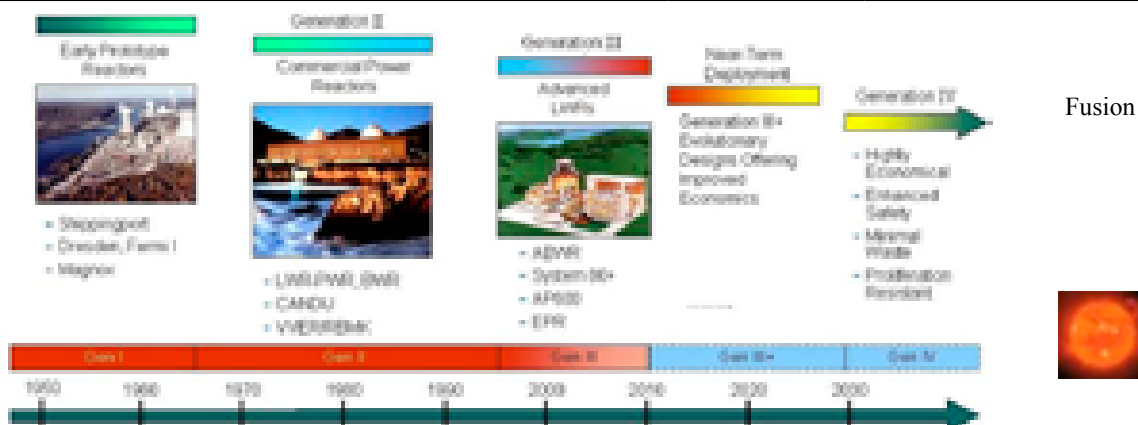
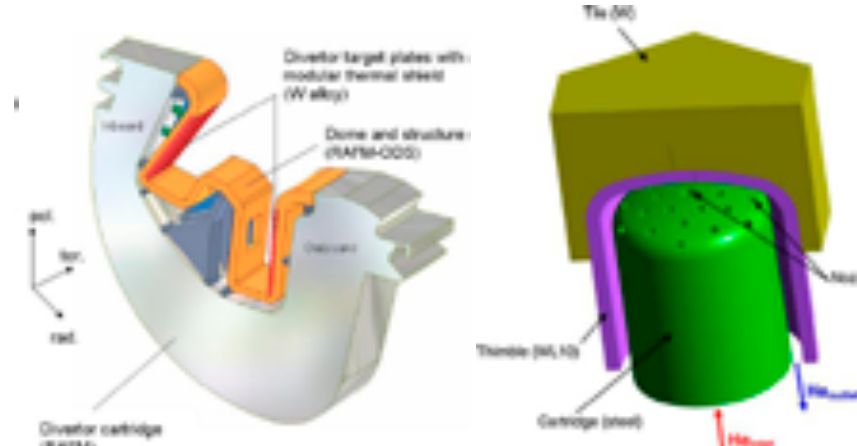


Figure 2 The basic outline of the divertor in DEMO reactor and the cooled thimble and tile

of commercial nuclear power resulted in a fleet of very reliable and safe power plants in comparison to conventional and renewable energy sources. The accident in Fukushima Daiichi confirmed the robustness of the plant design. Control of the plant has been maintained to a large degree despite experiencing an earthquake of 9.0 on the Richter scale which was followed by at least 10 aftershocks exceeding 7.0 on the Richter scale, flooding of 4-5m of water and four hydrogen explosions. This unprecedented natural disaster unfortunately resulted in the release of radioactive substances. It should be noted however, that the total release of substances from the 4 damaged units amounts to less than 20% of releases from the single unit at the Chernobyl (Ukraine) plant during the accident in 1986.



A quarter of a century of safe operation may have contributed to the deceptive impression of faultless safety culture. Indeed, Japanese officials have clearly acknowledged that they did not consider the possibility of something like the Fukushima accident actually happening. As a consequence, they could not be adequately prepared. It seems now that the plant staff battled heroically and successfully to minimize the damage. They were however not able to fully compensate for deficiencies in preparations for emergency conditions of clearly unexpected magnitude. Additionally, nuclear power is currently facing the renewal of human generations. Developed post industrial societies are therefore challenged to sustain and further develop nuclear research, education and knowledge management. Recent regionalization and globalization of power markets have provided new opportunities and challenges, which may be more pronounced in countries with rather limited resources. The current status of nuclear engineering research and education in Slovenia is briefly discussed below. The information is focused on the Reactor Engineering Division of the Jožef Stefan Institute, the sole nuclear engineering research group in Slovenia and the core of Slovene nuclear engineering education.

Research in Reactor Engineering Division (JSI)

The majority of the research activities of the Reactor Engineering division are performed with the aim of contributing to the safety of nuclear installations. The main directions of the research are in-line with the nuclear safety functions and include thermal hydraulics safety

analyses, ageing and integrity of the reactor pressure boundary, probabilistic safety analyses and severe accidents. As depicted in Figure 1, all four major directions currently deal with generations II (currently in operation), III and III+ (currently in construction) of nuclear power plants. Topics related to heat transfer and component integrity also extend towards the conceptual generation IV and fusion reactors. The core of the research work is development and application of numerical simulations. The necessary experimental support is available through wide networks of regional and global cooperation. Results of selected recent projects involving multiphysics, multiscale and international consortia are briefly outlined below. These are followed by selected examples of applied projects performed in the role of Technical Support Organization to the Slovene nuclear regulatory body (www.ursjv.si). A regularly updated overview of the Reactor Engineering Division is available on-line at www2.ijs.si/~r4www.

Thermomechanical analysis of a thimble and tile in the divertor of a DEMO fusion reactor

The divertor of the DEMO fusion reactor will be exposed to thermal fluxes of up to 15MW/m². The upper side of the tile (Figure 2 right) is exposed to the radiation of plasma, while the lower part is cooled with jets of helium. A steady state thermo-mechanical analysis was performed using ANSYS-CFX-11 and ABAQUS 6.9 codes. The RANS approach with SST turbulence model was used to describe the fluid flow. The fluid after leaving the nozzles



Leon Cizelj, Head, Reactor Engineering Division, Associate professor of nuclear engineering at Faculty of Mathematics and Physics, University of Ljubljana



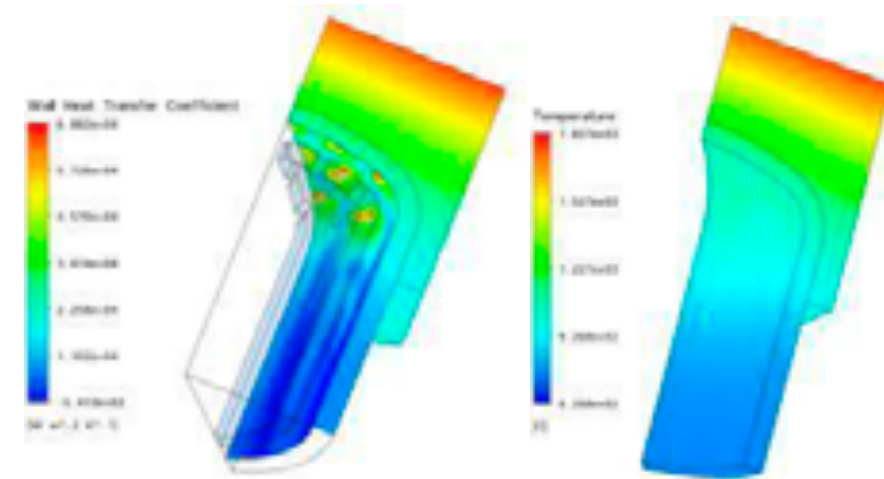
Anže Barle

impinges on the fluid-thimble interface, resulting in a strong local variation of heat fluxes. This local variability is described using the heat transfer (film) coefficients (Figure 3 left). The resulting temperatures and thermal stresses in the tile and thimble are shown in Figure 3 middle and right, respectively.

Two-fluid model with interface sharpening

Two-fluid models are applicable for simulations of all types of two-phase flows ranging from separated flows with large characteristic interfacial length scales to highly dispersed flows with very small characteristic interfacial length scales. The main drawback of the two-fluid model, when used for simulations of stratified flows, is the numerical diffusion of the interface. Stratified flows can be easily and more accurately solved with interface tracking methods; however, these methods are limited to the flows that do not develop into dispersed types of flows. A new approach, has been proposed where the advantage of the two-fluid model is combined with the conservative level set method for interface tracking. The advection step of the volume fraction transport equation is followed by the interface sharpening, which preserves the thickness of the interface during the simulation. The proposed two-fluid model with interface sharpening was found to be more accurate than the existing two-fluid models. The mixed flow with both stratified and dispersed flow was simulated with the coupled model. In the coupled model, the dispersed two-fluid model and two-fluid model with interface sharpening are used locally, depending on the parameter which recognizes the flow regime.

Figure 3 Heat transfer coefficient at the fluid-thimble interface (left). The temperatures (middle) and von Mises stresses (right) in the thimble and tile.



Nuclear engineering education at the Faculty of Mathematics and Physics, University of Ljubljana

Iztok Tiselj



Prof. Dr. Iztok Tiselj, scientific counselor at Reactor Engineering division and Chair of nuclear engineering at Faculty of Mathematics and Physics, University of Ljubljana.

The reactor engineering division maintains strong connections with University of Ljubljana in the field of nuclear engineering education. Five researchers of the department are elected as university professors and participate at the Faculty of Mathematics and Physics master and doctoral degree programs of Nuclear engineering. Programs were initiated in 1986 by Professor Borut Mavko.

Today's alumni of the nuclear engineering is about 40 Masters of engineering and 30 Doctors who hold key positions in the Slovenian nuclear industry, regulatory bodies and research institutions.

The University of Ljubljana is one of the founding members of ENEN - European Nuclear Education Network association, which has a mission to preserve and develop expertise in the nuclear fields through higher education and training. Students of nuclear engineering that take at least one semester of their education at the sister universities within ENEN association, are awarded the title "European Master in nuclear engineering".

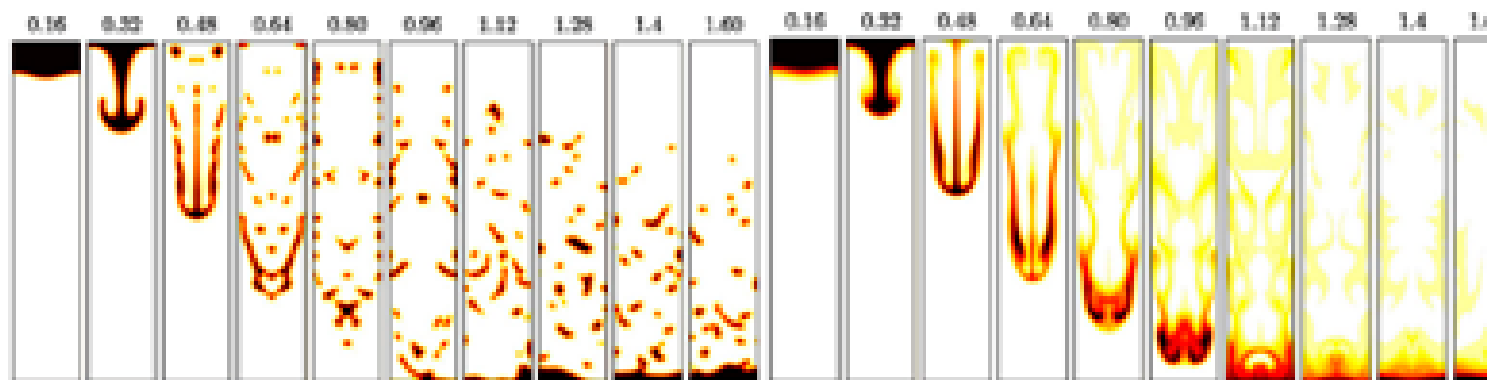


Figure 4 A Rayleigh-Taylor instability simulated with (left) and without surface sharpening (right): volume fraction at different times t (s)

Severe Accidents

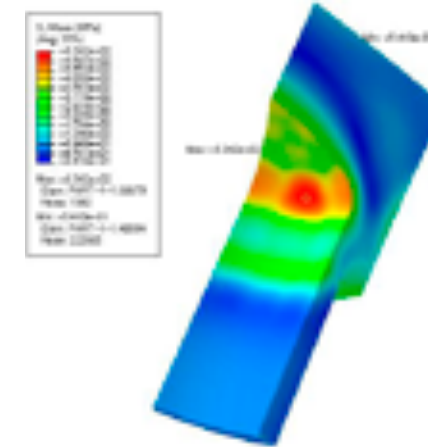
Ivo Kljenak, Matjaž Leskovar

The defense in depth principle follows the "what-if" philosophy and therefore also acknowledges events with low probability. These include severe accidents, which are very low probability events that might involve core melting, plant damage and subsequent dispersal of radioactive materials into the environment. Examples of such events include the recent Fukushima Daiichi accident.

Various national and international research programs have been conducted for decades to improve the knowledge of severe accidents. Improved knowledge could substantially contribute to the management of such accidents and therefore enhance the safety of nuclear power plants. The Reactor Engineering Division of the Jožef Stefan Institute is actively involved in the most important programmes through international and bilateral cooperations. In the EU 7. Framework Program severe accident research network of excellence SARNET, 42 Organisations from 19 European countries and Canada, Korea and the USA are participating.



Prof. Dr. Ivo Kljenak, senior research associate, Reactor Engineering Division, Assistant professor of nuclear engineering at Faculty of Mathematics and Physics, University of Ljubljana.



Examples of international cooperation

The Reactor Engineering Division is currently actively participating in several international projects. It participates in the Framework programmes of the European Commission (EURATOM) including NURISP (Nuclear Reactor Integrated Simulation Project), THINS (Thermal Hydraulics of Innovative Nuclear Systems), NULIFE (Nuclear Plant Life Prediction), SARNET2 (Severe Accident Research Network of Excellence), LACOMECCO (Large Scale Experiments on Core Degradation, Melt Retention and Containment Behaviour), MULTIMETAL (Structural performance of multi-metal components) and NEWLANCER (New MS Linking for an Advanced Cohesion in Euratom Research).

Bilateral cooperation with the French Commissariat l'énergie atomique (CEA) include projects entitled "Modelling of Condensation Induced Water Hammer and Boiling Crisis in Subcooled Boiling", "Flow Influence of Melt Solidification on Steam Explosion", "Analysis of Ex-Vessel Molten Fuel-Coolant Interaction", and "Simulation of Hydrogen Combustion Experiments in the ENACCEF Experimental Facility". Other important co operations include the Phebus Fission Project lead by the European Joint Research Centre and the French Institut de radioprotection et de s reté nucléaire (IRSN), the European Sustainable Nuclear Energy Technology Platform and the CAMP (Code Application and Maintenance Program) led by the US Nuclear regulatory Commission.

There is also extensive cooperation with OECD/NEA. Examples of active projects include SETH-2 (containment thermal-hydraulics) and SERENA (ex-vessel steam explosions).



Dr. Matjaž Leskovar, senior research associate, Reactor Engineering Division.

In the international Phebus programme being led by IRSN (France), comprising of six integral experiments on severe reactor accidents, dealing with the entire severe accident sequence, the Reactor Engineering Division is involved in the Fuel Bundle and the Containment and Aerosol Chemistry Interpretation Circles. The Reactor Engineering Division is participating also in a number of bilateral projects with CEA (France), modelling hydrogen combustion and steam explosions, with IRSN (France), developing the fuel-coolant interaction code MC3D, and with KAERI (Korea), simulating steam explosion experiments.

Reactor Engineering Division (JSI) as a Technical Support Organization

The Reactor Engineering Division also acts as a Technical Support Organization (TSO) to the regulatory body. Additionally, technical support to the utility is traditionally performed. The following two examples illustrate development work, which has been pursued primarily to improve the tools and models used in the technical support activities.

Animation model for RELAP5 simulation of the Krško nuclear power plant

Today most software applications, also in the nuclear field, come with a graphical user interface. The first graphical user interface for the RELAP5 thermal-hydraulic computer code was called the Nuclear Plant Analyzer (NPA). Later, Symbolic Nuclear Analysis Package (SNAP) was developed. In the present study SNAP animation model of Krško nuclear power plant (NPP) was developed to animate RELAP5 calculations. In the example the reference calculations for Krško full scope simulator validation were performed with the latest RELAP5/MOD3.3 Patch 03 code and compared to previous RELAP5 versions to provide verified source data, needed to demonstrate the animation model. In total six scenarios were analyzed: two scenarios of the small-break loss-of-coolant accident, two scenarios of the loss of main feedwater, a scenario of anticipated transient without scram, and a scenario involving the rupture of a steam generator tube. The use of SNAP for the animation of Krško nuclear power plant analyses displayed several benefits, especially the better understanding of calculated physical phenomena and processes. An animation tool was created, which facilitates the analysis of very complex accident scenarios. The graphical interface helps maintain the overview whilst focusing on the main influences. In addition, the use of such support tools with system codes may contribute significantly to higher quality safety analyses.

Safety culture

By the definition of the International Nuclear Safety Advisory Group (IAEA Safety Series No 75, 1991) Safety Culture denotes the assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance.

Safety Culture has two general components. The first is the necessary framework within an organization and is the responsibility of management hierarchy. This includes all levels of society starting from a legislative level and ending with the individual. The second is the attitude of staff at all levels in response to and benefiting from the framework.

In all types of activities, for organizations and for individuals at all levels, attention to safety involves many elements including:

- Individual awareness of the importance of safety.
 - Knowledge and competence, conferred by training and instruction of personnel and by through self-education.
 - Commitment, requiring demonstration at senior management level of the highest priority of safety and adoption by individuals of the common goal of safety.
 - Motivation, through leadership, the setting of objectives and systems of rewards and sanctions, and through individuals' self-generated attitudes.
 - Supervision, including audit and review practices, with readiness to respond to individuals' questioning attitudes.
 - Responsibility, through formal assignment and description of duties and their understanding by individuals.
- The most common indicator of inappropriate safety culture is complacency.

Future activities include simulations with TRACE, which is an advanced thermal-hydraulic computer code for safety analyses. The animation model will also be helpful to TRACE.

This activity has been performed within the Code Application and Maintenance Program led by the US Nuclear Regulatory Commission.

Modular 3-D Finite Element Model for Fatigue Analyses of a PWR Reactor Coolant System

A set of computational tools have been developed, which assist the user in the deployment of modular spatial finite elements of the main components of the reactor coolant system, e.g. pipes, pressure vessels and pumps. The modularity ensures that the components can be analyzed individually or in a system. In addition, individual com-

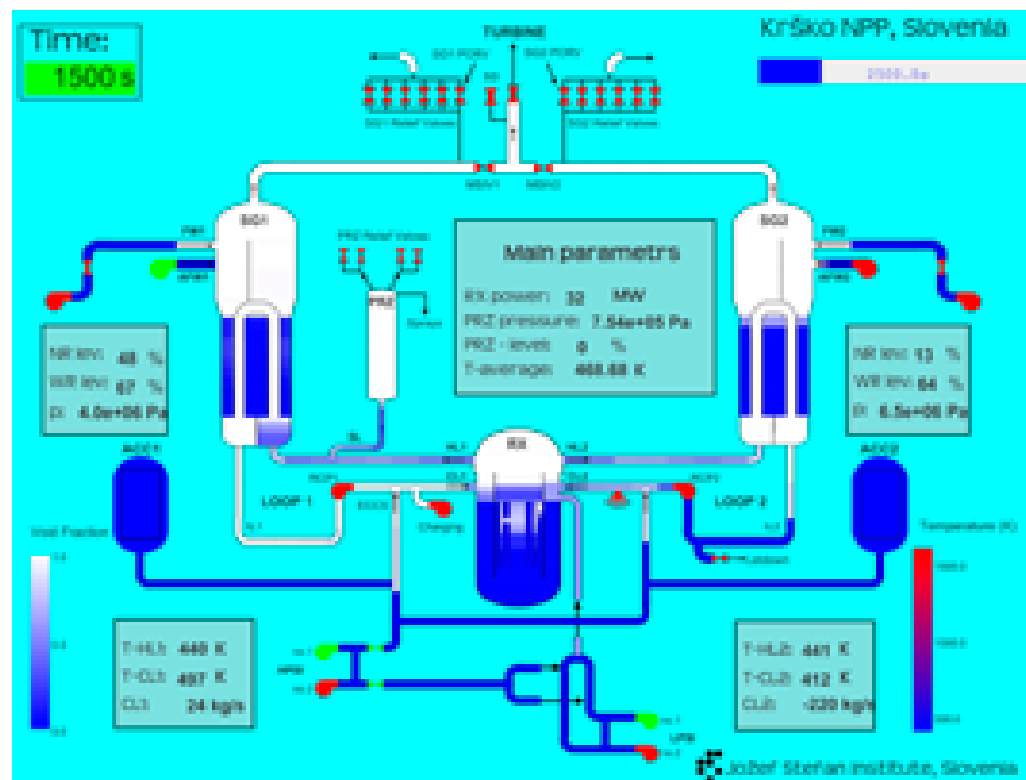


Figure 5 SNAP animation mask showing void conditions at 1500s – 15.24 cm break size small break loss of coolant accident (SBLOCA)

Nuclear safety

The primary goal of nuclear safety is to protect staff, public and environment from the effects of ionizing radiation. This goal is achieved through maintaining three primary safety functions, control of the fission reaction, cooling of the reactor and containment of the radioactive materials.

These safety functions are maintained in accordance with the defense in depth principle. This includes redundant and diverse safety systems and multiple safety barriers preventing the release of the radioactive materials in the environment.

The damage of the reactors and release of radioactive materials at Fukushima Daiichi was caused by a temporary break of the second safety function: cooling of the reactor. This resulted in the condition known as a severe accident. In all four affected reactors, the improvised cooling of the reactor and spent fuel pits was successfully achieved within hours of the loss of the cooling function.

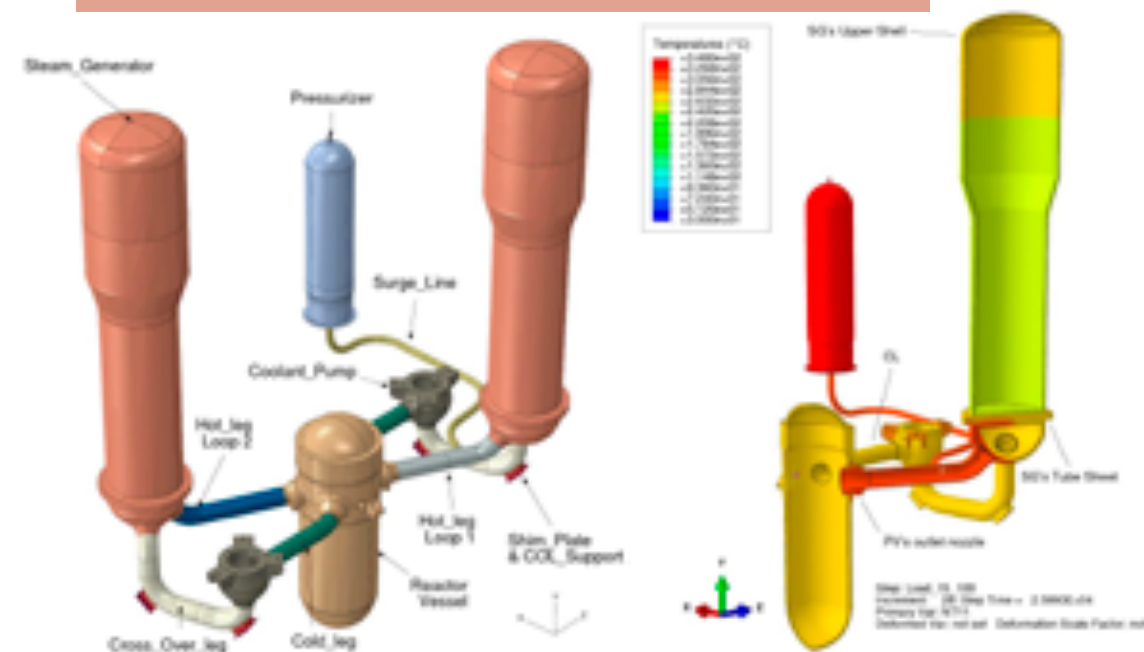


Figure 6 Model of a PWR Reactor Coolant System (left) and temperatures during step load (right)

ponents can be meshed with different mesh densities, as required by the specifics of the particular transient studied. All components are meshed with hexahedral elements with quadratic interpolation.

The components have been located spatially to perform a complete assembly of a 3D modular solid model for a generic 2 loop second generation PWR. The basic objective of this tool is to be used in future fatigue analysis assessments using the finite element method.

Simulations already performed with the entire 2 loop PWR reactor coolant system (RCS) include heat transfer and stress analysis for a complete loading and unloading cycle of the RCS. The implemented transients are as follows: system loading from room temperature until full reactor power, and the unloading of the system down to cold shutdown conditions. The loads applied to the system are gravity (deadweight), temperatures and pressures.

Summary

Research, education and knowledge management are essential for the safe utilization of nuclear power today and in the future. Major future challenges include the education of a new generation of nuclear professionals, further enhancement of safety culture and open public debate about the benefits and risks of nuclear energy.

The Reactor Engineering Division of the Jožef Stefan Institute (Figure 7), in partnership with the Faculty of Mathematics and Physics of the University of Ljubljana and a number of academic and industrial partners abroad, is prepared for these challenges. However sustainable investments into research, education and knowledge management by the European Commission, national governments and private sector remain indispensable.



The team of Reactor Engineering Division (June 2011)

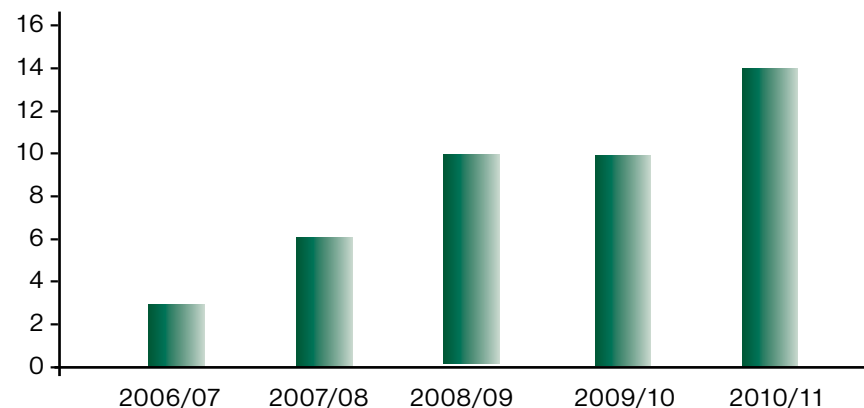
Biomolecular sciences at the University of Nova Gorica

Elsa Fabbretti, Martina Bergant Marušič and Lorena Butinar

Over the last five years, the University of Nova Gorica has implemented a programme of strong growth in scientific research for the purpose of enhancing international cooperation and personnel mobility at a student and faculty level, an issue that is in accordance with EU guidelines for modern higher education activities. In particular, robust investments in facilities and infrastructure, in addition to active recruitment, have encouraged the undertaking of several major projects in biomolecular disciplines. These endeavours have rapidly translated into the initiation of a new higher education **international PhD programme in molecular genetics and biotechnology**, a result of the joint efforts of the University of Nova Gorica and the International Centre for Genetic Engineering and Biotechnology (ICGEB, Trieste, Italy). This PhD programme is composed of a theoretical part (mainly taking the form of seminars, workshops and collective literature readings) and an experimental research component that covers the majority of the credits of the academic year (40 ECTS over a total of 60 credits). The programme and the academic activities carried out are performed under the supervision of an international panel of scientific advisors (the Scientific Council). Most of teaching and research

activities carried out are conducted in English in order to assist students in becoming members of an international community with competitive scientific perspectives.

The study of biomolecular science at our university is, as a result, growing every year in terms of the recruitment and enrolment of new senior and young researchers. Over the past five years, a total of 21 PhD students have enrolled; this trend has been growing recently, which confirms the strong interest held in the biomolecular, biomedicine and biotechnology fields (Fig. 5). In 2010, two students obtained their PhD degree, concluding the first cycle of our programme, and discussed their thesis before an examiners committee composed of foreign scientists, while a further four students are currently in the process of submitting their theses.



Number of students enrolled into the Molecular Genetics and Biotechnology program at University of Nova Gorica in the last 5 years.



Prof. Dr Danilo Zavrtanik

Prof. Dr Danilo Zavrtanik, Rector of the University of Nova Gorica:

“One of the strategic research fields studied at the University of Nova Gorica (UNG) is the life sciences. Founded in 1995, the University has, from the outset, been keen on developing a scientific and educational environment of the highest standards. It has also observed and conducted innovative research in the field of life sciences, working closely with internationally renowned institutions. The university’s latest research in molecular biology, genetic engineering, neurophysiology, and related fields, seems to be promising in advancing the current state of knowledge, and in applying the latest techniques in the evolving field of biomedicine. Therefore, a plan to launch a new, innovative Centre for Aging Research is seen as the next natural step. We are delighted that we have been able to develop a strong molecular biology group, and offer research opportunities to a number of promising young scientists at our faculty and laboratory over the past few years. We hope to have a chance to add a few more in the near future.”

Table 1 - Funders of Molecular Biology activities at the University of Nova Gorica:

National students fellowships	Foreign students fellowships	Research
Slovenian Research Agency (ARRS)	Slovenian Human Resources Development and Scholarship Fund (Ad Futura)	Slovenian Research Agency (ARRS)
Public Agency for Technology of the Republic of Slovenia (TIA)	International Centre for Genetic Engineering and Biotechnology (ICGEB)	Collaborative Research Programme (CRP) – ICGEB
Regional development agency of Northern Primorska Ltd Nova Gorica (RRA)	Central European Initiative (CEI)	International School for Advanced Studies (SISSA) and Telethon Foundation Italy
International School for Advanced Studies (SISSA)	Centre of the Republic of Slovenia for Mobility and European Educational and Training Programmes (CMEPIUS)	
	Wuhan University of Geoscience (China)	

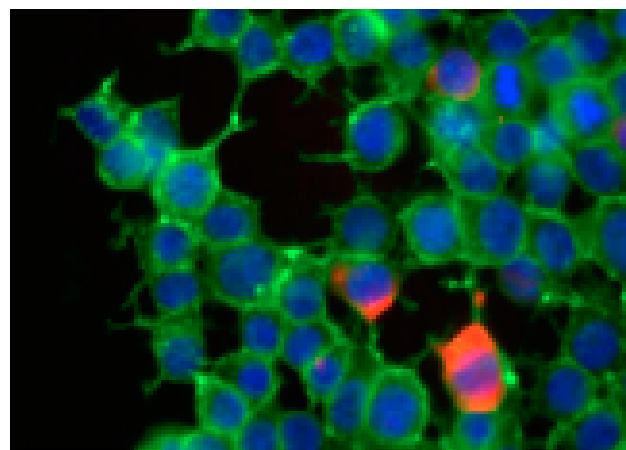
TABLE 2 - Biomolecular Projects at the University of Nova Gorica

Projects	Departments
Mechanisms of neurotoxicity to chemicals and metals, oxidative stress mechanisms, ageing	Molecular Biology and Environmental science
Study of pain receptor modulators, proteomics, vesicle release mechanisms, pain receptor characterisation (Young researcher position 2011)	Molecular Biology
Physical, chemical and cellular effects of bio-conjugated synthetic nanomaterials	Molecular Biology and Material research laboratory
Genes behind aroma compounds in wine: study of putative aroma-associated genes in wine related yeasts; research on molecular biology, genetics, genomics, transcriptomics, metabolomics of wine related yeasts	Molecular Biology and Wine Research Centre
Grapevine viral diseases. the pathogen infection on the grapevine transcriptome and metabolome	Wine Research Centre and Molecular Biology
Development of methodology for the evaluation of antimicrobial activity of prepared TiO ₂ photocatalytic films	Environmental science and Molecular Biology

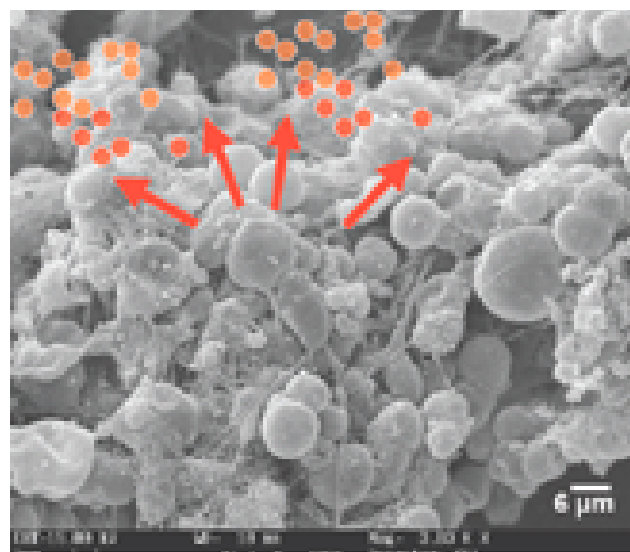
Future projects and new ideas: Centre for Aging Research

Building on the existing expertise in molecular biology, protein characterisation, neurobiology, toxicology and nanostructured materials, we have launched a plan for a new International Centre for Aging Research (ICAR). Ageing has a significant social and economic impact on the society, since a longer life expectancy is not associated with an acceptable standard of health and quality of life. This is an important issue, as can be seen in the EU's strong interest in promoting the development of road maps to guide European research on ageing and health until 2025 ("Futurage"), and in the FP7 Health priorities for 2012. The main goal for us is to find novel strategies to improve the health conditions of older people, minimising their diseases, disabilities, chronic pain and discomfort. Recent studies suggest that very low doses of biologically active chemicals – including toxic contaminants in the environment – alter gene expression and molecular pathways, thereby affecting the proper functioning of tissue and organs, and providing a major risk factor in the normal healthy life of the elderly.

Our interest in understanding molecular and cellular signs of transition to chronic disease has led us to explore, for example, the **fragility of the repair mechanisms** in neuronal models as a result of a chronic exposure to noxious chemicals. We have recently explored the consequences of different doses of chemical compounds on mitochondrial activity, the enzyme functions involved in oxidative stress

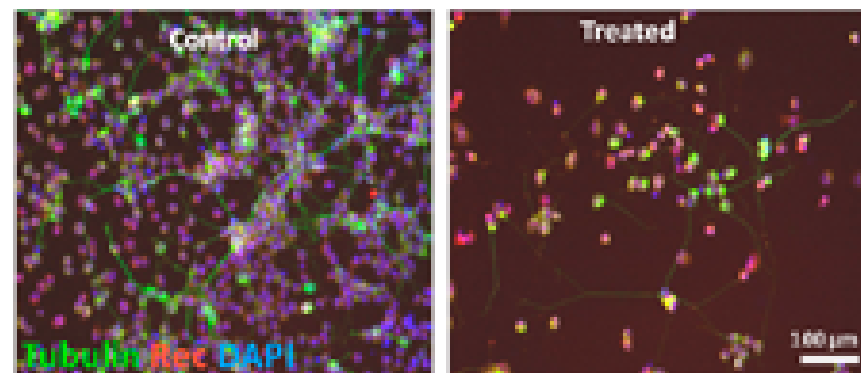


Microscopy as an elective methods for cel reactivity and discovery of biomearke.



Scanning electron microscopy of mouse trigeminal ganglia represents a complex tissue where chronic pain is expressed via the release of neuronal and inflammatory soluble mediators. Scale bar = 6 μm. Photo E. Fabbretti and M. Zweyer.

reactions, and the molecular signalling cascades that mediate these effects. In the relevant literature, one can find descriptions of prototypic examples of the environmental hazards posed by chemicals such as MPTP and rotenone as etiology of Parkinson's disease by destroying the dopaminergic neurons in the substantia nigra of the brain. These findings supported the use of *in vitro* models of this disease in order to unveil its molecular mechanisms.



Neuronal models in culture are suitable for toxicity tests. Note large reduction of neuronal processes in treated (right) versus control (left) cells. Scale bar = 100 μm. Photo E. Fabbretti.

Within the ICAR, we are also willing to explore **biocompatibility**, toxicity and the potential use of nanomaterials as **drug-delivery tools**, as well as new technologies (artificial tissues and nutraceuticals from plants) helpful for **regeneration and repair**. This is a cutting-edge project which started recently with the design and development of biotechnologically-based experimental models to test the properties and bio-compatibility of innovative materials and new chemicals, mimicking enzymatic reactions or interfering with intracellular machineries.

Interdisciplinary research and international collaborations

Interdisciplinary research not only catalyses new ideas but also helps to create scientific links and new economic and social strategies. It is important to emphasise that, within the scope of this research philosophy, molecular biology plays a central role in the diverse range of disciplines involved in the wider study of life sciences. In small universities or research centres, a division into several self-competitive mini-domain units can render the perception of an effective atmosphere difficult, and the circulation of ideas to become "fragmented". Furthermore, excellence in research cannot be achieved without a critical evaluation and an ongoing comparison with the parameters applied to evaluate science at an international level. In order to comply with these issues, the University of Nova Gorica has established several partnerships with research institutes in Slovenia and abroad. Among the projects already mentioned, we should highlight major partnerships with the tumour virology laboratory at the ICGEB, Lund Uni-

versity in Sweden, and the trigeminal migraine pain team project led by the Neurobiology Department of the International School for Advanced Studies (SISSA Trieste, Italy) which also includes the Department of Pharmaceutical Sciences at the University of Milan and Leiden Migraine medical center (Holland).

Over the last few years, in collaboration with the environmental research laboratory at our university, we started to explore the effects of exposure to a new generation pesticides, their commercial formulation, metabolites and

Cellular crosstalk and complex tissues responses

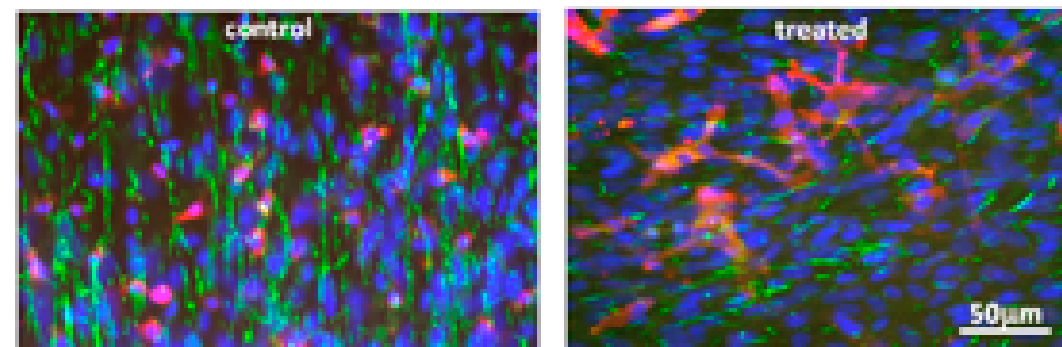
Elsa Fabbretti

Recently, I worked on the signal transduction pathways and molecular mechanisms of pain, studying the biology of the pain-sensing neurons in a basal or hyper-active state. My current research interests are in the field of aberrant cell-to-cell crosstalk influencing the macromolecular machineries important in controlling ageing or complex adaptation processes. In particular, I now wish to understand how powerful soluble mediators released at a precise moment in time and in a defined space in complex tissues lead to new tissue states where different cell types contribute to maladaptive change and disease. During 2010, at the University of Nova Gorica, I focused on various aspects associated with the impact of the environment on human health. The lifelong exposure of humans to complex mixtures of environmental contaminants can affect the body's physiology and induce adverse cumulative effects, leading to multiple diseases and faster ageing.

A major field where these concepts can also be applied is neurobiology research, and in particular pain, where crosstalk between neuronal and non-neuronal cells is an important aspect to be explored, especially in the context of neurogenic inflammation phenomena (Figure 6). The main question is unresolved: how to disclose the key molecular switches responsible for irreversible transitions from a healthy basal, controlled state to a diseased one, like occur in chronic pain disorders that have a social and economical biomedical priority. Among other several projects carried out at the University of Nova Gorica, we are now characterising the molecular determinants that distinguish a human pain receptor sequence from that of a rodent, in order to point key target based on human sequence. In the recent past, I identified specific key amino acid residues for the human pain receptor func-

derivatives on neuronal cell models in culture using state-of-the-art toxicological methodologies and new methods to assess the **oxidative stress caused by environmental stressors**. Our data on the oxidative stress mechanisms in neurons were presented at the European Meeting on Environmental Chemistry (EMEC11) and during several seminars at various foreign universities. This work also promoted an exchange of students and researchers between the University of Nova Gorica and the Ruder Bošković

Institute in Zagreb (Croatia), with whom we have established an international agreement. Furthermore, in recent years, we have also consolidated our international cooperation with Beijing University in China, due to their growing interest in biomolecular and toxicology fields. Finally, the good feedback received from Slovenia and abroad is proof of the significant biomedical and social importance of this project. Importantly, linking the interests of the ICAR regarding biocompatible innova-



Organotypic culture of mouse trigeminal ganglia in control (left) and after 10-day exposure (right) to pollutants. Scale bar = 50 μm. Photo E. Fabbretti.



Doc. Dr Elsa Fabbretti

tion, which should contribute to disclosing the receptor kinetics and serve as the target for novel pharmacological drugs specific to human receptors.

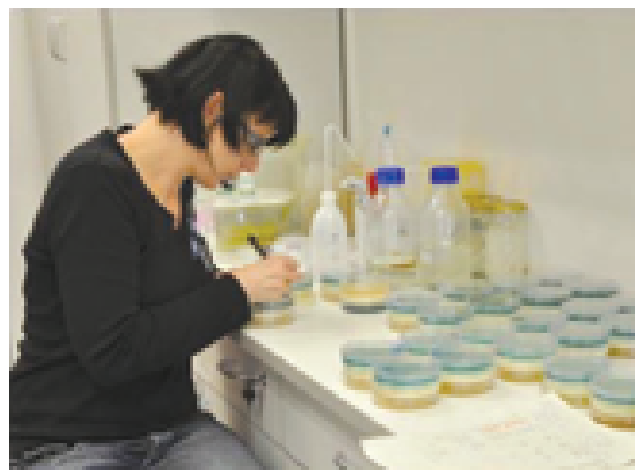
Since the importance of soluble ATP as a pain mediator, I have been interested for several years in purinergic signalling, which offers an opportunity to organise an international symposium on the physiology and pathophysiology of purinergic signalling within the congress of the Federation of European Physiological Societies (FEPS 2009) in Ljubljana, where top scientists in the field were invited.

tive materials useful for biomedical purposes, and the interests of the material research laboratory at the University of Nova Gorica, we recently commenced an interdisciplinary project to explore the basic physical-chemical properties of **bio-conjugated nanoparticles** useful for biomedical applications. This project, highly advanced in terms of its objectives, conjoins the physical and chemical characterisations of nanomaterials in their native and bioconjugated form, as well as new properties and the application of bio-conjugated materials when applied to cell biology or biomedical approaches.

In partnership with the laboratory for environmental research, and supported by a European grant for applied research, we are also studying the **anti-bacterial properties of TiO₂-based photocatalytic surfaces**. Anti-bacterial evaluations of TiO₂ films have been successfully performed in recent years, with continuous efforts to develop more sensitive and accurate methods. The determination of nanotoxicity in mammalian systems, as well as studies of the tracking of

adsorbed nanoparticles in mammalian tissue, their intracellular distribution and their biological effects by using different methods, including X-ray absorption spectroscopy techniques, is also one of our strongest interests.

Another interdisciplinary project in which several Molecular Genetics and Biotechnology Programme PhD students are involved is that led by our University Wine Research Centre, in close cooperation with the National Institute of Biology (NIB). The students are involved in projects studying grape viral diseases and plant physiology, with



a particular emphasis on transcriptomics and metabolomics in the grapevine pathogen infections (Fig. 13). Furthermore, the centre recently started work on a project which aims to study in detail the expression of yeast genes responsible for specific wine aromas, with the ultimate goal being to explore new potential aromatic compounds and to develop/select new yeast strains with different aromatic profiles. The project implies the use of various approaches, such as molecular biology, genetics, genomics, transcriptomics and metabolomics in order to study yeasts

Research on Human Papillomaviruses

Martina Bergant Marušič

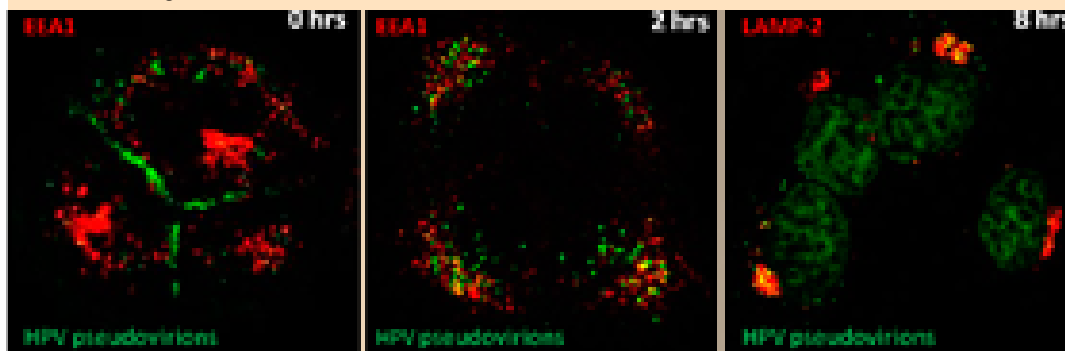
Human papillomaviruses (HPVs) are a large family of small double-stranded DNA viruses, which cause the most common sexually transmitted infection in the world



and are responsible for nearly all cases of cervical cancer. Approximately 4% of all cancers worldwide are associated with HPV. Recently, two HPV prophylactic vaccines against the most significant oncogenic HPV types: 16 and 18, became available. However, these vaccines protect against only two of the 15 oncogenic genital HPV types and their long-term outcome is still unknown. The challenge remains to develop cheap, thermostable vaccines that can provide long-term (decades) protection to most, if not all, oncogenic HPV types. The most promising of the non-VLP second generation HPV vaccines include L1 capsomeres and L2 protein and peptides. Recent data on the mechanisms and dynamics of viral entry provide a rationale for the protection offered by these new approaches.

In close collaboration with the Tumour Virology group at the ICGEB, where I am currently undertaking my post-doctoral research work, we are attempting to resolve some of the poorly understood non-structural properties of the HPV minor capsid protein L2. It is thought that L2 participates in the encapsidation of the viral genome and plays a number of essential roles in HPV infection. In order to study viral entry and intracellular trafficking, we made use of a system for the large-scale production of HPV virus-like particles (VLPs), where a reporter gene is encapsidated into HPV capsid proteins. We have already identified a novel interacting partner, the cellular adaptor protein sorting Nexin 17 (SNX17), which appears to be crucial for HPV16 infection. Our data suggest that SNX17 enables the retention of HPV viral particles in the late endosomes, supporting an efficient egress of the L2-DNA complexes and transport of viral DNA to the nucleus. Previously, we have also identified a novel posttranslation modification of the L2 protein by sumoylation, which regulates viral DNA encapsidation and capsid formation in the late phases of the HPV life cycle. Taken together, we are trying to identify some missing stones regarding the role of L2 in the virus infectious processes as well as the details of the molecular mechanisms through which the viral

genome is trafficked from the cell membrane to the nucleus. We hope that our research may ultimately aid the design of novel therapeutic molecules capable of blocking HPV transmission in existing HPV infections, which could not benefit from a prophylactic vaccination. (Fig. 12)



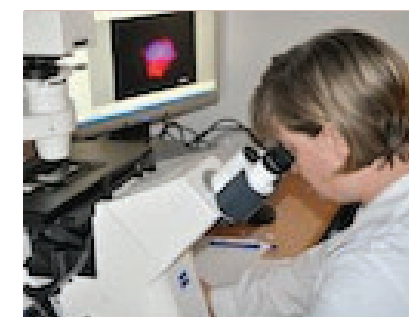
Travelling of the HPV-16 pseudovirions (PsVs - in green) from cellular membrane (0 hrs), through early endosomes (2 hrs; EEA1 - in red) and toward lysosomes (8 hrs; LAMP2 - in red). Photo M. Bergant

related to Slovenian wine. This work has the potential to be a pioneer in a new era of wine making, where complex aromatic profiles could be reproduced and even pre-designed. The project will be conducted in collaboration with NIB and two international laboratories: Jure Piškur's group from Lund University (Sweden), a leading laboratory in yeast biodiversity, evolution and molecular genetics, and Urška Vrhovšek at the Edmund Mach Foundation (FEM) in San Michele (Italy), which is a leading laboratory for the analysis of aromatic compounds in food. Our project will work closely with the EU project entitled *Cornucopia* (coordinated by Prof. Piškur) which has only just recently commenced; this project recently obtained a substantial grant to explore yeast biodiversity in order to identify new aromatic molecules for the food industry.

Conclusions

Working in research is an exciting experience for scientists and students alike. However, this is only the case if one stays up-to-speed with the rest of the global scientific community so that one may actively participate in the generation of new ideas and projects whose boundaries can stretch far and wide.

In recent years, the field of molecular biology has made impressive progress in answering fundamental questions that range from basic science to medicine and bioengineering. Furthermore, biotechnology's importance also stems from applications of major molecular biology discoveries to the large productive market sector. This approach has translated "researcher data" into material useful for a substantial social and economical development. Therefore, our academic mission is to provide the University of Nova Gorica's students with a stimulating environment, a critical milieu discussing research limits, and the perspectives necessary to encourage good science and good scientists. Although competitive science is inevitably a matter of resources, timing, and facilities (and, of course, publication rate), we motivate our students with innovative objectives that may have an impact in the scientific community. To conclude, despite the recent history of our academic work, we are convinced that the methods, ethics and passion for science that we transfer daily to our students, will produce scientific capital of long-lasting value.



Yeast biodiversity for wine production

Lorena Butinar

Yeasts are among the major food production microorganisms and have been used for millennia for the production of wine, beer and leaven bread. During the last decades, only a few yeast species have been intensively studied in the laboratory, and only a few have been used in various controlled biotech processes. A majority of yeasts, the "non-conventional yeasts", have thus far remained largely unexplored, both in fundamental studies and for possible commercialisation.

In the food industry, the increasing trend of using pure starter cultures has strongly decreased the diversity among the currently employed yeast species and even the strains within a species. We will alter this trend by introducing new species and selected strains, as well as mixed cultures. We will focus on two larger yeast groups, the *Saccharomyces/Kluyveromyces* and *Brettanomyces/Dekkera* clades, which are known to be associated with the wine-making process, and we will perform the following experiments: (i) a bioinformatic analysis of the presence of genes which are already known to contribute to some aroma compounds; (ii) the development of new tools to increase or decrease the expression of putative aroma genes in non-conventional yeasts; (iii) finding genes which are responsible for a certain aromatic profile and the generation of mutant

strains; (iv) fermentations using different yeast strains in a defined medium, and a transcriptome and chemical analysis thereafter; (v) must fermentations employing single yeast inoculations and co-inoculations, and a subsequent analysis of the micro-flora development and aroma compounds; and (vi) as a future objective in the project, we will introduce new strains with exciting aromatic profiles to local wine producers.

Yeast biodiversity constitutes a huge, untapped reservoir for potential innovation in the food industry, for example in the form of new



Dr Lorena Butinar

isolates for the production of new aroma compounds.

Wine Research Laboratory:
Prof. Jure Piškur, Lorena Butinar,
Kajetan Trošt, Melita Sternad Lemut



LIFE

Seeing, Working and Thinking GREEN at the Laboratory for Telecommunications

ICT-based Sustainable Development Society

Andrej Gregorc

The times we live in are turbulent. Turbulent in terms of technological development, political changes and lately also in terms of social order. The past three decades have been dominated by financial sector and its (sometimes morally questionable) manipulations and speculations. It appears as if the era of enormous double-digit economic growth and prosperity is gone for a long time, therefore leaving us with the quest for living better and happier by possessing and consuming less. The global economic crisis in the past few years has brought many challenges and drawbacks to the societies, but it has also brought some opportunities. People in the past got used to constant upgradings, enlargements in size and quantity as well as wealth growth. But in the recent years many have been realizing they can do or unfortunately have to do just as good with less, with a smaller size on a smaller scale. Although it is

unclear where the recent and present social unrest and agitation will bring us, one thing is certain – whichever political rule and social order – there will be a growing demand for using natural and social resources wisely and sustainably. The undeveloped or underdeveloped part of the world will still base its success on GDP growth, but also in these societies ICT can be used as a vital and powerful tool to skip some of the phases in development of the society, especially those environmentally extremely unfriendly. The future development paradigms will need to be based on eco-friendly development, better social equality and above all the ability to provide jobs for the youth. This situation represents the chance ICT and the technological world shouldn't miss, giving people the solutions to retain their level of com-

fort by using more energy-efficient devices and technologies, which at the same time leave a much smaller pollution footprint. The rapidly changing and prospective ICT sector can also play a vital role in incorporating nations' younger generations into job markets and global economy. Prof. Dr. Janez Bešter explains it is essential for every society to establish an "ecosystem of talents", which identifies the prosperous and talented young individuals, offers them all the support during the initial education process and later supports them in their first entrepreneur steps. The ecosystem of talents must not be established in the old-fashioned way of hierarchy, but rather as a society of learning networks, connecting horizontally and laterally rather than vertically. Laboratory for Telecommunications is involved in many initiatives for stimulating and supporting young prosperous individuals, providing them access to ICT knowledge and latest technologies. LIFE also established The ICT Academy (www.ict-academy.eu), where professionals and companies are able to upgrade their knowledge and skills as well as keep in touch with latest technological developments.

The model of creative business solutions has changed greatly over the years. Today most of the visionary ideas are produced by extremely young, often not yet educated, unbiased individuals, who lack sufficient if not any funding to further elaborate their "wild creations". Mankind has passed the threshold between information society and the knowledge society the moment when most of us were able to use and master the technologies of everyday life. All this huge amount of information, knowledge and data is now available to everybody, but we are presently unable to sort it, filter it, critically evaluate it and above all wisely use it to create something new out of it. The threshold between the knowledge society and the wisdom society will be much harder to cross. It will only happen when we are able to rapidly synthesize and use all the knowledge already available and dispersed today. Some estimates (rather optimistically) predict it will happen sometime around 2050, but if ICT

takes on a more vital role in this process as it is the key technology supporting all of it, it can shorten the time and dramatically enhance human potential and creativity in the coming decades. Besides economic crises and dilemmas with respect to future social order there is the ever-present problem of global warming and global climate change. Although some scepticism is always rational, denying the existence of global climate change is irresponsible and scientifically wrong, not to mention moral and ethical aspects. Even if, by some divine coincidence present global warming trend is just a fragment in the natural Earth's cycle, acknowledging the problem and working hard to reduce human contribution to it, only benefits mankind's future. While on the other hand denying the problem and doing nothing in direction of solving it can prove catastrophic, if or better when all of us realize the scale of problems correlated with global climate change. The fight against global warming and global pollution can metaphorically be defined as World War III, a war where there is no enemy on the opposite side, the enemy is mankind to itself. Coinciding with evident failures in social orders and systems the world today has the unique opportunity to correct what mankind has been doing wrong for centuries and to establish new behavioural patterns, from which people and the planet will only benefit mutually.



Andrej Gregorc



Such new behavioural patterns should be based on nature and its cycles and must not again put consumption and high profits in the center of the development model.

With rocketing fuel costs the world has been facing in recent years ICT services and solutions can, in many cases, offer an enormously cheaper and easier alternative. With the implementation of advanced ICT products there are very few instances left where people still need to travel in person or perform duties by themselves »in situ«. Using upgraded e-business services eliminates the need for personal meetings, conferences and panels. Taking advantage of distant data recording, collecting and reading further reduces travelling needs. Implementation of an e-business management allows us to adequately steer, control and supervise our paperless business model. All of the above results in great reduction of fuel and travel costs and thus also greatly reduces environmental impact and carbon footprint. Above all the time normally used for travelling, commuting, transferring, etc, is now available to be used for more creative and business-enhancing activities. What is the purpose of sending an employee nine time zones away to participate in

Prof. Dr Janez Bešter

“Every society must establish an “ecosystem of talents”, which identifies the prosperous and talented young individuals, supports them during education and later in their first entrepreneurial steps. Third great phase in the development of telecommunications »internet of things« will revolutionize our lives and provide answers to dilemmas we are not even yet aware of.”



be done by penalizing such behaviour with higher prices and costs, but the latter does not change the consumption levels and over a longer period of time rarely directly affects individual's consumption habits. It is the awareness of end-consumers that really makes

a difference. Trying to persuade people to be wary about setting heating/cooling temperatures, driving less and in a more efficient way, using more appliances during low-consumption periods, buying latest-technology and lowest-consumption appliances and products, etc, can quickly and easily be comprehended as nuisance. With all the hectic worries of every-day life who would want to bother with all these unnecessary details just in order to save a few bucks and spare Earth a tiny fragment. Prof. Dr Andrej Kos emphasizes it is in this precise paradox where ICT needs to exploit its potential and



Prof. Dr Andrej Kos

“ICT services and products can function as a fuel alternative and should be greatly considered as such in the future business as well as social order models. Slovenia's small 2-million, but well developed and demanding market, serves as an excellent testing ground for any new solution, product or service.”

a business meeting all sleepy and jet-lagged? Using advanced ICT solutions the employee can do it from his office in the comfort of his everyday environment, well rested and focused, with all the support he needs from his co-workers instantly available. Or why would anybody want to travel to a dislocated plant to check gauges when one could do that with just a click. ICT services and products in this sense really function as a fuel alternative, states Prof. Dr Andrej Kos, and should be greatly considered as such in the future business as well as social order models.

Providing energy has been one of the greater challenges of mankind. If the goal of merely providing enough energy can theoretically be met, it is the goal of providing enough of environmentally friendly energy that makes us inventive. There are many approaches and aspects of tackling the energy dilemma. Firstly, there is the imminent need to change people's perception of energy as something granted. When each individual understands and realizes that every appliance, vehicle, cooling or heating system he uses consumes and requires energy the first step is made. Bringing bad energy consumption habits under control can

exercise its abilities. If we were able to connect all of the energy-consuming devices of one individual into a single network, combined with the information of daily habits, requirements and specifics of this person's life together with the information about consumption, energy prices, low-cost periods, we could or better we should end up with a self managing energy system which would maximize individual's needs while simultaneously minimize energy consumption. Such a system would only require a few initial inputs from the user and maybe an adjustment to it once in a while, but 99% of the time it would provide the user an effortless and optimized personal energy management. Such energy-management system can be achieved by greatly connecting ICT, electronics and energetics. With the third great phase in the development of telecommunications »internet of things« is looming out the door and will provide most of the technological input needed to implement the solutions stated above. New appliances and devices must be designed durably, with a possibility of upgrading instead of requiring users to change devices with each new service level change. Initially this will raise the

unit price of electronic equipment, but lower the general costs over a longer period of time as there will be no need for new purchases, while at the same time it will greatly reduce electronic waste.

There are great opportunities in optimization of energy transport and production as well. Providing a greater energy share by means of renewable energy requires a higher transfer capacity. There are great losses in long-distance energy transfers, the reason for them in most cases being in poor energy network planning and management. ICT systems can monitor, manage and predict energy demands and consumption, subsequently greatly reducing the occurrence of last-minute shortages, thus eliminating the need for long-distance transfers. One of Slovenia's priorities and also potential opportunities is the modernization of its energetic system which must base on innovation, smart networks, latest technological developments and detailed investment scheme. In the coming 10 years only the modernization of the distribution network in Slovenia is valued at approximately 1,6 billion EUR. The development of ICT-based smart networks is a niche Slovenia could further exploit. Slovenia could use its resources to establish a platform and testing environment for smart networks and smart measuring systems, which could then be offered on the market elsewhere within EU and further afield.

Prof. Dr Janez Bešter, Head of Laboratory for Telecommunications, is proud Slovenia has been among the pioneers in developing intelligent transport system as it produced its own satellite-based toll collection system already almost ten years ago. The system was brought to a full-scale test phase, however its implementation is still pending. Laboratory for Telecommunications at the Faculty of Electrical Engineering as one of the four partners in the project subsequently launched Intelligent Transport Systems Platform (www.openobu.com) which provides multi-purpose solutions for smart automotive and intelligent transportation applications. The platform can be used for services in e-toll, logistics fleet control, insurance, government and metro agencies, geographic information systems, surveillance and security of transport networks, public transit and in end-user applications.

The platform was launched with the aim of providing vendors, service providers and transport infrastructure operators with a powerful techno-



logical tool to seize new business opportunities and take advantage of innovative, value-added services. The partners in this project can provide customers with every step in creation of tailor-made solutions from initial concept through research and development, testing, implementation and all the way to project management, user training, service maintenance and upgrading. Slovenia's small 2-million, but well developed and demanding market, serves as an excellent testing ground for any new solution. It quickly provides reliable feedback which can then be used to make adjustments, corrections or fine-tuning before implementing these solutions on large-scale markets. Every single technological break-through and solution shouldn't be directly transferred to a new market without acknowledging the local cultural characteristics and specifics, asserts Prof. Dr Andrej Kos. For best

results the process should actually work vice-versa. The needs and demands of a specific local environment should be evaluated first, then the existing solutions from other markets can be modified, joined or combined to meet the very detailed specific requirement of this particular market.

Trying to answer all these challenges with an integrated approach Slovenian Competence Centre OpComm (www.opcomm.eu) was established. The Opcomm Competence Centre's short-term goal is to design and build the prototype of an open communication platform, which will serve as the basis for the development of various new advanced services and applications for the Internet of Things. Its long-term goals are aimed at strengthening competencies for the development of innovative products, business models and solutions for the global market, steering technological trends, increas-

ing competitiveness on international markets, establishing long-term strategic cooperation and partnerships within and beyond the consortium as well as internationally.

The programme of the Competence Centre is focused on user platforms and interfaces and encompasses research, design and prototype development of the application-oriented platform with open interfaces to support smart services and smart networks, distributed intelligence at the edge of broadband network and advanced services and applications for object management. The Future Internet lays stress on the applicability of services, quality of user experience, applicable value of data and content, and - in connection with the Internet of Things - interaction with the "material world", either in the form of communication and cooperation between devices (machine2machine - M2M) or as Smartgrids. This requires efficient interaction between smart user terminals and devices, contextually dependent services and the communication network. The centre's activities can be divided into three large categories:

- The Internet of Things (IoT) principle as a part of the Future Internet concept and the interlacing of the Internet and everyday objects, with numerous applications from the so called M2M (machine to machine) communication to Smart Grids in the energy field. Basically this means ensuring the connectivity of smart devices and their application to the everyday social life of individuals, groups and community.

- Data interfaces in general terms, notably the technologies providing solutions to the abundance of information/data, the need for real time processing and the challenges of information/data applicability in given circumstances, contexts and user groups.

- Virtualisation and cloud computing and the transfer of applications to central environments with servers (data centres) which will be optimised in terms of efficient energy use and the required equipment, maintenance and operation. Data centres will be accessed through smart (intelligent) networks with various smart devices which will soon be found everywhere (mobile telephones, household appliances, cars etc.).

The Competence Centre develops knowledge, technologies and processes which will in medium term provide solutions for following key challenges and problematic issues:

- slow pace of broadband access and Internet development and con-



sequently insufficient utilisation of the advantages offered by the Future Internet due to expensive equipment and uneconomical business models that are currently used in building networks;

- abundance of data, information and content which can not be efficiently used for individual integrated applications (smart cities, smart logistics, smart health, smart energy, smart grids, smart buildings and smart homes);

- increasing number of smart devices - by 2020 the Internet will connect several billion devices around the world and communication between devices will represent about 95% of all data traffic and data flow in modern communication networks.

All technology devices, products and services are actually an additional human sense as they have the ability to perceive impulses undetectable by other senses. Each individual

is now capable of transmitting his feelings and emotions to others over long distances in real time and regardless of the location, which denotes a "telepathic" stage in the development of human society. Each of us now possesses the capability of photographic memory, since technology enables us a 100% recall of data or knowledge which was recorded and stored somewhere. It is the speed of recollection process and the accuracy of the inquiry that makes this ability a total success or a complete failure with frustrating results. There are very few instances where technology can not yet provide us with the technological aspect of the required service. However there are still infinite possibilities and enormous work to be done before we will be able to exploit technology for the mere benefit of the society and not the other way around.

Information Society Conference

Matjaž Gams
Mitja Luštrek

Each autumn for the last 14 years the Jožef Stefan Institute has hosted the Information Society Multiconference. The multiconference usually consists of 10 or so conferences, each with its own topic and program committee, but all related to the information society in a technological and sociological sense.

rybody in the developed world has the access to numerous computing devices, robotics and automation are increasingly present in the industry and are beginning to trickle into everyday

In 2011, the multiconference opened with talks by Zoran Stančič, the representative of the EU Directorate-General for the Information Society and Media, and Norbert Kroó, a distinguished member of the Hungarian Academy of Sciences. Information Society awards were given to Vladimir Batagelj for his life's work in theoretical computer science and the shaping of the Slovenian computer-science community, and Janez Brank for recent achievements in the organization of ACM computer-science competitions. For the first time information 'strawberry and lemon prizes' were awarded for the best and worst information-society public services. The lemon was given to the countrywide real-estate inventory which was flawed in numerous ways, while the strawberry was awarded for the streamlining of the access to healthcare data.

Attending the multiconference, one must acknowledge that 2011 was another year of steady progress for the information society, seemingly



unaffected by the economic crisis that plagues the world. Moore's law still holds, making computers and other electronic devices ever faster, smaller and more ubiquitous. Virtually eve-

Plenary session of the conference at the Jozef Stefan Institute.



Right: Zoran Stančič, the representative of the EU Directorate-General for the Information Society and Media was the honorary speaker of the Information Society conference.



Left: The IS award for life achievements was given to Vladimir Batagelj for achievements in theoretical computer science.

life in the form of robotic vacuum cleaners and lawnmowers. Like the progress in hardware, the amount of information and knowledge generated, transmitted and stored is likewise increasing rapidly. The main goal of the multiconference is to spread the awareness of what information society can do for us all.



Ptuj Castle

Owing to its strategic location, Grajski hrib (Castle Hill) has been inhabited since antiquity. The castle today bears testament to centuries of alterations and extensions. It houses the collections of the Regional Museum. The Ptuj-Ormož Regional Museum is a public institution that covers the area of culture and takes care of the entire Lower Podravje Region's movable cultural heritage. The Museum is divided into various departments: archaeological, ethnological, cultural-historical, pedagogical, historical, restoration, and a library. The departments are responsible for historical documents and evidence, and for taking care of their visitors. Material is available to visitors in the form of fixed layouts: collections on the feudal dwelling culture, weapons, musical instruments, a castle gallery, a collection of traditional carnival masks, an ethnological collection, as well as some temporary exhibitions.



PTUJ - THE OLDEST TOWN IN SLOVENIA



Town on the Water

The Drava River and Ptuj Lake have a great deal to offer lovers of sailing, rowing, motor boats, scooters and panoramic boat rides. They also attract fans of cycling, running and hiking, who can take a stroll around the lake while enjoying the views of the rich habitat which is home to many rare and protected species of bird. The Drava River and Ptuj Lake form part of the important European bird reserves and Natura 2000 areas. In Ranca, the Ptuj Marina, Slovenia's only inland water port, you can also just sit and enjoy a cold drink and experience unforgettable sunsets as your gaze alights upon the castle, the hills of Pohorje, Donačka Gora and Boč. During the summer months, Ranca offers a range of enjoyable sporting and entertainment events.

Ptuj through history

The history of Ptuj actually dates back to prehistoric times, going back more than 4,000 years. Ptuj reached one of its high points in Classical antiquity, when the area that is current day Slovenia was occupied by the Romans. They established a legion-

ary camp for two legions to protect the border. First, there was the Eighth Augustan Legion and then the Thirteenth Twin Legion. At the beginning of the second century, Ptuj was assigned the status of colony by Emperor Trajan, which is the highest rank for a Roman city. It was named COLONIA ULPIA TRAIANA POETOVIO, after the Emperor's family name. Ptuj developed into a blossoming provincial Roman city, with a plethora of city quarters, prosperous crafts and trades, and interesting local religious cults. The city became a

strong centre for Mithraism and, in the latter centuries of the Empire, a centre for Christianity with Saint Victorinus of Poetovio, a bishop of the city. At a certain point, the city also had its Customs. In the Early Middle Ages, after 874, the city and its environs fell into the hands of the Archbishopric of Salzburg and, with a few interruptions, remained under its influence until 1555. The city then became a principality and the surrounding property later became feudal land.

Ptuj was the only Slovenian city without a port to receive its statute, which it was awarded in 1376. A strong awareness of the needs of the city and a desire to legally regulate its life are expressed in the statute's nigh-on 200 articles. The oldest statute of Ptuj served as a template for the statutes of many continental cities in Slovenia, being the second most comprehensive statute in this part of Europe after Vienna's. Only one copy has been preserved to this day and is kept in the Herzog August Library in Wolfenbüttel (Lower Saxony) in Germany. A uniform



and an extremely important army post. Ptuj was awarded its city rights, thereby formally becoming a city in about 1250. The trade route from Hungary to Venice via Ptuj helped the city prosper. When the Turkish invaded, Ptuj became one of the Drava River Valley's main border fortresses and remained so until the end of the wars with the kurucs in 1711. The loss of an important military role, changes to economic and trade flows, administrative reforms and numerous large fires, draining the city further, were the reasons Ptuj regressed to being an average rural town. Empress Maria Theresa (1717 -1780) tried to find a way to help Ptuj. She visited there herself in 1750 and decided to establish a permanent garrison for disabled soldiers, immediately increasing the number of inhabitants. Maria Theresa verified numerous statutes for different guilds, including blacksmiths, coopers, weavers, stonecutters and potters, in order to boost the city's flagging economy. By 1785, in addition to its 1,200 inhabitants, there were also 350 able-bodied and 700 disabled soldiers in the city. In October 1887, Ptuj got its own statute and city municipality voting regulations, thereby becoming an Imperial royal autonomous principality chamber city. In 1918, after World War I and the fall of the Austro-Hungarian monarchy, it became part of the Kingdom of Serbs, Croats and Slovenes and later of Yugoslavia.

and very legible manuscript written in Middle High German, it is made up of 52 parchment sheets bound in a late medieval manner. The bishops of Salzburg used to leave the castle to the Lords of Ptuj, who, despite being only Salzburg ministeriales, gradually gained a lot of power and one of their functions was to serve as supreme provincial judges in Styria. The last remaining member of the family died in 1438. Ptuj later became an ancient parish, a place where fairs were held regularly,





Ptuj today

The economic development of Ptuj and its urban areas in the twentieth century was a result of the city's main role as a trade hub in a predominantly rural area. The biggest economic entity formed in the city was Perutnina Ptuj (Ptuj Poultry), a food industry company. It started out as a poultry buying station, established in 1905. Viticulture and wine distribution were also important economic activities. Today, it is the biggest city in the Lower Drava River Valley, the centre of the region's only city municipality and the centre the administrative unit of Ptuj. One way to follow Ptuj's current involvement in the hub of the Lower Drava River Valley's economic activities and social processes is through the introduction of typical rural ethnologic features to the city scene. The traditional Kurentovanje carnival event has been held since 1960, earning Ptuj the reputation of being something of a carnival city.

Town of Culture

A brief historical overview of the Stone Age, Bronze Age and Iron Age reveals that Ptuj is certainly one of Europe's

Summer Performances and Events

Throughout the year, particularly in the summer, Ptuj hosts numerous performances, festivals, concerts and other events (Ptuj castle games, ART festival, Roman games, a popular folk music festival, the "Days of poetry and wine" Festival, the "Open town" Festival, amongst others). The array of cultural activities on offer is also aimed at speeding up the development of tourism in the town.

greatest cultural treasures. In the past, Ptuj was an important crossroads between the East and the West, and the famous amber route ran through it in prehistoric times. The city experienced two important development peaks in its history: during Roman colonization and the late Middle Ages. The city of Poetovio, with its 40,000 residents, was one of the Roman provinces' largest cities. Between the ninth and sixteenth centuries, the city acquired its characteristic cityscape, which is evident in its triangular appearance, closed on both sides with the Dominican and Minorite monasteries and capped with the mighty castle of Ptuj. Besides its rich architectural legacy, Ptuj also boasts great diversity in its cultural heritage, mainly sustained by a number of traditional events held here. Among the most important of these is certainly Kurentovanje (the international carnival festival), the largest ethnographic festival in Europe.

Town of Health and Welfare

Ptuj is the only place in Slovenia that brings together more than two millennia of tradition in health and wellbeing. Holidays in Terme Ptuj (Ptuj Spa) are a source of health and relaxation, but also a great opportunity for actively spent leisure time and lively water play. The park and its surroundings offer a wide array of possibilities for an active holiday: experience the delights of water in one of the biggest spas in Central Europe, play golf or tennis, take a hot air balloon ride, etc. It is one of the newest Slovenian spas, where you are offered accommodation in high-quality apartments and bungalows of different sizes, camping facilities and accommodation in the new four-star Grand Hotel Primus. The spa consists of a total of 4,200 m² of water surface with healing mineral water in the indoor and outdoor swimming pools, but is also well known for being home to the largest water slide in Slovenia. Ptuj Thermal Park plays hosts to all kinds of events throughout the year, many of which are inspired by its Roman history: the Roman theme wedding in April; the central summer event called Roman Games; and the Saturnalia at Christmas, amongst others.

As Ptuj and its surroundings are famous for their wine tradition, the Ptuj Thermal Park holds exclusive wine evenings called Primus's Wine Stories, where leading viticulturists and cellars present their first-rate wine products.

Maribor 2012 – European capital of culture, Ptuj partner town

As a partner town, Ptuj is involved in the Maribor 2012 – European capital of culture project. Its piece de résistance will be the Art & Heritage Carnival, which will host a range of cultural events, relying on the area's rich cultural heritage and its unique ethnographic heritage. This presents an opportunity to upgrade the cultural infrastructure. The renovation of the Dominican Monastery and the building of a new multipurpose cultural hall are top priorities and the city is already making substantial efforts to this end. The project presents a huge opportunity to raise awareness of the meaning of Ptuj as a Slovenian and European cultural jewel.

Ptuj's rich and proud tradition serves as the basis for its participation in the ECOC project, while the town is hoping to build on this to safeguard its future and that of its inhabitants. Ptuj joins the project as a proud, ancient city, replete with culture and projects, the most famous being the Kurent Carnival, one of the largest ethnographic festivals in this part of Europe.



Town of Hundred Treasures

The passing of time has given Ptuj two monasteries and two magnificent churches. Reforms were not favourable for the Dominican convent meaning those living there could no longer do so; instead the convent now hosts a part of the collections of Pokrajinski muzej Ptuj -Ormož (Ptuj-Ormož Regional Museum). In the quiet shelter of its old walls, you can take in the archaeological and numismatic collections and the Mithras on display. The Minorite monastery, which was built soon after the Dominican, still performs its functions today. Visitors find it interesting mainly because of its Minorite library. Its rooms are the scene of some world-class exhibitions and cultural events, and its arcaded courtyard serves as the setting for a variety of

summer events. The reconstructed church of Sts Peter and Paul belongs to the convent. On a tour of the Old Town, visitors can go to see the town parish Church of St Jurij (St George), the richest and most beautiful architectural monument in Ptuj, which dates from the twelfth century. There are Renaissance and Baroque tombstones from the former cemetery on the outer walls. The mighty City Tower and Orpheus monuments stand near the church. Reference was made to the tower in the town's first statute as far back as in 1376. In 1830, the curate Simon Povoden rebuilt the ancient monuments found in Ptuj and its surroundings, into the tower, in order to protect them from collapse. This has resulted in one of the oldest outdoor lapidaries. The Orpheus monument is a Roman tombstone made of Pohorje marble, almost five metres in height. The central scene is a relief depiction of the ancient singer Orpheus. In the Middle Ages, it was used as a pillory ("pranger"). All those eager to take in some cultural events can attend performances in the renovated theatre building of Mestno gledališče Ptuj (Ptuj Town Theatre), browse the well-stocked collections of books in Knjižnica Ivana Potrča (Ivan Potrč Library) and Mali grad (the Little Castle) or peruse the permanent and temporary exhibitions in Miheličeva galerija (Mihelič Gallery) and other city museums and galleries.

Food and Wine on Offer in Ptuj

Ptuj and its surroundings have always been famous for their excellent and historically diverse cuisine and excellent wines. In times gone by, they used to mainly trade using wine and this tradition still lives on in the town. It is the oldest town in Slovenia and has over seven centuries of tradition when it comes to making and cultivating quality wine. It is here that the oldest wine cellar in Slovenia can be found.

The wine cellar in Ptuj has finally seen its dreams come true! For its wines have become an established mark of quality, exceeding the expectations of discerning consumers all over the world. The exceptional potential of the fabulous wine-growing sites in the Haloze and Slovenske Gorice hills has been captured in new bottles bearing the simple but meaningful slogan,



Pullus: Wine with Taste. The Pullus trademark is regularly awarded the highest accolades in competitions around the world.

The cellar is equipped with light and sound effects which blend with the down-to-earth reality of the wooden barrels it stores. The archives contain the most valuable treasures, including the oldest wine in Slovenia: Zlata trta (Golden Vintage) from 1917. The Wine Room accommodates 60 guests who are treated to carefully selected wine samples to be sipped and enjoyed while watching a multi-vision presentation entitled: When a Drop Sparkles.

The fine wines the region has to offer complement the local delicacies nicely, examples of which would be Ptuj chicken, turkey with baked noodles, sausages, ham and blood sausages with cabbage, cucumbers with potatoes, dumplings (štruklji), buckwheat and corn rolls, the Haloška gibanica cake, mushroom soup with buckwheat mush, and sour soup with pork, amongst other. Ptuj's chefs are experts in preparing these traditional dishes with a modern twist.



KURENT OR KORANT
By Andrej Brenc

... According to an ancient belief the Kurent is a demon chasing winter away and calling spring to the country. Although Kurent has long lost its magic power, it cannot be considered as an ordinary carnival mask, for it still inspires mystical and powerful feelings. The most prominent part of the Kurent's outfit is the head-mask which also makes Kurents different from each other.







Golf Course

Sports enthusiasts have a number of facilities at their disposal, among which the most abundant are tennis courts and well-maintained cycling, jogging and hiking trails. From the Old Town, golf enthusiasts are only a stone's throw away from the golf course (with an area of 50 hectares), which is truly special due to its varied terrain and large number of water hazards. Ptuj Golf Course has 18 holes next to a modern club space made of glass and aluminium, and a practice range for practicing driving and iron play. It is situated beneath the impressive Ptuj Castle. The River Drava has always defined the town and the golf course is no exception. It also has many water hazards. The fourteenth hole is particularly remarkable since it involves a spectacular shot onto an island. You will experience all the excitement the game of golf has to offer on this course and that is why golfers love to return come back to play here time and again.



CoE and CC

The Centers of Excellence

- The CoE NOT
- The CoE CIPKeBiP
- The CoE PoliMaT
- The CoE NAMASTE

CoE NOT

The Centre of Excellence for Low-Carbon Technologies

Miran Gaberšček and Ivana Kovač

E-mobility in Slovenia

It is a fact that fossil fuels are limited and that the whole world is facing a challenge as to how to change its dependence on fossil fuels and the way of everyday life. The use of fossil fuels in the transport and industry over last decades, has probably significantly contributed to the climate changes observed in recent years. The EU and Slovenia are searching for answers to these challenges, one of which is investment into the research of new technologies for the use and storage of renewable energy. In this spirit, the major emphasis in

the Slovenian CoE Call published in May 2009 was on promoting activities that would lead to a low-carbon society in the future, that is, a society based on technologies using energy sources other than fossil fuels. From this perspective, it is no surprise that the Centre of Excellence for Low-Carbon Technologies (CoE NOT) has been selected for this funding. The CoE NOT's ultimate goal is to research, develop and extend low-carbon technologies throughout Slovenian society and beyond. CoE NOT comprises 22 partners of which 12 are academic laboratories (located at the National Institute of Chemistry (NIC), the Jožef Stefan Institute and two universities: the University of Ljubljana and the University of Nova Gorica), while 10 partners (Cinkarna, Domel, INEA, Iskra Tela, Mebius, Silkem, Petrol, TEŠ and RCVT) are Slovenian companies operating in the field of new energy technologies.

One of the projects carried out within the CoE NOT is "E-mobility in Slovenia". The CoE NOT strives to unite all the essential Slovenian potentials that enable a unified, comprehensive and systematic development of advanced technologies that will facilitate Slovenia's transition into a low-carbon society. The E-mobility in Slovenia project is a joint endeavour between two research organisations: the CoE NOT and the National Institute of Chemistry. The objective of the joint activities is to present the electric car to a wider population, respond to questions raised



Prof. Dr Miran Gaberšček



Ivana Kovač

by the public regarding electric cars and to elucidate the advantages of such means of transport. The goals of E-mobility in Slovenia are as follows:

- to foster cooperation between research and development and the private sector to develop a safe, affordable and reliable electric car;
- to become better acquainted with the advantages of environmentally friendly transport and the use of renewable energy sources; and
- to bring the electric car closer to users.

There are different technologies used to power an electric car. Currently, the two most developed technologies are battery-powered electric vehicles (which mostly use lithium batteries) and fuel cell vehicles. The latter are fuelled by hydrogen and use oxygen from the air to create the water and electricity that powers the electric motor.

Janko Jamnik, PhD, Director of NIC:

»Cooperation between NIC and CO-NOT is excellent. This holds true also for the project entitled "e-mobility for Slovenia". The work is organised according to the competences of both institutions: the basic science and perfectly synchronised administration by NIC counterparts nicely the well spreaded and carefully organised industrial network provided by CO-NOT. We believe that e-mobility project could also be one of the alternatives for the CO-NOT activities after the four-years governmentally founded period.



Researchers at the CoE NOT are developing the various hydrogen and lithium technologies necessary for the successful development of fuel cell and battery cars.

Electric cars have several potential benefits compared to conventional internal combustion vehicles. They are as follows:

- significant reduction of urban air pollution, since they do not emit harmful exhaust pipe pollutants from the source of power onboard;
- reduced greenhouse gas emissions from the source of power onboard, depending on the fuel and technology used for the generation of electricity to charge the batteries; and
- less dependence on foreign oil.

Despite their potential benefits, electric cars face several barriers and limitations. The main problems are that electric cars are significantly more expensive than conventional and hybrid electric vehicles owing to the additional expense of their lithium-ion battery, the lack of public and private recharging infrastructure, the driver's fear of the batteries running out of energy before reaching their destination since batteries still have a low energy density, they do not save sufficient electricity per kilogram or per

volume unit, and they also have a short life-cycle. A further problem with batteries is the recycling issue, which has not yet been resolved satisfactorily. The E-mobility in Slovenia project aims to promote the electric car at various levels.

1. On the first level, the project aims to educate students about the emerging technologies to be found in the electric car. Therefore, a team of students, supervised by experts from academia and industry, has been set up to build their own electric car prototype.
2. On the second level, we are looking to encourage the producers of components that are potentially interesting for integration into electric vehicles (which need not be limited to cars, but can range from bikes to buses – the latter being interesting for future city policies, etc.). The background for this action is as follows: Currently, the electric car is being developed more or less by the existing established car manufacturers who are not open to cooperation with external partners (the overriding “philosophy” is to produce the whole car in “one’s own backyard”). This

effectively means that component producers from countries without their own automobile brands are excluded from the development cycles – even if the technologies they use are cutting edge. Within the framework of the project, the partners are preparing a common platform which will serve as a testing point for various components produced by Slovenian companies. It is expected that the cooperation between producers of automotive parts in the region – who are presently scattered and unconnected – will be enhanced. Furthermore, the

tendency towards monopolism in new technologies will be reduced.

3. On the third level, the common platform serves as a basis for the development of new products, particularly those that are based on the interaction of various components. Examples of these are transmission optimisation, heat management, energy management, and the inclusion and optimisation of range extenders, etc. In this part, the project will bring relevant academic partners in the region and appropriate industries closer together. Next, the project promotes the devel-



opment of interfaces between electric car components and the consumers (society). Innovative, smart solutions which will increase the acceptance of this new car technology will be proposed. Examples would be the smart communication tools for use between the car and its user and the like. On the fourth level the project addresses policy makers to assist with the promotion of electric vehicle technologies. This will be achieved mainly by making the other three activities an attractive proposition for cities. For example, the platform will promote the testing of com-

ponents that might be used in the development of electric buses (supporting various clean city projects). In addition, the project will promote dialogue regarding the development of electric mobility between selected cities in partner countries; goal: common strategy.

4. The CoE NOT will also set up two hydrogen filling stations – one in Ljubljana and one in Velenje – as demonstration projects, providing Slovenia with its own hydrogen route for cars and buses.

Fuel cell powered vehicles

The EU target of 80% decarbonisation by 2050 will require the 95% decarbonisation of the road transport sector; this cannot be achieved using traditional combustion engines (Source: McKinsey Global GHG Abatement Cost Curve; International Energy Agency World Energy Outlook 2009; US Environmental Protection Agency; European Environment Agency). As well as batteries, fuel cells are the most promising technology for achieving these goals. A fuel cell is a high efficiency electro-chemical converter that uses oxygen/air and hydrogen to produce electricity and heat. The only by-product is water, and there are no CO2 emissions. Hydrogen can be produced

locally using biomass, thereby drastically reducing Slovenia’s dependence on oil imports and improving the trade balance.

Three large-scale projects are underway in the Centre of Excellence for



Prof. Dr Mihael Sekavčnik

Low-Carbon Technologies (CoE LCT) in the field of hydrogen technologies. The objective of one of these projects is to set up the first two hydrogen refuelling stations in Slovenia by the summer of 2012. The refuelling stations will be located in Petrol refuelling stations and will be easily transportable from one demo site to another. At the same time, we are applying to additional calls that would enable us delivery of fuel cell bus and cars. The project is led by Petrol d.d., in cooperation with Domel



Dr Marta Svolfšak

d.o.o., TPJ d.o.o. and the Development Centre for Hydrogen Technologies (DCHT).



M.Sc. Tone Luznar

COE NOT

INEA d.o.o., TEŠ d.o.o. and the Faculty of Mechanical Engineering at the University of Ljubljana are joining forces in a demo project where hydrogen production using electrolyzers is implemented to actively balance electricity production with a high proportion of renewable energy sources on one side and electricity demand on the other. The hydrogen produced is used as an energy carrier in stationary and mobile applications. For example, hydrogen refuelling and production infrastructure, including various CHP applications and electric cars, can be integrated into the energy system using smart grids. The demo project will provide real use case circumstances for testing and validation and thus valuable input for the next-generation development of hydrogen and smart grid core technologies.

The National Institute of Chemistry, the Jožef Štefan Institute and Mebisu d.o.o. have made some important scientific breakthroughs that will expedite the commercialisation of these technologies, all of which have strong levels of potential for the Slovenian economy; Domel d.o.o. is global supplier of the gas delivery systems used in fuel cell aggregates and enjoys a significant market share. INEA d.o.o. is a member of the European Fuel Cell and Hydrogen Joint Technology Initiative Industry Grouping (NEW IG), which closely monitors the latest EU developments in the field of hydrogen technologies and provides possibilities for Slovenian companies to be part of a long term public-private partnership under the auspices of the Seventh Framework Programme (FP7) of the European Community.

The Municipality of Bled became a member of HyRaMP, an EU-level organisation that enables us to influence EU programmes and cooperate with key players at an EU level. In cooperation with TPJ d.o.o. and other partners, Domel d.o.o. organised a Rampini fuel cell bus demonstration at the 2010 World Rowing Championship and a fuel cell bus carried hundreds of passengers around the lake. The project is planned to be repeated this year at the 2011 World Rowing Championship and in Strategic forum in Bled.



M.Sc. Jure Vindišar

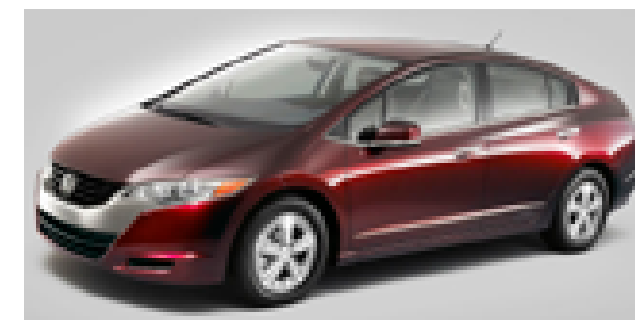
A fuel cell bus at the World Rowing Championship in Bled. A hydrogen refuelling system can be seen in the picture on the left.

Honda FCX (left) and Mercedes B-Class F-Cell (right) represent technically sophisticated vehicles with excellent driving characteristics, comfort and 500 km driving range. Prior serial production hydrogen refuelling infrastructure should be expanded and production costs should be decreased (Source: Honda, Mercedes).

At present, it is not a routine task to purchase and use a hydrogen vehicle. Car producers, for example, have demo programmes limited to smaller areas (e.g. California, regions in Japan, Norway and Germany). Most of the players are planning for the mass production of fuel cell vehicles in 2015. Mercedes estimates that the price will be comparable to that of a diesel hybrid, while Toyota and Hyundai estimate the cost to be lower than USD 50,000.

Fuel cells are convenient for use in buses. Bus producers such as Mercedes, Van Hool and Rampini offer these buses. The current prices of buses are at least three times higher than conventional buses, but are expected to decrease by 50% by 2015.

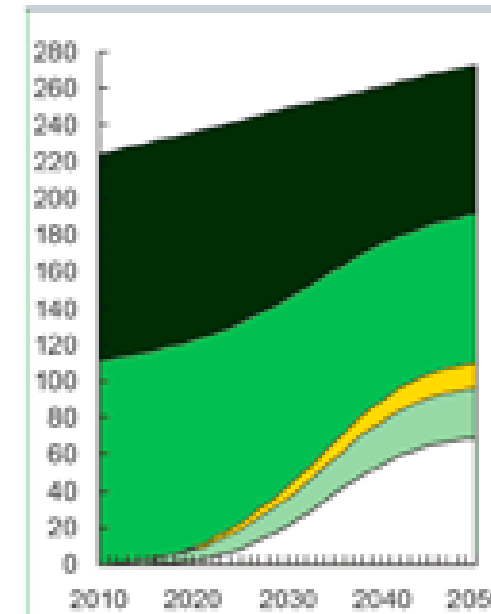
There is huge debate as to which technology will dominate in the transport sector: batteries or fuel cells? According to the latest market analysis, carried out by McKinsey & Company in cooperation with largest car producers Mercedes, Kia, Hyundai, Nissan, and Honda, both technologies complement each other. The most likely scenario is that batteries will dominate in smaller vehicles, motorbikes and bikes and fuel cells will dominate larger vehicles and buses.



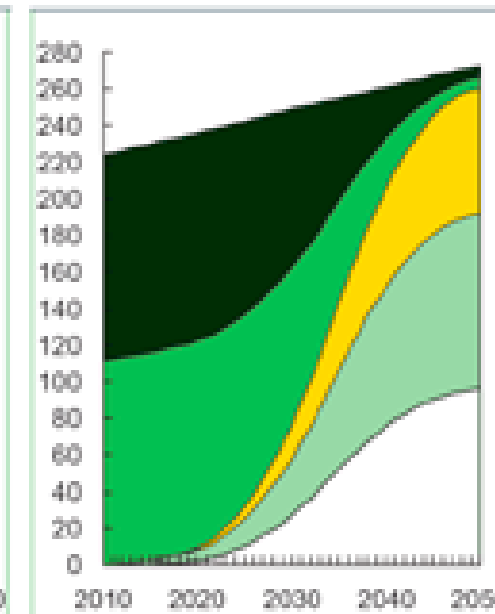
Gašper Benedik

- bencinski motor
- dizelski motor
- gorivne celice
- akumulator
- hibridni pogon

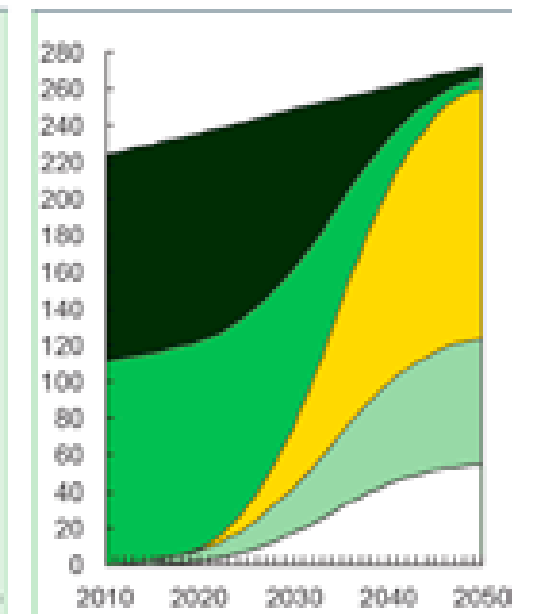
SCENARIJ A
PREVLADA KLASIČNIH VOZIL



SCENARIJ B
PREVLADA AKUMULATORSKIH VOZIL



SCENARIJ C
PREVLADA VOZIL Z GORIVNIMI CELICAMI



A recent McKinsey study entitled A portfolio of power-trains for Europe: a fact-based analysis, 2010 envisages three possible scenarios. In the first, conventional vehicles dominate; in the second, battery electric vehicles prevail; and in the third, fuel cell vehicles hold sway.

CIPKEBIP

Centre of Excellence for Integrated Approaches in Chemistry and Biology of Proteins

The results and knowledge gleaned from the research will be used in the development of technological processes within the scope of national and international projects carried out with partners from industry. The knowledge gained will serve to increase the competitiveness of small and large companies alike in the biotechnology market. The cumulative effect of the Centre of Excellence will also be demonstrated through the education of young scientists who will be able to continue their professional careers, both in industry and research institutions.

<http://www.cipkebip.org>

*Dušan Turk, Scientific Director
Livija Tušar, General Director
Maja Rupnik, project leader
Enej Kuščer, project leader
Nina Gunde-Cimerman, project leader*

The Centre of Excellence for Integrated Approaches in Chemistry and Biology of Proteins combines the knowledge, experience and technology of ten top Slovenian organisations involved in protein research:

- ◆ Jožef Stefan Institute
- ◆ University of Ljubljana, Faculty of Medicine, Biotechnical Faculty
- ◆ University of Maribor, Faculty of Medicine
- ◆ University Medical Centre Ljubljana
- ◆ Institute of Public Health Maribor
- ◆ Lek Pharmaceuticals d.d., Ljubljana
- ◆ ACIES Ltd.
- ◆ Medis Ltd.
- ◆ TikhePharma Ltd.
- ◆ JENKO Ltd.

The activities carried out at the CIPKEBIP focus on two main areas:

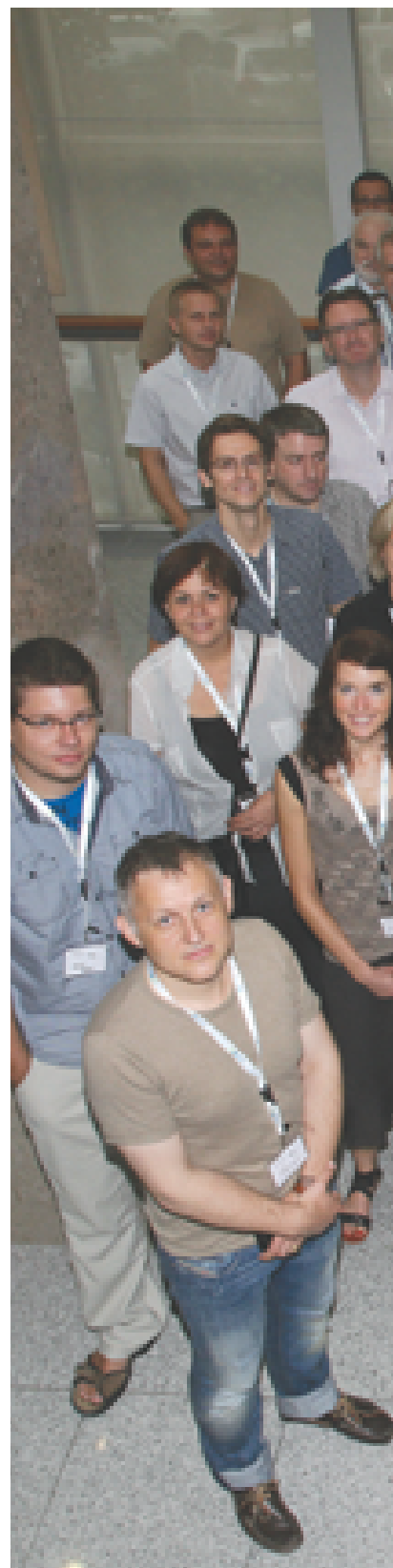
- ◆ the purchase of up-to-date research equipment on the chemistry and biology of proteins (as of 31 December 2011, 79% of the research equipment is already available to researchers);
- ◆ research, which is organised into four research activities (projects) and involves public research and business institutions (the CIPKEBIP founders).

1. Mechanisms and Pathways of Immune Response with three subareas

- a. "Generic mechanisms of immune response"
- b. "Pathogens and their interactions with host"
- c. "Modulation of immune response by small molecules"

The objective of the research is the study of the mechanisms of interactions between cells and organisms with pathogens during infection and the mechanisms of early immune response development.

The project leader is Prof. Dr Maja Rupnik.



2. Intra and intercellular communication with four subareas

- a. Organelle mediated signalling
- b. Protein mediated signalling
- c. Signalling pathways as targets of small molecules
- d. Nanobiosensors

The objectives of the research are as follows:

- ◆ To acquire new knowledge of the

mechanism of action of some key physiological processes important in the biomedical aspects

- ◆ The transmission of signals in the cell
- ◆ The use of proteins and organic synthesis in production
- ◆ Biosynthesis and the environmentally friendly organic synthesis of active ingredients and raw materials.

The project leader is Dr Enej Kuščer.

3. Adaptation mechanisms of extremophiles to extreme parameters in the environment

The study of the adaptive mechanisms of eukaryotic organisms, particularly extremely halotolerant black yeast *Hortaea werneckii* to extreme concentrations of NaCl on the level of physiology and signalling, and the study of hyperthermophilic archaea *Aeropyrum*

CIPKEBIP researchers at the CIPKEBIP annual conference, held at the Jožef Stefan Institute.



Photo: Marjan Smrke, JSI.

Pernix on the level of serine protease pernizin . In June 2011, the CIPKEBIP principle investigator Prof. Dr Nina Gunde-Cimerman and her colleagues published an article on pathogenic and polyextremophilic black yeasts occurring in household appliances, which garnered major attention from the media and the scientific community.

The project leader is Prof. Dr Nina Gunde-Cimerman.

4. Protein Bank: the production and storage of proteins and their complexes

The production of proteins and the improvement of their properties to support academic and industrial partners. Biochemical and structural characterisation of proteins with an emphasis on the binding studies of medicaments, viruses and bacterial components

The project leader is Prof. Dr Dušan Turk.

In July 2011 the research activities of CIPKEBIP were evaluated and some positive recommendations were received. On 12 December 2011, these future recommendations were discussed with the members of the CIPKEBIP Advisory Council: Dr Imre Berger, Dr Susanne Engelmann and Prof. Dr Uroš Urleb.

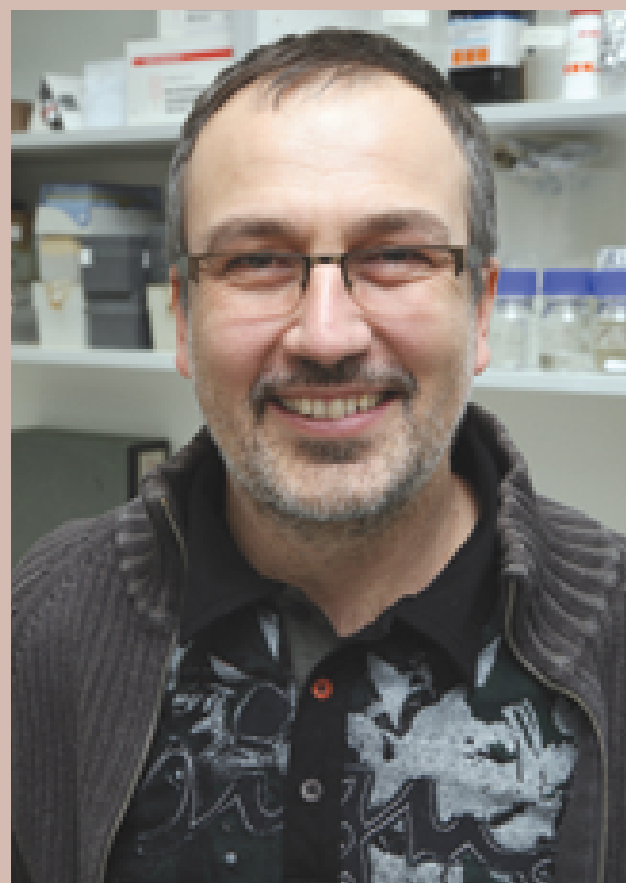
In 2011 the CIPKEBIP conference entitled "Biosynthetic and metabolic engineering in industrial drug and process development" was organised. The purpose of the conference was to present the latest achievements in the pro-

NEW EFFECTIVE METHOD OF CANCER TREATMENT The development of a new, efficient delivery system for medicine

Boris Turk

After cardiovascular diseases, cancer represents the largest health problem in the developed world. Efficient chemotherapy still remains a major challenge, as anti-cancer drugs are highly toxic. Moreover, a number of potential anticancer agents exhibit poor bioavailability. One of the major challenges in biomedicine is therefore the development of new delivery systems which will enable the efficient delivery of drugs and hence reduce their toxicity and increase their bioavailability.

The research team led by Asst. Prof. Dr Olga Vasiljeva and Prof. Dr Boris Turk, in collaboration with colleagues from Russia, Germany and the U.S. have developed a new, highly efficient delivery system which is based on iron oxide magnetic nanoparticles encapsulated in liposomes. The researchers involved are members of three Slovenian Centres of Excellence, namely CO CIPKEBIP Centre of Excellence for Integrated Approaches in the Chemistry and Biology of Proteins, CO NANO Centre of Excellence for Nanoscience and Nanotechnology and CO ENFIST Centre of Excellence for Health and Life Sciences and Advanced New Materials.



Prof. Dr Boris Turk, Jožef Stefan Institute, Department of Biochemistry and Molecular and Structural Biology

Such ferri-liposomes can be directed to the area of the tumour and the tumour microenvironment using an external magnet, attached to the tumour site. Since these new nanoparticles also have extraordinary MRI (magnetic resonance imaging) contrast properties for detection, the

- ◆ Jožef Stefan Institute, Department of Biochemistry and Molecular and Structural Biology
- ◆ Centre of Excellence for Integrated Approaches in Chemistry and Biology of Proteins
- ◆ University of Ljubljana, Faculty of Chemistry and Chemical Technology
- ◆ Centre of Excellence for Nanosciences and Nanotechnology

system allows the simultaneous non-invasive in vivo monitoring of drug delivery (Fig. 1). In a mouse model for breast cancer, the efficiency of the standard chemo-

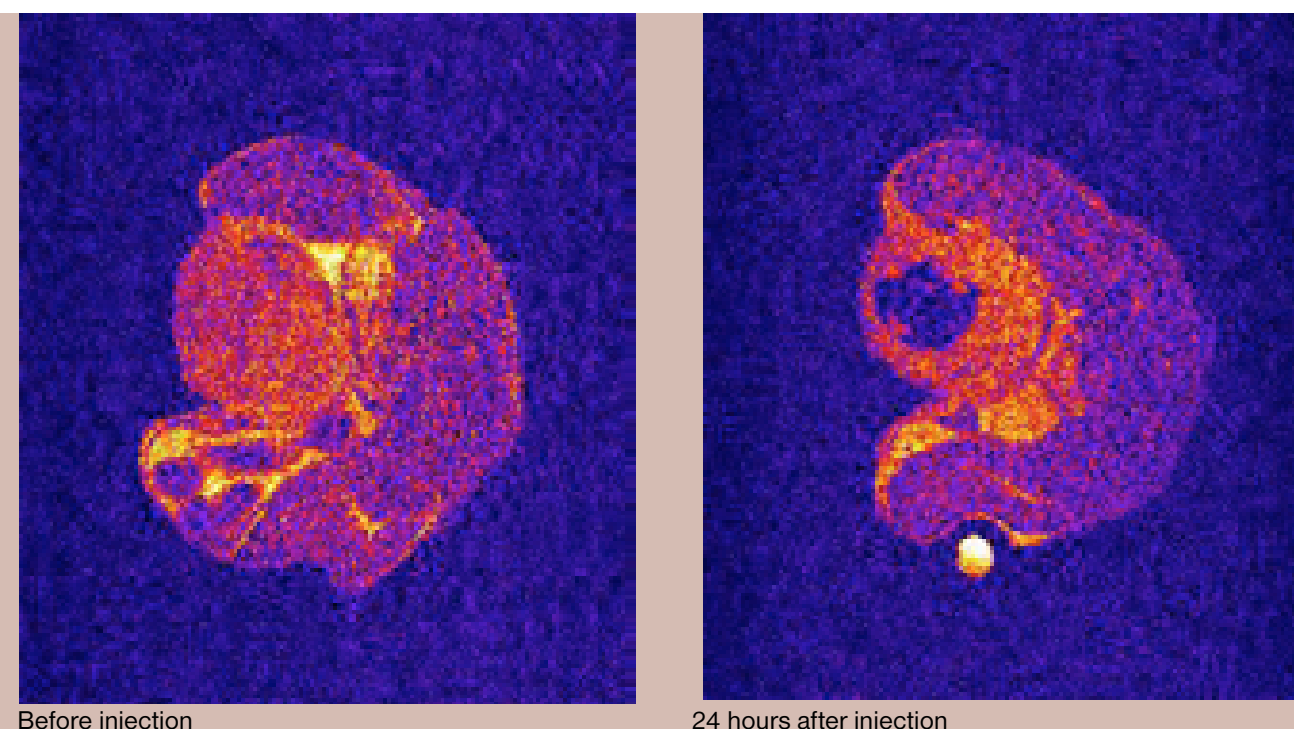


Figure 1: In vivo MRI detection of ferri-liposomes targeted to the mammary tumour by an external magnet.

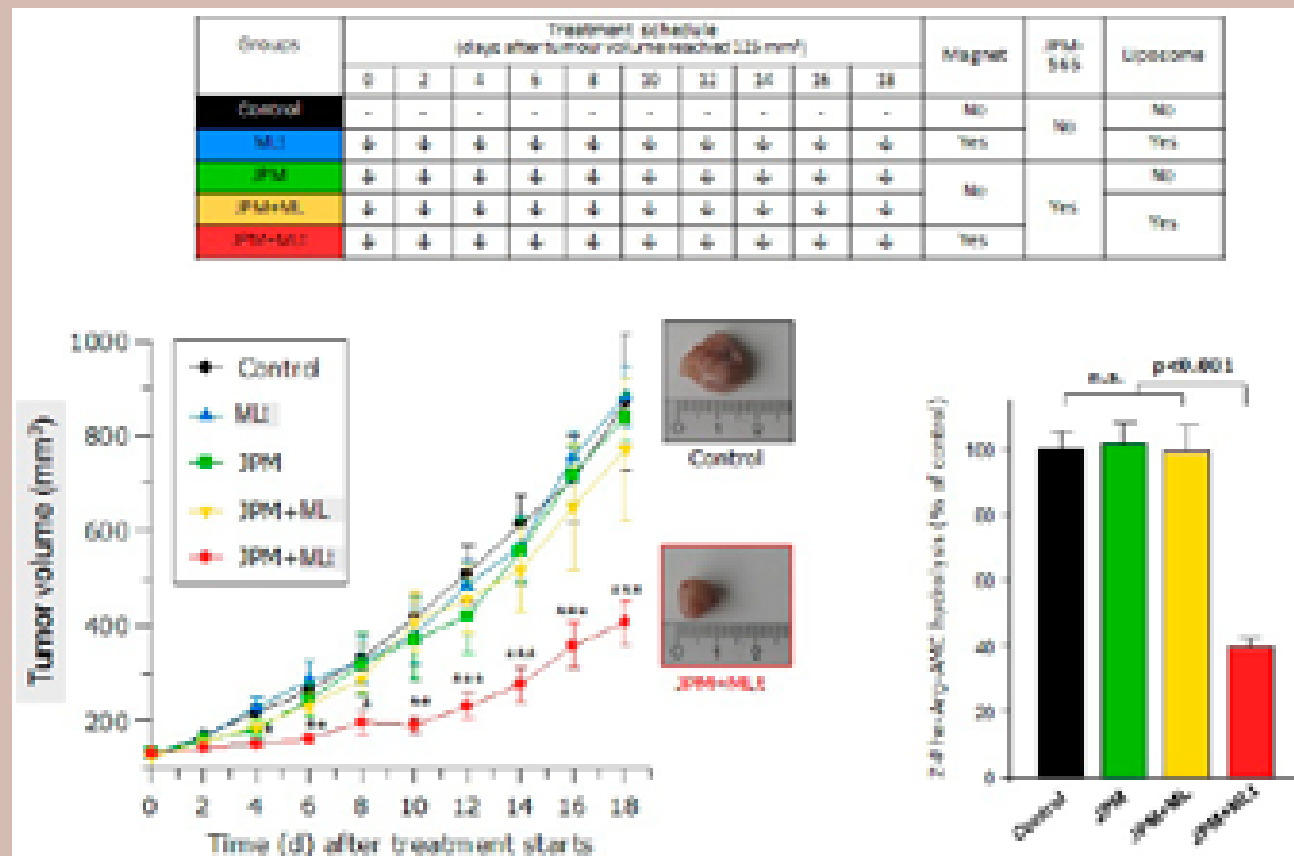


Figure 2: The new drug delivery system significantly improved the bioavailability of the protease inhibitor and slowed down tumour growth.

therapeutic agent doxorubicin was demonstrated to have significantly improved using this system. Moreover, the system enabled the efficient delivery of a protease inhibitor, which significantly delayed tumour growth, and this was achieved without targeting completely inefficient in the same system due to the poor bioavailability of the compound (Fig. 2).

This system therefore undoubtedly has remarkable potential for drug delivery, not only for diseases such as cancer but also in general since, in principle, it allows for the encapsulation of numerous potential active substances and their further targeting to the site of action. The article entitled "Ferri-liposomes as an MRI-visible drug-delivery

The development of a new, efficient delivery system for medicine

system for targeting tumours and their microenvironment," which describes this system, was published in the prestigious journal Nature Nanotechnology (the leader in nanotechnology), as the first work published by Slovenian authors in this journal.

duction of small bioactive molecules and intermediates of natural or (semi) synthetic origin of medical and industrial importance, focusing particularly on aspects concerning drug discovery and development of industrial (bio) processes.

The most notable CIPKEBIP research achievements for 2011 are as follows:

AWARDS

Prof. DDr Boris Turk received the Zois Award for best scientific research contributions on the transmission of signals with proteases (24 November 2011).

The most influential publications:

Georgy Mikhaylov (IJS), Ursa Mikac (IJS, EN-FIST), Anna A. Magaeva, Volya I. Itin, Evgeniy P. Naiden, Ivan Psakhye, Liane Babes, Thomas Reinheckel, Christoph Peters, Robert Zeiser, Matthew Bogoyo, Vito Turk (IJS, CIPKEBIP), Sergey G. Psakhye, Boris Turk* (IJS, UL FKKT, CIPKEBIP, CO NANO), Olga Vasiljeva* (IJS). **Ferri-liposomes as an MRI-visible drug delivery system for targeting tumours and their microenvironment.** 2011, *Nature Nanotechnology*, Vol. 6, September 2011.

P. Zalar, M. Novak, G.S. DE Hoog, Nina Gunde-Cimerman (University of Ljubljana, Biotechnical faculty, CIPKEBIP). **Dishwashers – A man-made ecological niche accommodating human opportunistic fungal pathogens,** *Fungal Biology*, 2011.

New instrumental acquisitions at the Department for Molecular and Biomedical Sciences, Jožef Stefan Institute, will foster the research of secreted phospholipases A2 and more

Igor Krizaj

The main tasks of our group in the scope of the Centre of Excellence (CoE) for Integrated Approaches in Chemistry and Biology of Proteins (CIPKeBiP) are the research of secreted phospholipases A2 (sPLA2s), originating from either animal venoms or mammalian tissues, and the determination of the primary structure of proteins.

In the past year, our group at the Department for Molecular and Biomedical Sciences, Jožef Stefan Institute, obtained two valuable infrastructural acquisitions which will broaden and accelerate our studies on the (patho)physiology of sPLA2s and enable an accurate sub-picomole polypeptide sequencing by the means of Edman chemistry.



Igor Krizaj, Jožef Stefan Institute, Department of Molecular and Biomedical Sciences, CIPKEBIP

Secreted PLA2s are esterases that hydrolyse the sn-2 ester bond of glycerophospholipids. The products of their enzymatic activity, fatty acids and lysophospholipids, and also sPLA2s acting as ligands for tissue receptors, are involved in numerous physiological and pathological processes in organisms. By deepening our understanding of how snake venom sPLA2s endowed with presynaptic neurotoxicity influences the nerve function and haemostasis, we are looking forward to developing innovative molecular tools to study nerve function (e.g. exo- and endocytosis) and dysfunction (neurodegeneration and regeneration), haemostasis (the diagnosis



Figure 1: the flow cytometer (BD FACSCalibur) system is a renowned bench-top flow cytometer with a modular design, which has a proven record of performance, sensitivity and flexibility, and has been a valued tool in research and clinical laboratories worldwide for a number of years.

and treatment of blood coagulation disorders), and to develop more efficient envenomation protection and therapy procedures. We are attempting to explain the role of endogenous sPLA2s in cell proliferation and apoptosis, with a focus on their function in breast cancer.

In order to extend and supplement our sPLA2 studies, a BD FACS-Calibur flow cytometer has been acquired (Fig. 1).

Flow cytometry is a relatively new and powerful technique which is fast becoming indispensable for every well-equipped cell biology laboratory today. Its basic advantage lies in the simultaneous multi-parameter analysis of single cells in suspension flowing past a laser-illuminated point of measurement. Particularly important is the fact that a large number of cells can be measured within a short period of time (tens of seconds to minutes), effectively revealing the heterogeneity of populations: different subsets of cells are identified, quantified and optionally sorted according to light scattering parameters (cell size and internal complexity) and the presence of fluorescent molecules, typically in the form of labelled-antibodies, dyes or fluorescent proteins.

Thus, any cell component or process that can be detected by a fluorescent compound can be analysed and accurately quantified. The FACSCalibur system is equipped with a single 488 nm laser source enabling 5-parameter analysis, but its modular design enables easy upgrades with a second light source, automated sample loader or a cell sorter. The instrument is an essential tool in our laboratory for a wide variety of applications ranging from simple cell characterisation to the quantitative measurements of changes in specific cellular compounds or processes. In the scope of our studies of the effects of snake venom and mammalian endogenous sPLA2 on various neuronal and breast cancer cells, we are focusing our analysis on the cellular processes and molecules that affect cell growth and survival. Multi-parametric flow cytometry

measurements enable quantitative DNA and cell cycle analyses (Fig. 2) (e.g. an accurate determination of the number of cells in a particular stage of the cycle, the detection of cell-cycle arrests, DNA synthesis and senescence), determination of programmed cell-death and necrotic processes by following specific cellular changes (e.g. cellular membrane asymmetry and integrity, mitochondrial function, reactive oxygen species generation, DNA fragmentation, enzymatic reactions or the detection of specific marker molecules). The flow cytometer is also indispensable in accurately quantifying the cellular expression of sPLA2s and

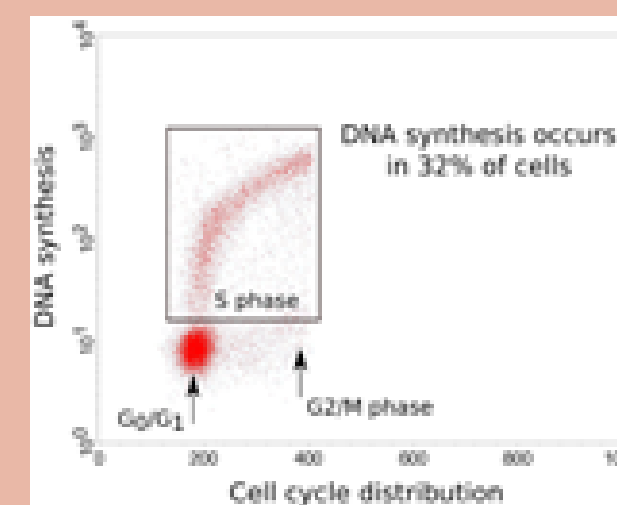


Figure 2: the influence of sPLA2s on the proliferation of MDA-MB-231 breast cancer cells was analysed by flow cytometry using two-colour staining. DNA synthesis was followed by the specific incorporation and detection of a nucleoside analogue in replicating cells. The cell cycle status of each cell in the population (DNA content) was determined using a quantitative DNA binding dye.

other proteins of interest, either by using fluorescent protein fusions or immunodetection with fluorescently labelled antibodies. Furthermore, on the basis of techniques such as fluorescence resonance energy transfer (FRET), the flow cytometer will be an invaluable tool in our attempts to develop assays for analysis of the interactions between sPLA2s and their specific cellular protein targets. Our group, the only one of its kind in Slovenia, has more than twenty years of experience in protein primary structure analysis. In order to meet the needs of contemporary protein primary structure analysis, most



Figure 3: the Procise 492A protein sequencing system (Applied Biosystems) has been completely renewed to meet the needs of contemporary protein primary structure analysis.

of the hardware of the old Procise 492A protein sequencing system (Applied Biosystems) has been renewed and up-to-date software installed (Fig. 3).

In addition, a modern liquid chromatography (LC) system Flexar FX-15 (Perkin Elmer) has been installed for the final preparation of peptide samples before sequencing (Fig. 4). The protein sequencing system is now operating effectively on the sub-picomolar level and we are participating with protein structure analysis in various projects. For example, we are currently sequencing haemorrhagic or anticoagulant snake venom metalloproteinases, and cytolytic proteins and lectins from mushrooms.



Figure 4: the Flexar FX-15 UHPLC system (Perkin Elmer) is a liquid chromatography system used to prepare peptide samples for automated Edman sequencing.

A new MALDI-TOF/TOF mass spectrometer at CIP-KEBIP

Robert Vidmar

CIPKEBIP
Jožef Stefan Institute, Department of Biochemistry and Molecular and Structural Biology
robert.vidmar@ijs.si

The most important instrument acquired with the grant for the Centre of Excellence (CoE) for Integrated Approaches in the Chemistry and Biology of Proteins is the MALDI-TOF/TOF mass spectrometer ultrafleXtreme™ III (Bruker). In today's merits an invaluable analytical instrument in every larger biochemistry laboratory gives us an opportunity to pursue excellence in the fast-developing field of modern protein science and confirms that mass spectrometry continues to be one of the core technologies of this CoE.

Today, mass spectrometry (MS) is the most useful analytical technique for protein analysis, since it provides a relatively simple means for determining one of the fundamental properties of biological molecules, i.e. their molecular mass. Several strategies are available for analysis, depending on the complexity of the sample and the information needed.

MALDI-MS analysis is especially suitable for the characterisation of purified proteins, simple mixtures of proteins and the quality control of proteins for biotechnological applications. In these cases, the identity of the protein is often known, the amino acid sequence is available either from protein databases or by translation from the corresponding gene sequences and therefore only the identity needs to be confirmed. The mass determination of a protein under investigation will also reveal any differences from the calculated molecular mass, as determined from the amino acid sequence. Similarly, an MS analysis of peptides, known as peptide mass

fingerprinting (PMF), derived from a protein by an enzymatic digestion will confirm the amino acid sequence of individual peptides and also reveal the presence of any chemical modifications by a mass difference relative to the expected masses of the unmodified peptides.

A complete protein analyses by multiple MALDI-MS experiments,

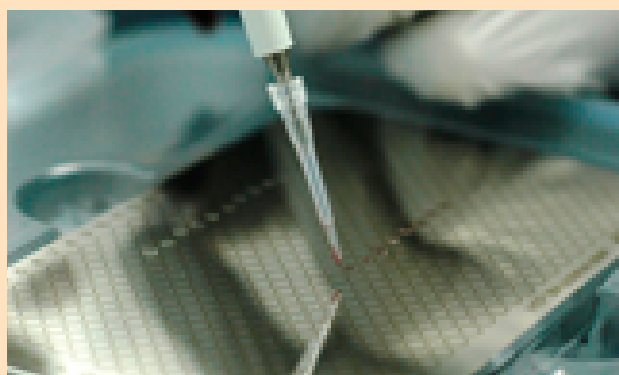


Figure 1: Sample application on a MALDI plate prior to insertion into the mass spectrometer for analysis. (Photo: Blaž Vidmar)

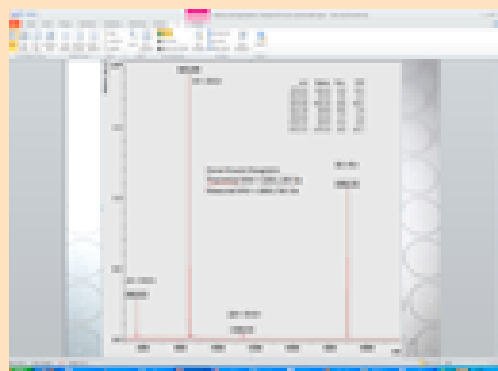


Figure 2: MALDI plate insertion into the MALDI-TOF/TOF instrument. (Photo: Blaž Vidmar)



Figure 3: MS spectra of intact myoglobin as an example of a native protein mass determination. (Photo: Blaž Vidmar)

which are routinely performed on our instrument, include intact mass determination, peptide mass mapping experiments and the MS/MS sequencing of peptides. We also perform top-down sequencing experiments on high purity proteins, where protein N- and C-terminal sequences are obtained without protein pretreatment with digestion proteases. Complex analysis of post-translational modifications, such as phosphorylation, glycosylation and pegylation are also planned to be introduced into the work.

Intact mass determination experiments were already performed on proteins with molecular weights of up to 100 kDa, where the instrument's upper limit of 500 kDa is still to be reached. In these cases, the mass accuracy of the instrument exceeds 0.5 Da for 15 000 Da proteins (Fig. 3) and drops to 10 Da for 50 000 Da proteins. Besides the instrument's characteristics, mass accuracy also improves with protein homogeneity and the absence of post-translational modifications.

Another important aspect of our work is protein identification using both peptide mass fingerprinting and the MS/MS sequencing of peptides. For proteins to be amenable for sequencing they have to be proteolytically cleaved to form peptides. Peptide masses ranging from 700 to 4000 Da are then measured and subsequently fragmented to obtain amino acid sequence information. The protein identification workflow has been largely optimised to suit high-throughput standards and is now automated. The automation mode includes PMF experiments with subsequent automatic peak selection for fragmentation and, lastly, database search. The output is the list of identified proteins that is manually evaluated to obtain high standards for identifications. The acquisition of a high resolution MALDI-TOF/TOF instrument is of a great value for the departments of biochemistry and molecular biology, as well as the academic and industry partners gathered under the CoE CIPKEBIP.

Super-resolution Microscopy and Cell Physiology at LN-MCP, Institute of Pathophysiology,

Robert Zorec, Marko Kreft

Faculty of Medicine, University of Ljubljana, CIPKEBIP

The subcellular physiology of secretory organelles is crucial for the understanding of the nature of cell-to-cell communication and also for the production of recombinant proteins. A powerful approach to study this is optophysiology using fluorescence microscopy and electrophysiology to monitor minute ionic currents through the membrane and changes in the membrane area by electrical capacitance. Partners of the Centre of Excellence run an advanced optical microscopy facility, equipped with two confocal microscopes, two hi-temporal resolution microscopes and several fluorescent microscopes equipped with FRET applications, patch-clamp amplifier workstations with signal acquisition systems and manipulators for electrophysiology and microinjection. Confocal microscopy offers several advantages over conventional fluorescence microscopes to view subcellular structures. Information is collected from a well-defined optical section; out of focus fluorescence is thus eliminated, which results in increased contrast and clarity of image signal detection. Stacks of optical sections taken at successive focal planes can be reconstructed to produce a three dimensional view of a specimen. Confocal microscopy therefore provides the means



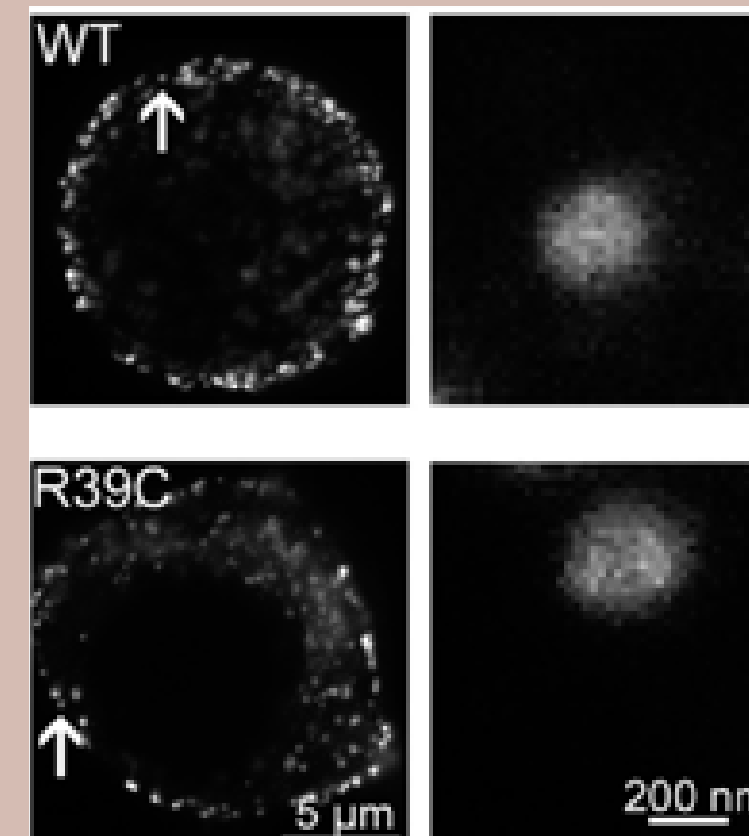
Robert Zorec

Mutants of Munc18-1 stabilise the fusion pores at narrower diameters, whereas the diameter of vesicles is unchanged. STED images of prolactin-labelled vesicles in lactotrophs transfected with Munc18-1 WT and Munc18-1 R39C. Arrows in STED images mark vesicles shown at super-resolution on the right panels. (Jorgacevski et al. (2011). J. Neurosci . 31: 9055-66.)



Marko Kreft

to observe the structural components and physiological processes of live cells and tissues in three-dimensional space without physical sectioning. Repetitive imaging (a time series of images), allows for visualisation and analysis of physiological processes in living cells. Moreover, the spectral detector records the fluorescence spectrum at each three-dimensional pixel in time, which collectively generates



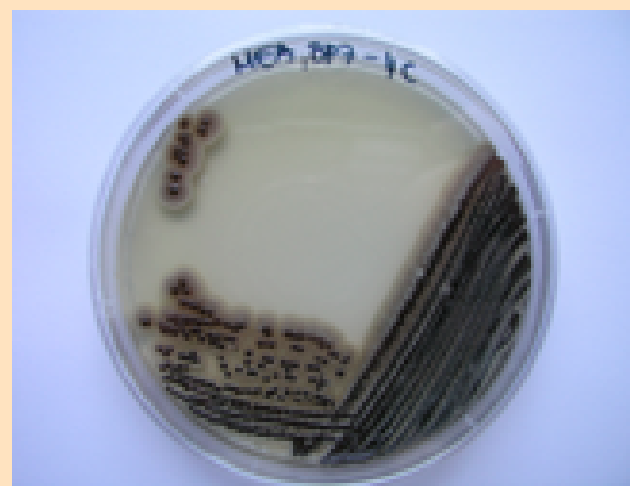
5-dimensional data sets of the sample. The research equipment for nano-optical microscopy will substantially increase the special resolution of fluorescent images by engaging Stimulated Emission Depletion microscopy (STED) and other approaches which have emerged only recently. This equipment represents the last word in optics, electronics and laser technology. The equipment will allow us to resolve structural and functional entities in cells beyond the Abbe diffraction limit.

My dishwasher is trying to kill me

New research finds harmful fungal pathogens living in dishwasher seals

Nina Gunde-Cimerman
CIPKEBIP
University of Ljubljana,
Biotechnical Faculty.

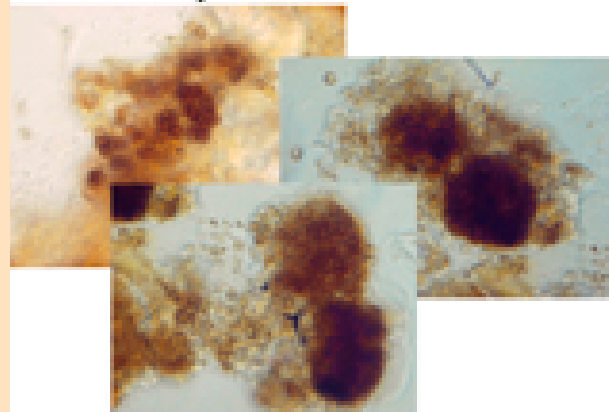
In June 2011 the group headed by Prof. N. Gunde-Cimerman, principal investigator of the research on the adaptations of extremophilic microorganisms within CIPKEBIP, published an article entitled "Dishwashers – A man-made ecological niche accommodating human opportunistic fungal pathogens" by P. Zalar, M. Novaka, G.S. de Hoog and N. Gunde-Cimerman. The article, which appeared in *Fungal Biology* (Elsevier), vol.115, issue 10, pp. 997-1008, 2011, immediately garnered major attention by the media and the scientific community. The combined online traffic hits on the major global media out-



Household extreme environments?



Directly from a dishwasher



lets that covered the story reached, at a conservative estimate, around 100 million people per day and 800 million people in one week. The scientific community reported the discovery in *Scientific American*, *ScienceBlogs* amongst others, while numerous scientists referenced it in their own blogs. In short, the story went viral and opened up a new field of research – the evolution of polyextremotolerant fungi into pathogens in our homes.

With modern living comes an increasing need for electrical household equipment such as dishwashers,

washing machines and coffee machines. A characteristic of these appliances is a moist and hot environment. In the case of dishwashers, high temperatures of between 60 to 80 C are produced intermittently and aggressive detergents and high concentrations of salt are used in each washing cycle.

The group led by Prof. N. Gunde-Cimerman has demonstrated that certain fungi, rarely isolated in nature and potentially dangerous to human health, have found a home living in extreme conditions in some of the most common household appliances.

The study focused on the occurrence of potentially pathogenic fungal flora located in dishwashers, over a sample of private homes from 101 cities on 5 continents. A total of 62% of the dishwashers contained fungi on the rubber band in the dishwasher door, 56% of which accommodated the polyextremotolerant black yeasts *Exophiala dermatitidis* and *E. phaeomuriformis*.

Both *Exophiala* species showed remarkable tolerance towards heat, to high salt concentrations, to aggressive detergents, as well as to both acid and alkaline water. This is a combination of extreme properties not previously observed in fungi.

Exophiala species are rarely isolated from nature, occasionally from saunas, but frequently encountered as agents of human disease, both in compromised and healthy people. They are also known to be involved in the asymptomatic pulmonary colonisation of patients with cystic fibrosis, and also occasionally cause fatal infections in healthy humans. The invasion of black yeasts into our homes represents a potential health risk.

The discovery of this widespread presence of extremophilic fungi in some of our common household appliances suggests that these organisms have embarked on an extraordinary evolutionary process that could pose a significant risk to human health in the future.



Prof. Dr. Nina Gunde-Cimerman

Lutetia, a new computer cluster, started operating this year

Sašo Džeroski, Bernard Ženko

A new computer cluster named Lutetia commenced operation this year at the Centre of Excellence for Integrated Approaches in Chemistry and Biology of Proteins (CIPKEBIP). The cluster is composed of two master servers, a disk subsystem, nine computer servers, and ancillary equipment.

A master server is a computer that handles user access to the cluster, distributes computational tasks to individual computing servers, and communicates the results back to the user. The cluster contains two identical master servers, so that if one of them

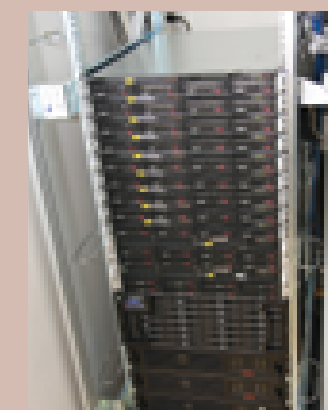


Sašo Džeroski

fails, the rest of the cluster can still function normally. Each of the Supermicro H8DG6-F-2U-RPS master servers contains two AMD Opteron 6134 (2.3GHz) processors with eight cores and 32GB of RAM. Computing servers are computers that actually perform all the required calculations. At this point, the cluster contains nine Supermicro AS-1022G-NTF-N computing servers, each containing two AMD Opteron 6136 (2.4GHz) processors with eight cores and 64GB of RAM. All user data is stored in the Infortrend EonStor S24F-R1840 WP-4 disk subsystem with 24 2TB hard disk drives. The drives are connected to a RAID disk array, which greatly reduces the possibility of data loss due to individual disk failure. The disk subsystem is connected directly to the master server, through which all the computing servers also have access to the data. The cluster design is modular, which makes it easy to upgrade the cluster in the future. We anticipate that the cluster will be extended with additional computing servers within the next two years.

The master servers as well as computing servers run the Fedora Linux

open source operating system. The distribution of computing tasks to computing servers is handled by the open source software package Cluster Resources Torque, through which users submit their jobs to the cluster and collect the final results at the end. Computational approaches play a very important role in protein research. The analysis of high-dimensional data (e.g. mass spectra) is computationally



very demanding; therefore, effective and timely analysis with desktop computers is not possible. The task needs to be handled by a cluster of computers with high computational capacity. The Lutetia computer cluster enables us to efficiently run computationally intensive analyses in computational biology and chemistry, and will be primarily used for data analysis with bioinformatics and machine learning methods.



Bernard Ženko

- ◆ Jožef Stefan Institute, Department of Knowledge Technologies
- ◆ Centre of Excellence for Integrated Approaches in Chemistry and Biology of Proteins



CE PoliMaT and Members of its Scientific Council

Left to right: Dr Miro Huskič (CE PoliMaT), Prof. Dr Peter Kranjc (CE PoliMaT), Prof. Dr Neil R. Cameron (University of Durham, U.K), Dr Andreas Holländer (Fraunhofer Institute for Applied Polymer Research, Potsdam, Germany), Dr Miroslava Duškova (Institute of Macromolecular Chemistry of the Academy of Sciences, Prague, Czech Republic), Mateja Dermastia, M.Sc. (Director of CE PoliMaT), Dr Zorica Crnjak Orel (CE PoliMaT),

CE PoliMaT: Our ambitions are international recognition, strong links with industry and formation of high-tech companies

Mateja Dermastia, Jadranka Jezeršek Turnes

The aim of the Centre of Excellence for Polymer Materials and Technologies is to become an internationally recognized center of excellence. Through strong research infrastructure, knowledge, an understanding of markets and trends, international connections and flexible development teams, CE PoliMaT supports the developmental efforts of Slovenian industrial partners and ensures the transformation of knowledge into products and services for high-tech market niches. 2011 was marked by hard work for CE PoliMaT: interdisciplinary research, studying the development potential for innovative, marketable products, as well as successful cooperation and linkages with industrial partners.

The development potential of CE PoliMaT is in the diversity of its 21 found-

Prof. Dr Gerhard Wegner, Director of the Institute of Microtechnology (IMM) and Professor Emeritus of the Max Planck Institute for Polymer Research from Mainz, Germany, at the first International Workshop of CE PoliMaT.



Prof. Dr Gerhard Wegner (Director of the Institute of Microtechnology and Professor Emeritus of the Max Planck Institute for Polymer Research, Mainz, Germany), Prof. Dr Majda Žigon (CE PoliMaT) and Dr Tanja Rajkovič

ers (16 private companies, 5 public institutions), the knowledge and capabilities of 84 researchers, and in the research infrastructure, which includes 27 instruments of top-level research equipment and our own laboratory at the Ljubljana Technology Park. In 2011, CE PoliMaT scientists published 41 articles in scientific journals as well as 7 inventions, 11 innovations, and 3 international patent applications. We also co-founded a spin-off company – MikroCaps. CE PoliMaT organized the first International CE PoliMaT Workshop, which took place on 1st and 2nd December 2011, in Ljubljana. Both Slovenian and foreign members of the international Scientific Council from recognized institutions, as well as researchers from CE PoliMaT, participated in the workshop, presenting their work within the framework of the R&D projects through presentations and posters. “In 2011, we paid a lot of attention to internal communication with our employees because we are aware that we have to create a new research environment which recognizes the importance of both research and applied development for industry and which will encourage cooperation with industry and high-tech companies. That is how we will move in the direction of functioning like other similar institu-

tions throughout the world.” said the Director of CE PoliMaT, Mateja Dermastia, M.Sc. In order to strengthen the importance of and raise consciousness of this aim, all employees participated in the First Annual CE PoliMaT Strategy Days in spring 2011, searching for answers to the challenges of the future within the four research areas of the CE PoliMaT through a structured workshop. The development of these kinds of competencies of employed researchers was supported in the past year by experimental workshops dealing with the following: high-tech entrepreneurship, exploitation plans for joint projects and nano-security etc. CE PoliMaT communication was strengthened through an on-line newsletter – PoliInfo – which is aimed at informing employees and key stakeholders about current happenings at CE PoliMaT, as well as at strengthening the identity of CE PoliMaT. In November, PoliBlog was created on the www.polimat.si website, where initially the founders of CE PoliMaT are being presented. In 2011 the CE presented its activities at 26 international events and conferences in Slovenia and abroad. Its researchers gave lectures at esteemed events such as the European polymer congress in Granada, Spain, Polymers for Advanced Technologies 2011 in



Founders, management, and employees of CE PoliMaT at the two-day strategic internal get-together sketched out the directions for the long-term development of CE PoliMaT. The First Strategy Days of the CE were marked by dynamic workshops and expert discussions aimed at the identification of developmental opportunities in individual research areas and the challenges inherent in bringing about technological breakthroughs.



Lodz, Poland, the 7th Coatings Science International in Noordwijk, the Netherlands and the International conference on plasma science in Philadelphia, USA. Slovenian events covered itself to the public through a program at the Road to the Future international professional fair in Celje in April 2011, in Advanced Materials Conference in September 2011 in Ljubljana and in the international SLONANO scientific conference in October 2011 in Ljubljana. In November, CE PoliMaT also took part in a conference on centers of excellence organized by the Ministry for Higher Education, Science and Technology where it was strongly involved in the joint development initiatives of the centers of excellence. In addition to all of the abovementioned activities, CE PoliMaT proactively organized workshops and discussions with industrial partners, carried out in cooperation with the Association of German Engineers (VDI). On November 20, it hosted an Estonian delegation, who visited CE PoliMaT along with representatives of the Ministry.

An extremely important achievement of CE PoliMaT in 2011 was the opening of the new laboratory at the Ljubljana Technology Park site, which is equipped with state-of-the-art synthesis and analytical equipment. “The key advantage of the laboratory is the possibility of establishing recognized and important meeting point for polymer research in Slovenia, and particularly for the three key partners in the research process: science, industry and the market,” says Klemen Burja, head of the laboratory.

Difficult economic conditions demand a high degree of responsiveness to the needs of industrial partners by CE PoliMaT. Breakthroughs on new markets and technological niches require a strengthening of competencies with respect to global trends and the direction of developmental investment by the EU through 2020 (Horizon 2020).

Mateja Dermastia, M.Sc., Director of the PoliMaT Center of Excellence:

"Innovation is the result of systematic work and investment in a variety of fields, as well as of the persistence of those involved, both on the side of industry and on the side of science. The success of CE PoliMaT is not measured only by benchmarks of scientific excellence such as scientific articles and patents, but also by contributions to the increase in competitiveness of industry and the development of local/regional economies. Our ambition is to encourage projects with industrial partners,

to spur innovation, and encourage the creation of start-up companies and new jobs."



In the future, the activities of CE PoliMaT will be oriented towards the realization of its vision to become an internationally recognized center of excellence, which will, through its links to top-level scientific knowledge and the economy, as well as its openness to the new and innovative initiatives, ensure the transformation of knowledge into products and services in high-tech market niches.

For the above-mentioned reasons, 2012 will be concentrated on and oriented towards cooperation between industry and science.

The aim of cooperation with industry is also to speed up the development cycle, to strengthen the capacity for faster breakthroughs in new markets, and to increase professional effectiveness. Our approach is based on cooperative R&D projects in which researchers from the academic sphere and from industry work together. In addition to the current approach, CE PoliMaT is working on new business models to improve and increase cooperation with industry and to become a truly good partner for Slovenian industry, as well as for small and medium size companies.

In 2012, we are also planning a number of international events, among which is participation in the **International Conference on TECHNOLOGY AND INNOVA-**

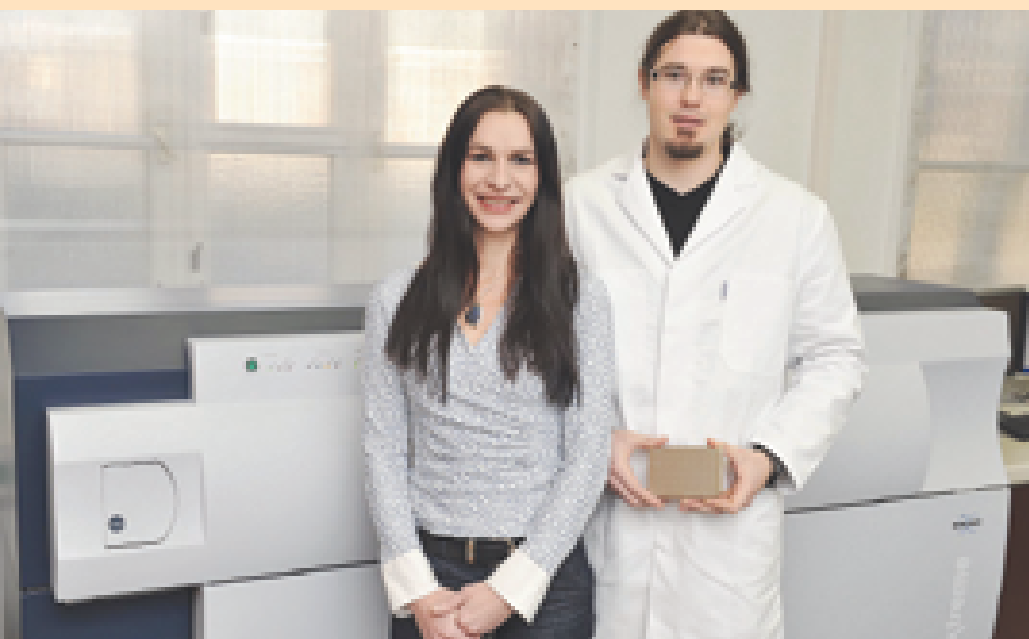
TION FOR GLOBAL DEVELOPMENT Schumpeter and Polymer Research, taking place in the USA from June 3-4, 2012 at the Harvard Kennedy School in Cambridge, Massachusetts. Scientists, high-tech companies, mayors, scientific attaches from Europe and other countries, and others will be attending this event. CE PoliMaT with its 84 researchers represents an exceptional concentration of knowledge in this field, which is also widely recognized in foreign research communities. We responded to the invitation from the Harvard Kennedy School that we would co-organize and be in charge of the part of the conference that deals with polymers for development (fields: health, agriculture, environment). We will be participating in four lectures, among which we will present our spin-off MicroCaps, which got the award for Technovation in April 2012 (Podim 2012), and we will be strongly including our industrial partners.

In September we will be participating in the FDI Summit Slovenia 2012 business investment conference, which will take place in Ljubljana from September 17-21, 2012. The goal of participation in this conference is to meet with potential business partners in the region. The FDI Summit Slovenia 2012 is an executive level business conference devoted to the investment environment and opportunities in Slovenia.

techniques such as MALDI ionization (matrix-assisted laser desorption/ionization) by which we can obtain intact molecular ions in the gas phase without the presence of fragmentations up to a mass of about 106 Da. The development of mass spectrometers with a high enough resolution and a high signal/noise ratio is also important – these are the time of flight (TOF) mass spectrometers. With these kinds of MS instruments, we can determine the chemical composition, functionality, kinds of end groups, microstructure (sequence), and the absolute molar mass up to about 105 Da of the polymer. We can also determine the presence of impurities and other side products that arise during the synthesis of polymers (cyclic structures, etc.). For the study of microstructures (sequences) and the distribution of functional groups in the chain it is incredibly useful to use tandem mass spectroscopy (MALDI-TOF-TOF MS), since it allows the controlled fragmentation of a given molecular ion in a collision cell between two parts of a tandem TOF-TOF analyzer. In cases where the polymer is previously fractionated using liquid chromatographic techniques (SEC, HPLC), we can also determine the distribution of defined characteristics of polymers, e.g. the distribution of molar mass, distribution of functionality or components. Due to the above capabilities of this technique, MALDI TOF MS instruments are an indispensable piece of equipment in every better equipped polymer laboratory today.

UltrafleXtreme MALDI-TOF-TOF is the instrument which represents the greatest investment in research equipment by CoE PoliMaT. Standing by the instrument are Dr Ema Žagar and Jure Cencelj. The mass spectrometer (MS) is an indispensable technique for characterizing complex polymeric materials primarily for development, i.e. soft ionic

Dr Ema Žagar and Jure Cencelj in front of the MALDI TOF TOF instrument



2012 will also be marked by intensive preparations for the Austrian Slovenian Polymer Meeting 2012, which will be held from April 3 - 5, 2013, an international scientific conference bringing together the whole region and presenting the newest research in the field of polymers.

The aim of the research and development work at CE PoliMaT in the upcoming year will be the development of new materials, specific applications

and solutions for industrial partners. The ambition of CE PoliMaT is to be able to quickly identify the problems of industrial partners and initiate new scientific understanding in applications for the market through innovations and patents. This approach will support the efforts of Slovenia in its transition to a low-carbon society, as well as in creating new jobs and high-tech companies for sustainable growth, and will enable CE PoliMaT to fulfill its mission.

Connecting Industry and CE PoliMaT

CE PoliMaT and the **Akripol** company, which is one of the co-founders of CE PoliMaT, have combined their research teams in a project to optimize production. The aim of the project to optimize production is to raise the efficiency of the functioning of certain production lines and thus to reach the projected capacity for producing acrylic sheets. **Dr Gabriela Ambrožič** and **Silvo Bolka, B.S.**, are the collaborators from the CE PoliMaT side. In the project, CE PoliMaT tracks development goals, such as: determining the models and preparation processes and the execution of the project for the industrial partners, the development of a network of researchers and engineers capable of carrying out complex projects oriented towards raising the competitiveness of the industrial partners, as well as establishing a development fund at CE PoliMaT.

Reaction Calorimeter 1 (RC1) is a sophisticated, multi-component instrument-reactor for carrying out syntheses, primarily for the synthesis of polymers or of nanoparticles. The system with a calorimeter is also equipped with additional probes: an infrared (IR) probe uses IR spectroscopy to track events in the reactor and the focused beam reflectance measurement (FBRM) probe can, for example, be used during the process of crystallization to track the size, growth or melting of particles. The instrument allows controlled dosing, pressure adjustment and the determination of thermodynamic changes (heating/cooling). The key advantage of RC1 is that it shortens the whole development process from formulation to scale-up, from technological process to production. It optimizes the time used and reduces the number of experiments needed. It offers, in essence, optimization of the entire development process in industry.



Klemen Burja, head of laboratory at CE PoliMaT, at Reaction Calorimeter 1.



Synthesis section of the laboratory at CE PoliMaT

CE PoliMaT has four priority fields of research:

Field 1: Technical products for advanced applications and energy. This field is oriented towards the development of high-tech materials with a high-value added. The key research focus is nanotechnology: new nanocomposites and nano-organized materials, which will allow better specific characteristics of materials to be created. This field is coordinated by Dr Zorica Crnjak Orel.

Field 2: Coatings and Adhesives. This field is very important for the Slovenian chemical industry since a large part of its income derives from the sale of these materials. The emphasis here is on improving synthesis procedures and reducing the use of organic solvents in production and later technological processes, as well as in the final formulations, and formulations of water-based coatings for advanced applications. This field is coordinated by Dr Peter Venturini.

Field 3: Renewable resources, degradation and stabilization. This field is oriented towards the use of materials from renewable resources in the production of polymers and towards the study of degradation processes and stabilization of natural and modified natural polymeric materials. The main emphasis is on the use of lignocellulosic biomass, which includes the liquification, modification and processing of wood and waste wood products, which will serve as the raw material for the production of other materials or for fuel. This field is coordinated by Janez Navodnik, B.Sc.

Field 4: Polymers for Health Safety and Medicine. This field is oriented towards the development of multifunctional materials for use in surgery and for the faster post-operative healing of wounds, the development of functional polymeric surfaces with specific anti-thrombogenic characteristics for venous transplants, biodegradable and biocompatible drug delivery systems and chromatographic macroporous polymeric materials for cleaning biological macromolecules. This field is coordinated by Prof. Dr Karin Stana-Kleinschek.

2011 was marked by excellent research work and the successful establishment of the laboratory at CE PoliMaT

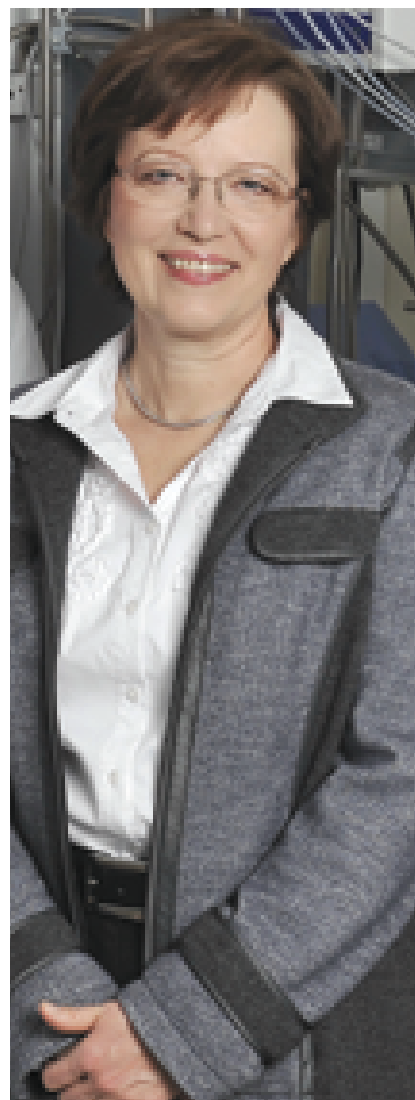
Jadranka Jezeršek Turnes

What kinds of scientific and professional results did CE PoliMaT achieve in 2011? As president of the Scientific Council of CE PoliMaT, are you satisfied with the results achieved and the professional advances made, as well as with the work carried out in 2011?

M. Žigon: The outcomes of the activities by individual R&D projects (RRP) were in accordance with expectations, just as they were planned to be. Certain projects' activities were oriented in the direction of more basic research, while others were more in the direction of developmental research. In the same way, the results of certain projects were mostly articles, some in the best journals of their fields, whilst in other cases, innovation, international and Slovenian patent applications, as well as prototypes suitable for testing with industrial partners, took the lead, which is one of the central goals of 2012. The work in 2011 was very intensive. The Scientific Council regularly tracks, evaluates and prepares recommendations for changes, so that individual activities can adjust to the outcomes of research and evaluation. In July, an international evaluation was carried out, which was favorable and matched, for the most part, the recommendations of the Scientific Council of CE.

CE PoliMaT hosted the International Workshop of the PoliMaT Center of Excellence, which was also attended by foreign members of the Scientific Council of CE PoliMaT. What were their recommendations from their recent visit to the International Workshop?

M. Žigon: Foreign members of the Scientific Council and those from business who are not members of CE PoliMaT presented the results of their research and expertise to those present at the workshop. **Prof. Dr Gerhard Wegner, Director of the Institute of Microtechnology (IMM) and**



Prof. Dr. Majda Žigon (CE PoliMaT)



Silvo Bolka at the liquid chromatograph used for HPLC/SEC analysis, which is used for cleaning or rather separating and determining the

individual components of polymers and polymeric materials, as well as for determining their molar mass and distribution of molar mass.



Klemen Burja, head of laboratory at CE PoliMaT



Polona Prosen carrying out a thermogravimetric analysis.

Professor Emeritus of the Max Planck Institute for Polymer Research from Mainz, Germany, emphasized the importance of the use of nanoparticles on the basis of polystyrene, a thermoplastic polymer, and polypyrrole, a conductive polymer, for plastic electronics. **Prof. Dr Neil R. Cameron from University of Durham, U.K.,** presented well-defined porous polymers, prepared by emulsion polymerization with a high proportion of internal phases (polyHIPE) and their applications as carriers for catalysts and as matrices for growing cell cultures in vitro. **Dr Andreas Holländer from the Fraunhofer Institute for Applied Polymer Research in Potsdam, Germany,** presented the activities of the institute and the Department for Functional Polymer Systems, where they study the technology of surfaces and of intermediate layers. He presented various applications such as printing, the prevention of forgery of surfaces, and the technology of encapsulation for organic light emitting diodes, OLED.

Dr Miroslava Duškova of the Institute of Macromolecular Chemistry of the Academy of Sciences from Prague, Czech Republic, presented the theory, the experimental results, and applications of synthetic polymeric hydrogels at the workshop. **Dr Mojca Fir Japelj from the firm CBS Institute from Trebnje, Slovenia,** presented an innovation in the use of polysulfide for sealing heat and sound insulation panels, which the CBS Institute presented at the 6th Annual Slovenian Forum of Innovation. **Dr Alexis Zrimec, Director of the firm Zaria iM,** presented the route from ideas through development and innovation to production, as well as the process of establishing a supportive environment for successful technology transfer and the effect of innovations on the market.

In the second part of the workshop, researchers from CE PoliMaT presented their results through either lectures or posters. The international workshop was a great opportunity for the direct exchange of ideas among employees as well as with members of the international Scientific Council. After the workshop ended, there was a session of the international Scientific Council, which weighed up whether the results shown were in accordance with the program goals, evaluated the quality of the research work carried out to date, and proposed directions for ongoing work.

What does the acquisition and start of work in the laboratory mean for research work and the ambitions of the CE PoliMaT?

M. Žigon: We are very happy about the new laboratory since it brings together a large number of pieces of new state-of-the-art research equipment in one place, as much for synthesis and processing, as for the characterization and analysis of polymeric materials and their components. All the equipment is important for the development and preparation of new materials and for the study of the interdependence between the components, the structure and the characteristics of the materials. A laboratory with suitable equipment also allows the execution of conventional laboratory synthesis and the preparation of samples for analysis. The space is also large enough for both work and study areas for those employed there. The laboratory certainly plays a very important role in the quality of the R&D activities carried out at CE PoliMaT.

We are proud of the **reaction calorimeter**, a high pressure laboratory reactor with in situ FTIR and probe for in-process particle characterization, which was first kept at the Mitol company in Sežana, where the first trials of synthesis of dispersions, aqueous binders, and nanopowders were held. It is also suitable for the transfer of processes from the laboratory scale to a larger scale, through which we can obtain larger quantities of samples for semi-industrial testing of new materials.

Using the laboratory mini-extruder we can already prepare composites and nanocomposites in gram quantities, which allows for the use of surface modified nanofillers that we are developing in milligram to gram quantities within the framework of the project 'Composites, Nanocomposites and Nanostructure', and we are studying their influence on the characteristics of the polymer matrices used.

We are also well-equipped for the analysis of materials. Here I must mention thermal analysis for tracking heat changes and reactions using the **differential scanning calorimeter (DSC)**, as well as the changes in mass or monitoring the degradation of materials using the **thermogravimetric analyzer (TGA)**. Because the TGA is equipped with a mass selective detector we will be able to determine the components that are released from the material when heated. In the laboratory we also have a **liquid chromatograph** with which we will be able to determine the molar masses of soluble components of polymer materials and their distribution using the SEC method as well as to separate and determine individual components of polymers and polymeric materials using HPLC method. Other important equipment for synthesis (a laboratory high-pressure reactor, a UV system for polymerization, laboratory mixer reactor, spray dryer), processing equipment (laboratory shear mixer for powders, laboratory and pilot scale electrospinning device) and analysis equipment (e.g. MALDI-TOF-TOF mass spectrometer, narrow-angle- SAXS and wide-angle x-ray spectrometer WAXS, respirometric analyzer of biodegradability, particle size analyzer in aqueous solution) are housed at various locations of the co-founders of the center and can be used at any time by arrangement with the operator; there will be a reservation system on the CE PoliMaT website for this purpose.



Dr. Gabriela Ambrožič at the Easy Max 102 instrument, where formulations for testing in Reaction Calorimeter 1 are prepared.

“Materials are conquering the world”. News from the Centre of Excellence:

Advanced Materials and Technologies for the Future, the Centre of Excellence NAMASTE.

The scientific results of the CoE partners are considered excellent. It is a particular strength of this CoE that it has an excellent balance between fundamental and applied research.

From the “Evaluation report” of the external expert (July 2011)

The Centre of Excellence NAMASTE is a multi-disciplinary and trans-disciplinary consortium of research institutions and industry, who have decided to merge academic, technological and business expertise, skills and equipment in order to achieve major scientific and

technological progress as well the transfer of results to industry. The working area is related mainly to inorganic, non-metallic materials as well as organics and composites and their implementation in electronics, optoelectronics, photonics and medicine. More specific topics are ceramic 2D and 3D structures; materials for over-voltage and EM protection; materials, micro- and nano-systems for sensors; soft composites for optical, electronic, photonic and sensor applications; and bioactive, biocompatible and bioinert materials. Strategic goals: continuity in research excellence, knowledge dissemination and technology transfer, and multi-disciplinary interconnections. The consortium consists of three research institutions with eleven research groups, three non-profit organizations, and thirteen companies from different regions of Slovenia.

The key issue for success is the scientific excellence of the research partners, the technological and business excellence of the industrial partners, and above all the confidence between the partners, particularly industry and academia, that is built on positive experiences. The last of these is the most important. The

Centre of Excellence NAMASTE therefore carefully tries to reinforce existing or build new connections based on common projects where members of the Centre of Excellence NAMASTE coming from academia and industry work together on a daily basis, by organizing training schools, strategic conferences, visits to industrial partners, etc. Among the most successful events was the Workshop on Material Characterisation, which had a large number of participants from industry together with students, and the last strategic conference with almost equal numbers of presentations from industry and research labs. In addition to the increased interest between those two groups, i.e., industry and research, we also note an increased level of communications within the industrial community. For more information visit <http://www.conamaste.si>.

This is the second presentation of the Centre of Excellence NAMASTE in Quark. This time we present several selected activities of our partners from the research institutions and industry, primarily those that were not reported in the previous issue.



Prof. Dr. Marija Kosec, Director.

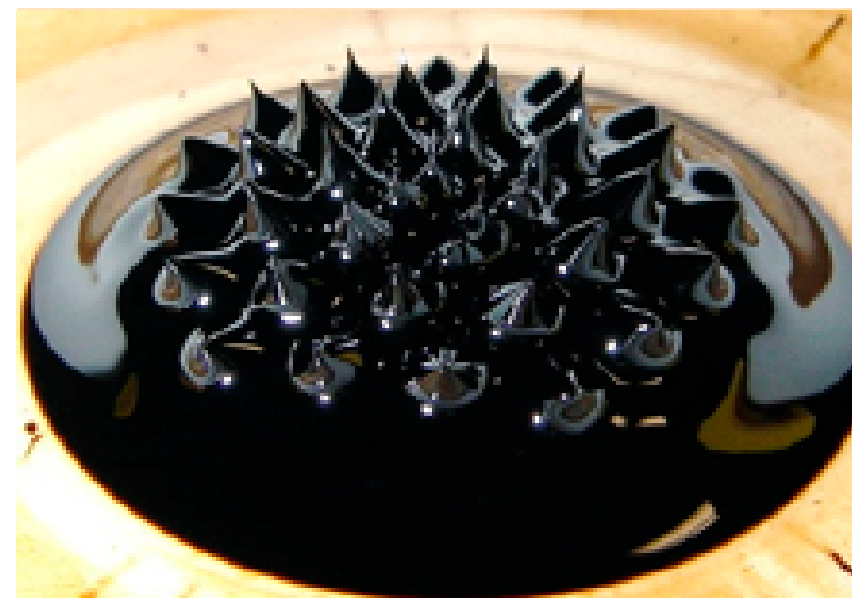


Figure 1: Magnetic fluid.

Nanofluids for applications in magnetic hyperthermia

Centre of Excellence NAMASTE

Faculty of Chemistry and Chemical Engineering, University of Maribor

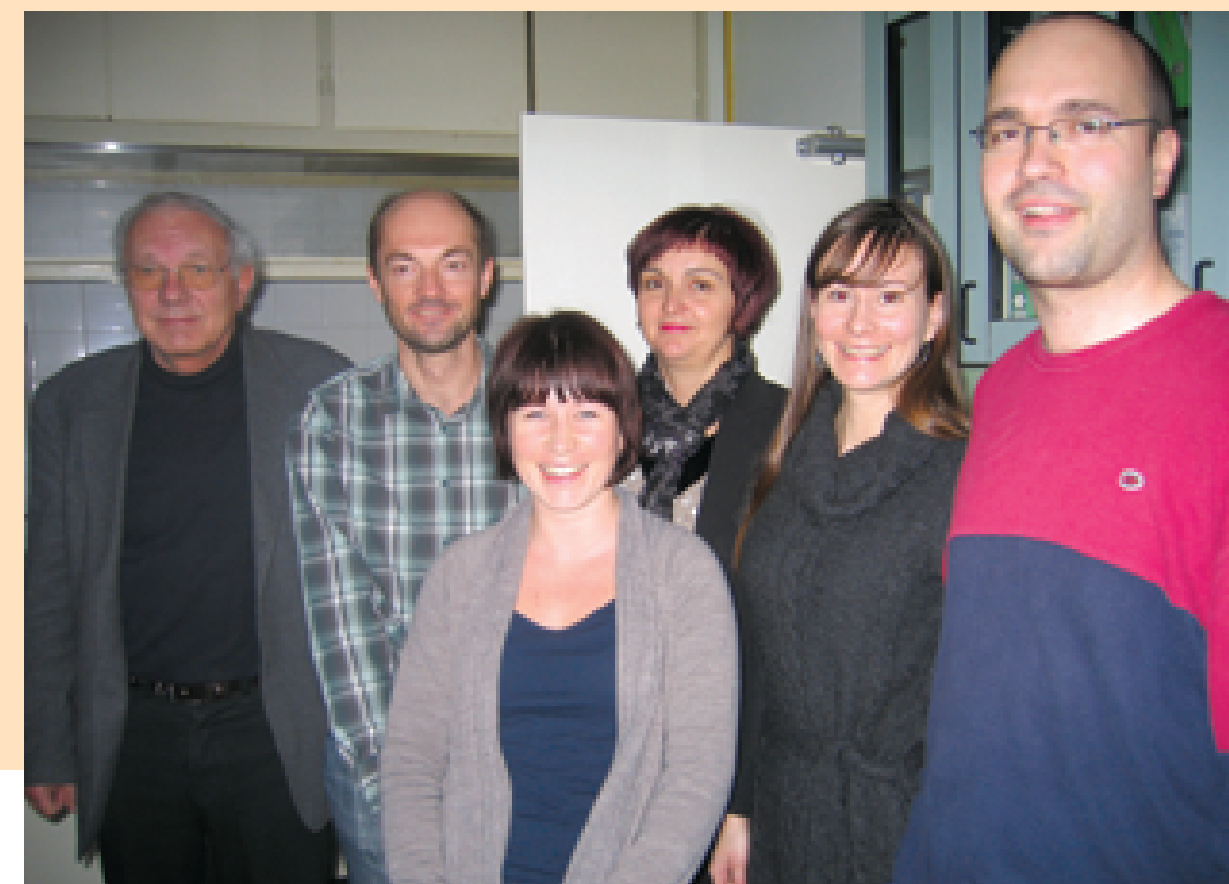
Asst. Prof. Irena Ban

The Department of Inorganic Chemistry at the Faculty of Chemistry and Chemical Engineering covers a range of research fields focusing on the investigation, synthesis and characterization of nanosized, magnetic materials for biomedical applications, such as magnetic resonance imaging, magnetic targeted drug delivery, and magnetic fluids for hyperthermia.

This scientific excellence is supported by new equipment, owned by the Centre of Excellence NAMASTE, which provides the necessary foundation

for carrying out the research. The Head of the Department and the research group in the Laboratory of Inorganic Chemistry is Prof. Miha Drofenik.

Research group of the Faculty of Chemistry and Chemical Engineering, University of Maribor and the Centre of Excellence NAMASTE.



The main research areas are:

- Synthesis of inorganic magnetic nanoparticles for the preparation of magnetic fluids,
- Synthesis of inorganic compounds by sonochemical reactions,
- Hydrothermal synthesis of hexaferrite magnetic nanoparticles.

It is well known that an increase in tumour temperature decreases the tumour's resistance to chemo- and radiation therapies. The localized magnetic hyperthermia exploits the greater sensitivity of the tumour cells when heating to about 42-45 °C. The treatment of the tumour cells, where any damage to healthy cells can be avoided, can be realized by using magnetic nanoparticles with controlled Curie temperatures. Magnetic-fluid hyperthermia involves the introduction of nanoparticles as mediators into the tumour tissue and heating them with an alternating magnetic field (AMF). The generated heat can be controlled using nanoparticles with an adaptable Curie temperature. For example, coated CuxNi1-x alloy particles, which should be biocompatible, have a Curie temperature (Tc) in the medically suitable range and efficiently absorb AMF energy below the Tc.

Several techniques are used for the preparation of magnetic nanoparticles that are suspended in magnetic fluids. The most frequently applied techniques in our laboratory are: mechanochemical synthesis, chemical co-precipitation by the microemulsion method and sonochemical synthesis.

The main object of the project is to prepare and optimize the magnetic fluids based on magnetic particles and an important step of the investigation proposed in this program is focused on the surface engineering of the nanoparticles.

R&D breakthrough in the field of ZnO-based varistor ceramics

Centre of Excellence NAMASTE

Jožef Stefan Institute

Prof. Slavko Bernik

A group of researchers from the Jožef Stefan Institute (JSI) is successfully continuing its research in the field of ZnO-type varistors based on low-doped varistor ceramics in collaboration with industrial partners from VARSIS and Iskra Zaščite, and also within the Centre of Excellence NAMASTE, which provides a new, high-quality R&D framework.

Research on ZnO-based varistor ceramics started at the institute about 35 years ago, soon after the first reports in the literature about the current-voltage non-linearity in doped ZnO ceramics. In collaboration with researchers from industry the transfer of know-how resulted in the industrial production of varistors in Slovenia, which started in 1981. Since that time the collaboration continued with numerous successfully realized projects and resulted in world-wide-recognized, top-class, energy varistors for low-, medium- and high-voltage applications in overvoltage protection, produced by the VARSIS company. These varistors are also used in surge-protection devices (SPDs) produced by Iskra Zaščite.

ZnO-based varistor ceramics – ZnO doped with typically 7 to 12 wt.% of oxides of Bi, Sb, Co, Mn, Ni and Cr – are characterized by a high current-voltage (I-U) non-linearity and energy-absorption capability. Hence, they are widely used for overvoltage protection at voltages ranging from a few volts up to several 100 kilovolts. Varistor ceramics are highly resistive up to the so-called break-down voltage, at which point it switches, in a matter of nano-seconds, into a highly conductive state so that the current increases by several orders of magnitude for a small change in voltage. While

the electrical characteristics in the pre-break-down region are controlled by electrostatic barriers at the grain boundaries, each ideally with a break-down voltage of about 3V, at high currents the conductivity of the ZnO grains is important. The size of the ZnO grains determines the number of grain boundaries for a given thickness of ceramic and its break-down voltage. Hence, control of the grain-growth and microstructure development is essential for the successful preparation of various types of varistors. For good current-voltage characteristics of the varistor ceramics only non-ohmic grain boundaries and

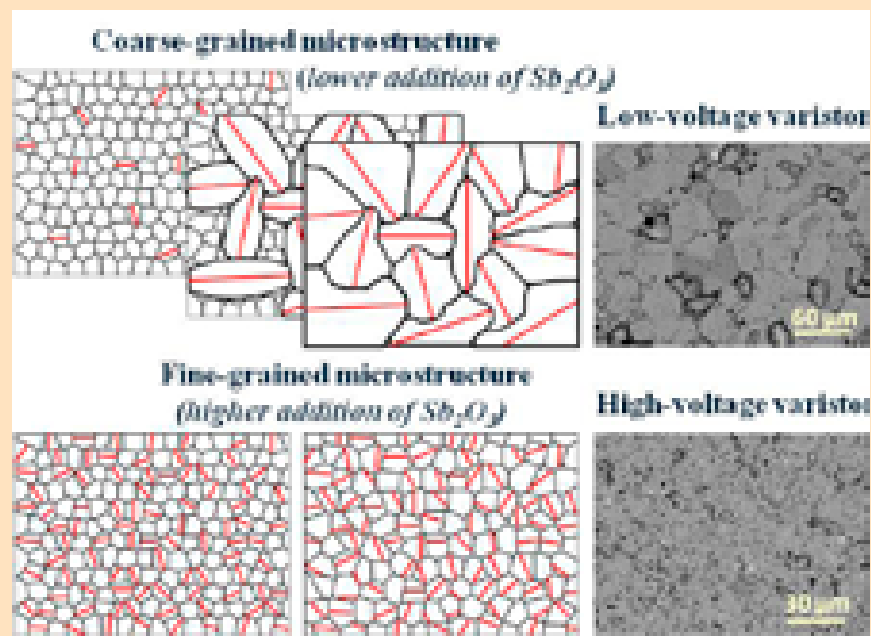


Figure 1: Inversion-boundary (IB) induced grain-growth mechanism enables the tailoring of either coarse- or fine-grained ZnO-based ceramics for low additions of IBs-triggering dopants (Sb_2O_3).

highly conducting ZnO grains of the appropriate size for a certain break-down voltage are essential.

In fine-grained ceramics for high voltages Sb_2O_3 is typically added, while in coarse-grained ceramics with a low break-down voltage TiO_2 is usually the dopant for the grain-growth control. Both dopants result in the formation of the spinel phase in reaction with ZnO. While in the case of Sb_2O_3 the inhibition of the grain growth is generally attributed to the reduced grain-boundary mobility caused by the Zener pinning effect of the spinel grains at the grain

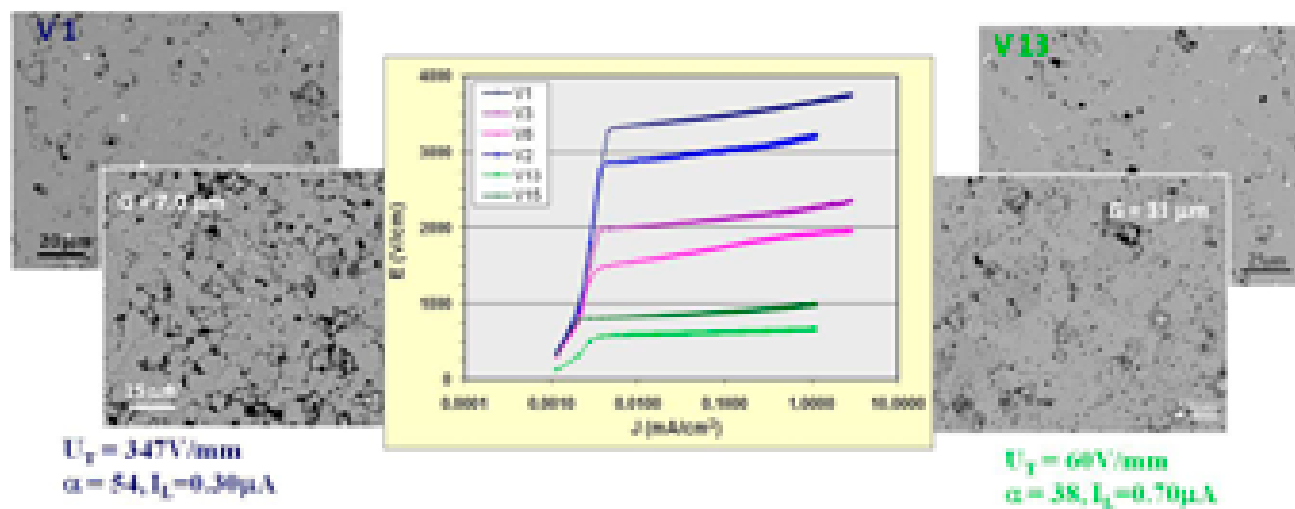


Figure 2: Microstructures and current-voltage characteristics (E vs. J) of low-doped varistor ceramics with the addition of 3-4 wt. % of varistor dopants to ZnO, sintered at 1200°C for 2 hours.



Research group working on ZnO-based varistor ceramics: from left to right Asst. Prof. Slavko Bernik, Dr. Nina Daneu, PhD student Matejka Podlogar, Dr. Aleksander Rečnik.

boundaries, enhanced grain growth with the addition of TiO_2 was never properly explained. However, both dopants result in the formation of inversion boundaries (IBs) in the ZnO grains; in the case of Sb_2O_3 the IBs are present in each ZnO grain of the varistor ceramics, while during the addition of TiO_2 only in some, typically extremely large, grains.

Researchers from the JSI discovered that IBs play a key role in grain growth and microstructure development, while the role of the spinel phase is subordinated. Grains that are infected with an IB in the early stage of sintering preferentially grow at the expense of normal grains until they collide with

each other and completely prevail in the microstructure. The number of grains infected with IBs can be controlled with small amounts of the IBs-triggering dopant (Fig. 1). At lower additions of Sb_2O_3 fewer grains are infected with an IB and can grow larger before they collide with each other, which results in coarse-grained ceramics. However, at larger additions of Sb_2O_3 more grains are infected with the IB and can grow very little before they impinge on each other, which gives fine-grained ceramics. Based on an understanding of the true mechanism that controls the grain growth in varistor ceramics, the group from the IJS developed varistor ceramics having only 3 to 4 wt. % of varistor dopants added to ZnO with an excellent I-U non-linearity and break-down voltages ranging from 60V/mm to 350V/mm, all with Sb_2O_3 as the additive for the grain-growth control (Fig. 2) and sintered at 1200°C for 2 hours. In contrast to the classical varistor ceramics with an about 3-times higher addition of dopants and a large amount of secondary phases (they are not important for the electrical characteristics and only hinder them),

low-doped varistor ceramics contain only minimum amounts of secondary phases (Fig. 3). Besides the ecological benefits, low-doped varistor ceramics also means saving on raw materials and significant cost reduction in the range from 0.5 to 1.4 per 1 kg of varistor mixture at current prices. The discovery of the researchers from the JSI set trends for the optimization of the compositions of varistor ceramics and the development of a new generation varistors of all types.

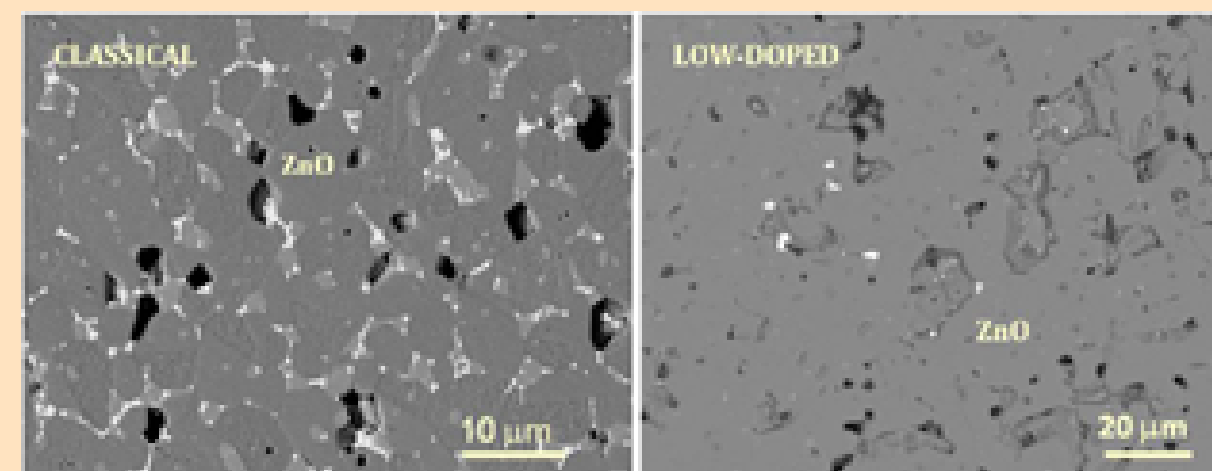


Figure 3: Microstructures of classical varistor ceramics (10 wt. % of varistor dopants) and low-doped varistor ceramics (3 wt. % of varistor dopants), sintered at 1200°C for 2 hours. Both materials have a break-down voltage at 200V/mm and a coefficient of non-linearity equal to 40. Note the difference between the samples in terms of the amounts of secondary phases.

An electromagnetic absorption material for use in architectural coatings

Nanotesla Institute
HELIOS Ltd.

Asst. Prof. Andrej Žnidaršič,
Dr Branka Mušič,
Dr Peter Venturini

The most important functions of paints are aesthetic and the protection of substrates. Nowadays, it is important to offer functional coatings to our customers. One field of activities in the field of functional coatings is oriented towards the development of advanced materials for decorative and functional applications. In this sense, our current interests are in many areas of surface science, including multifunctional, ceramic coatings. For this reason the Helios Group

collaborates with the Kolektor Group, Nanotesla Institute from Ljubljana, which is the R&D centre that builds on significant expertise in the field of nanomaterials and composites, microwave applications and magnetism as well as having years of industrial background and substantial investment in state-of-the-art equipment.

Major changes in wireless technology give us new possibilities for the development of electromagnetic composite systems. The everyday usage

of different devices emits electromagnetic radiation and, as a result, the amounts of electromagnetic radiation are continuously increasing. In the European Pre-standard ENV 50166-2:1995 – Human exposure to electromagnetic fields – High frequency, it states that electromagnetic fields interact with the human body and other systems through a number of physical mechanisms.

Therefore, the need to protect people and devices from harm and to prevent something from being detected by other instruments is spawning a world of activity in the development of novel, EM-wave-absorption materials. An ideal EM-wave absorber should possess light weight, high EM-wave absorption and multi-functionality. Electromagnetic protection coatings are interactive, responsive coatings and can offer advances in coatings, such as absorbing electromagnetic waves and providing protection from radiation. The purpose of our work was to investigate the electromagnetic-absorber properties of a resin compact containing ferrite powders. The putties were made from spinel structure ferrite powders with a defined synthesis process, particle size and surface area.

Here, the bandwidth is defined as the frequency width in which the reflection loss is less than -10 dB, which indicates that 90 % of the EM waves are absorbed. This shows that by changing the thickness of the material with the

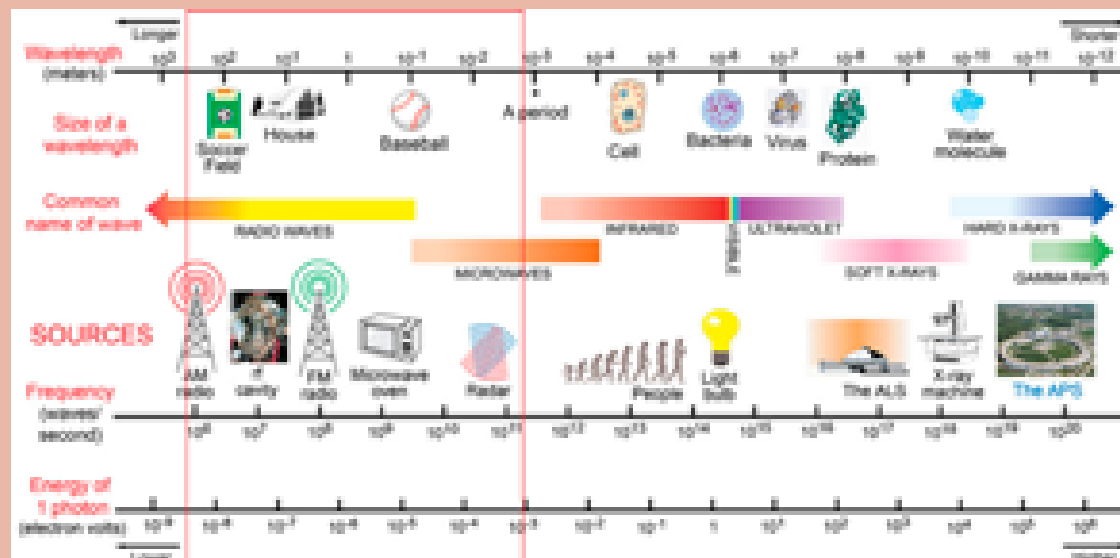


Figure 1: Electromagnetic spectrum.

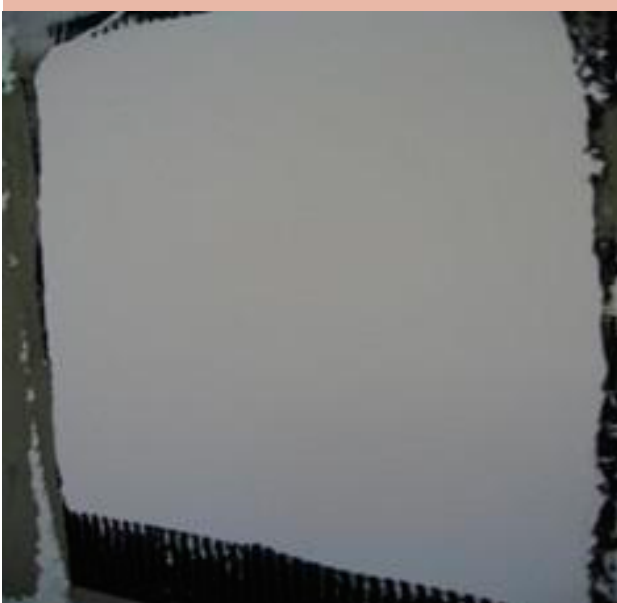


Figure 2: Image of the applicative putty, thickness 5 mm.

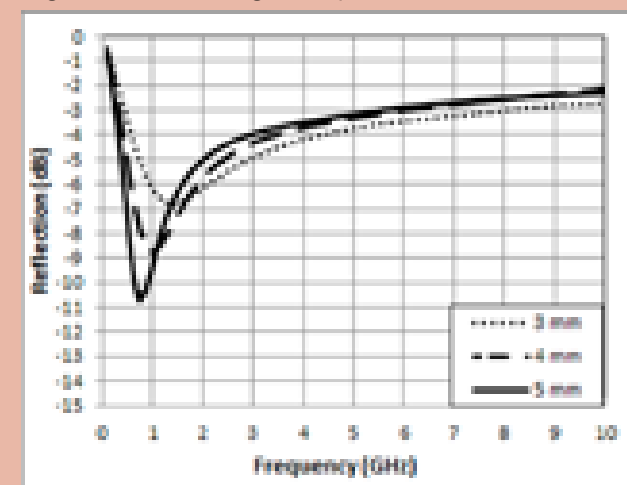


Figure 3: Reflection curves for different thicknesses of absorption layer.

spinel ferrite structure, the position and the attenuation-peak frequency can be easily manipulated in terms of the frequency range. We can conclude that composite materials with a large fraction of the spinel phase/structure can be used as electromagnetic wave absorbers in the lower GHz range.

Gas discharge tubes Iskra Zaščite

Iskra Zaščite Ltd.
Centre of Excellence NAMASTE
Dr Robert Rozman

Iskra Zaščite is today one of Europe's leading suppliers of surge-protection devices (SPDs) for power, data and telecommunications. One of the most important elements in SPDs is the gas discharge tube (GDT or gas arrester). To improve the flexibility in SPD production, we decided to develop our own GDTs.

In general, the GDT or gas arrester consists of two electrodes that are separated by a ceramic tube, the interior of which has been completely sealed and filled with an appropriate mixture of gases. In the presence of low voltages on the electrodes the GDT acts as a perfect insulator, while with the occurrence of surges the GDT begins to conduct an electrical current. To achieve repeatability of the production it is very important to have a knowledge of gas and plasma physics, the physics of materials and vacuum techniques. In addition, high-tech equipment is very important for the development and manufacture of GDTs. For the purpose of the development and production of GDTs we recently updated our laboratories with the construction of new clean-room facilities and a new, modern vacuum furnace.

In our GDTs the first electrode is a metal body and the second electrode is inserted through the insulator. Such a GDT is essentially different from the usual GDT with a ceramic body, which globally accounts for a more than 99% share. The advantage of a GDT with a metal body in comparison to the usual configuration, where the body is ceramic, is mainly in the larger areas of the electrode with the same external dimensions. The larger areas of the electrodes lead to higher current capabilities. In addition to this new geometry, the work within the Centre of Excellence NAMASTE was focused on finding the optimal materials and the proper gas mixture for the GDT. To define the materials and gases we

made a large set of samples, which we tested at a high-current surge generator. The final results show a large reduction in size for the GDT in comparison to the state of the art. With this innovation we achieve a very small size of the GDT for high-current surges, which allows significant savings with respect to the installation space compared to an ordinary GDT.

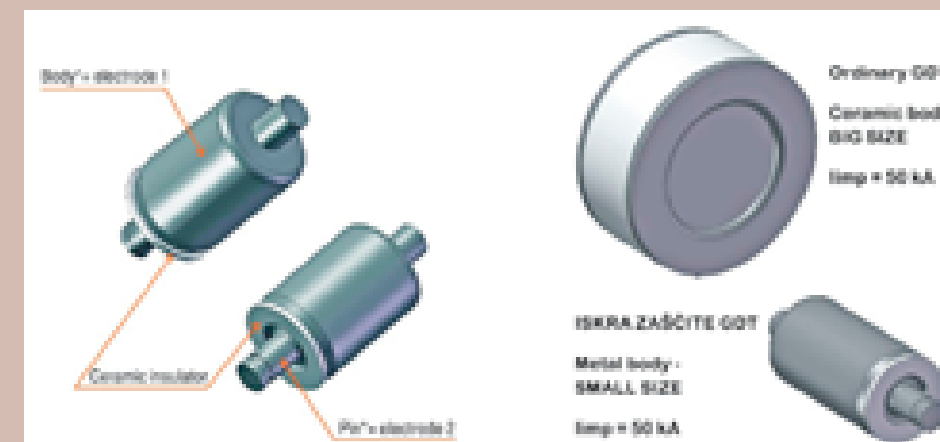


Figure 1: New patented construction of the GDT and a size comparison.

The main disadvantage of a GDT is the ability to extinguish the arc current in the presence of high follow currents. Therefore, the project includes the development of a special design of GDT, which will be able to extinguish the follow current of up to 25,000 A. This will lead us to a new SPD application where the GDT can be independently used between the line and the neutral (L-N).

Research group working on the development of gas discharge tubes (GDTs): from left to right, Dr Robert Rozman, M. Sc. Andrej Pregelj, France Breclj and Beno Pehani.



Liquid-Crystal light shutters for personal protection

Jožef Stefan Institute
Centre of Excellence NAMASTE
Balder Ltd

Prof. Janez Pirš,
M. Sc. Bojan Marin,
Bernarda Urankar,
Dušan Ponikvar

The technology for liquid-crystal applications has made an important breakthrough in the past ten years. The new, high-resolution LCD display panels for computer monitors and TV display panels have made liquid crystals the key technology for display applications. However, a number of non-display applications have emerged as well.

A typical example of this is LCD optical light shutters that allow for electrical control of the transmitted light based on the electrical and optical anisotropy of these materials. The most widespread application is automatic LCD protective light filters for personal protection in welding. With the difference from, e.g., regular high-definition TV screen having 2 million (1920 x 1080) display pixels (local light shutters) allowing for displaying images, the LCD protective light filters have only one such switching element, controlled by two electrodes. Compared to a standard display pixel (of the, e.g., TV screen) the LCD light switching protective filter must be able to:

- reduce the incident light by 1000 times more than a display pixel of a TV screen
- provide passive protection against harmful IR- and UV-light generated during the welding process
- selectively detect the welding light and modulate the transmitted light accordingly

Such extreme performance can be achieved only by:

- two LCD light shutters in tandem with a built-in optical compensation layer,
- a much higher driving electric field,

an additional passive optical band-pass filter transmitting incident light only in the visible spectral range.

As is evident from the figure, such a protective automatic optical filter is in fact a multilayer laminate comprising two LCD cells with additional optical compensation layers, four polarizing filters and a protective passive optical filter that reflects harmful infrared and ultraviolet light generated during the welding process.

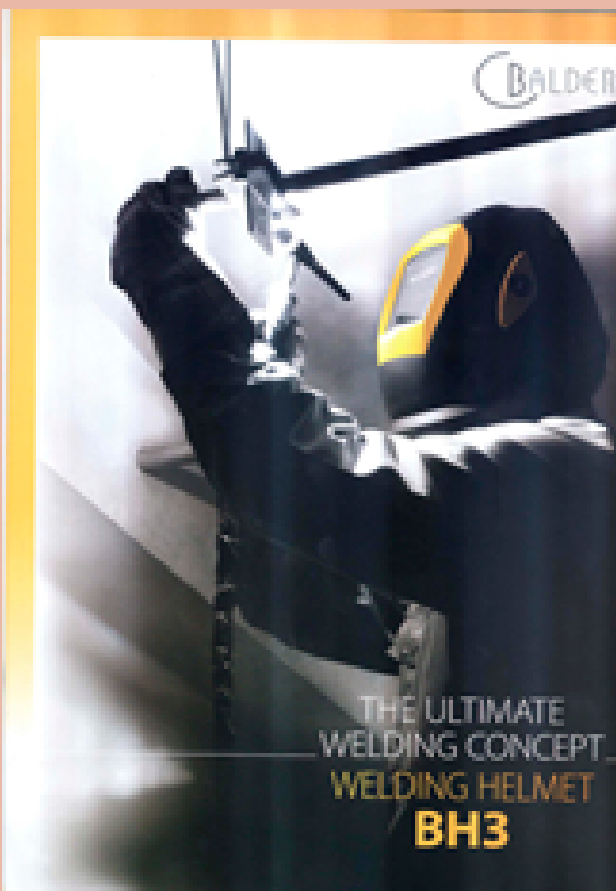
The protective welding helmet with a built-in automatic LCD light-switch-

ing filter significantly improves the working conditions for the welder. It provides the welder with complete protection as well as normal vision before, during and after the welding, without continuous "lifting and lowering" of the protective helmet. So the welder has both hands free and can perform his/her work much more efficiently – and much better.

In the course of a number of its research projects (NATOSfP, EU-FW5, as well as ARRS and TIA), the Jožef Stefan Institute (JSI) has developed an improved LCD light-shutter concept for personal protection applications. A number of original technical solutions (5 granted international patents) allow the JSI spin-off Company Balder Ltd to offer its new product line "ADC-plus" protective welding filters on the world market (3M, Honeywell, etc.) as the only automatic weld-



DIN-Plus 1/1/1/1, CE1/1/1/1 – quality certificate



ing filters in the world that can be labelled with the prestigious marking DIN Plus 1/1/1/1 or CE 1/1/1/1 (maximal optical quality) according to the international standard EN 379. On the grounds of the high performance of these products the International Standard Organization (ISO) invited the Jožef Stefan Institute and Balder Ltd to actively participate in its expert group ISO/TC94/SC6/WG2 and WG4 preparing the new ISO Standard: "Occupational Eye and Face Protection". Within CoE NAMASTE a number of improvements is expected.

Chemical Sensors and their Applications in Traceability and Safety Systems

Faculty of Electrical Engineering, University of Ljubljana
Centre of Excellence NAMASTE

Prof. Anton Pleteršek,
Prof. Janez Trontelj

The R&D activities of the Laboratory for Microelectronics (LMFE) are based on the market potential of non-contact food traceability, control, and the recording of storage conditions by monitoring temperature, humidity, shock, CO₂, chemicals, etc. For instance, a good example is monitoring the temperature and humidity in grain silos and performing a real-time analysis of the logged data. Monitoring individual staff members by usage of hand disinfectant on a continuous basis is again a good example. There are a number of other applications that will require highly selective sensors, for instance, for blood pressure by mobile applications. For any mobile and continuously operating application the final device should be as compact as possible and also offer a long battery life.

To this end, we have evaluated metal-oxide MOS-based sensors from different manufacturers in an integrated system and verified its operation in a laboratory environment. A lot of progress was made toward capacitive-based polymer sensors. Polymer-based sensors are promising because of their reduced power consumption and have therefore been the focus of much attention. The challenges in their design and fabrication are in their higher sensitivity to ambient humidity, selecting the most suitable polymers and the need for additional micromachining steps in their fabrication.

The most widely available commercially are metal-oxide semiconductor sensors based on tin dioxide (SnO₂) films. Their advantages are the low sensitivity to humidity and easy availability on the market. Their great disadvantage, however, is their large power consumption, due to the need for elevated temperatures during proper operation.

Therefore, the LMFE research is focused on developing low-cost, more sensitive, more selectively sensitive and micro-power-consuming chemical gas sensors. As polymer sensors are preferred because of their low power consumption due to the lack of heating, unlike resistive sensors which are heated, LMFE began to develop these sensors.

For proof-of-concept we have developed an analogue front end (AFE) for a resistive and capacitive-type polymer-based chemical sensor. It is designed to sense the change in resistivity or capacitance only. An absolute measurement is, therefore, not a major task; it is more important to acquire changes, and the

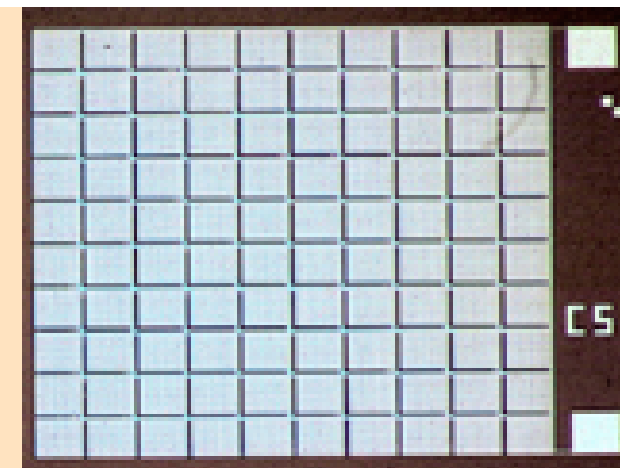


Figure 1: Capacitive sensor, developed in the Laboratory for Microelectronics, LMFE.

total change in a predefined time frame. This time frame depends on the application and has to be selectable by the customer. An application may trigger the AFE to start logging or may permanently scan the sensor and process information, verifying and logging data to the internal memory. As polymer-based sensors are very sensitive to humidity, we have developed two sensing methods. The first one uses a capacitive sensor that is sensitive to chemical vapour only, and the second, that uses two sensors combined into a differential architecture, where both are equally sensitive to humidity while only one sensor is highly sensitive to the selected vapour.

The continuous development of new chemical sensors is necessary. An important message also comes from the economic issue, i.e., only robust, reliable, rapid-recovery and low-cost solutions will be acceptable for a high-consumption market.

The LMFE currently investigates the development of low-power, resistive micro-sensors, based on a MEMS SnO₂ micro detector, placed over the thin nitride/oxide membrane, as shown in Figure 2.

The low-power analogue chemical sensors are still not commercially available. This is particularly so for sensors that are highly selectively sensitive to a specific chemical substance and insensitive to environmental conditions, such as humidity and temperature.

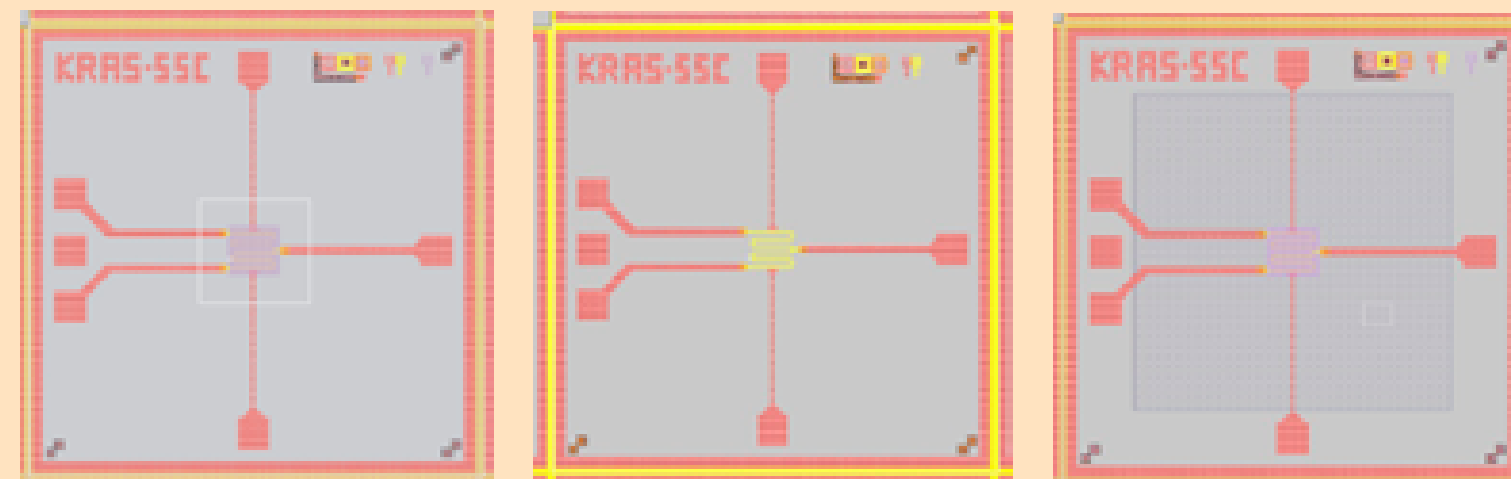


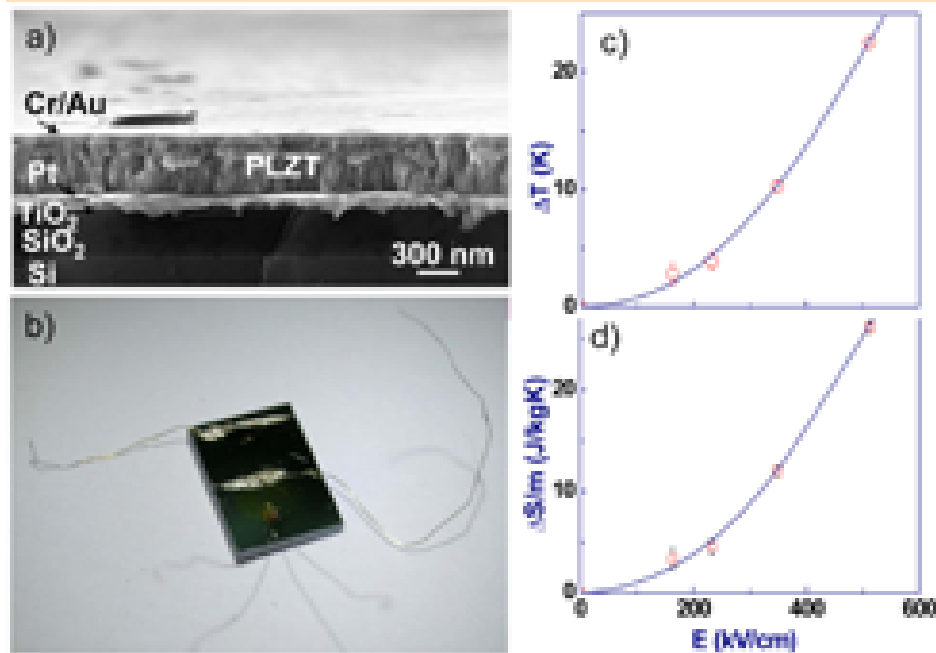
Figure 2: Mask set for low-power resistive chemical sensor that requires only 1mA current at a 3V supply.

Electrocaloric Materials/ Advanced Materials and Technologies for the Future

Centre of Excellence NAMASTE

Jožef Stefan Institute

Dr Hana Uršič



In the framework of the project “Advanced Materials and Technologies for the Future” the topic of electrocaloric materials is studied. The electrocaloric effect is described as a reversible temperature change of the material under an applied electric field at adiabatic condition. In other words, the material heats up or cools down due to an increase or decrease of the applied electric field, respectively. The electrocaloric effect is of great importance for applications in new-generation cooling and heating devices, which would be friendlier to the environment and would contribute to a reduction in power consumption. In this work group high-resolution calorimetry, dielectric spectroscopy and measurements of polarization are carried out on relaxor and ferroelectric bulk ceramics, thick and thin films in order to determine the magnitude of the electrocaloric effect. The studied materials are lead-based, such as $Pb(Mg_{1/3}Nb_{2/3})O_3$, $Pb(Mg_{1/3}Nb_{2/3})O_3-PbTiO_3$ and $(Pb,La)(Ti,Zr)O_3$ and also environment-friendly lead-free materials, for example, $K_{0.5}Na_{0.5}NbO_3-SrTiO_3$. The development of new electrocaloric materials may open up new opportunities and ideas for further applicative tasks in cooling and heating applications.

Figure 1: Microstructure of $(Pb_{0.98}La_{0.02})(Zr_{0.65}Ti_{0.35})O_3$ (PLZT) thin film on platinized silicon substrate (a) photograph of the thin-film sample with the electrical contacts (b) the temperature change (c) and entropy (d) vs. applied electric field measured using direct electrocaloric measurements. (By courtesy of Prof. Barbara Malič)

R&D of scaffolds: medical devices market waiting for a new boost

Jožef Stefan Institute

University of Maribor

Educell Ltd.

Centre of Excellence NAMASTE

Prof. Janez Štrancar

The significant increase in age-related diseases accompanying the aging of our population makes tissue engineering one of the fastest-growing sectors in the developed world. Unfortunately, this faster development is hindered by an incomplete understanding of the complex phenomena of cell-material interactions called biocompatibility. Current R&D activities mainly depend on trial-and-error bases, instead of relying on a knowledge-driven optimization of scaffold stability, porosity and degradation dynamics, as well as an elimination of

the cell-stress response to different properties of the material surfaces. It is, therefore, not surprising that despite large investments, promising results remain sporadic. Within the informal cooperation between the research groups of the Centre of Excellence NAMASTE, Jožef Stefan Institute, University of Maribor, a foreign research group at Politecnica di Torino as well as the biotechnological companies Educell d.o.o. (Ljubljana) and Di.pro (Torino) we focused on the systematic research of scaffolds made from biomaterials. With the application of newly developed biophysical techniques such as fluorescence and Raman micro-spectroscopy as well as optical micromanipulation, breakthroughs are expected in the understanding of the time-evolution of cell-material interactions and especially the response

of both material and cells to each other. Phenomena like material degradation and restructuring as well as cell differentiation are very relevant and have an economic impact in the further developments of scaffolds and tissue engineering. This intense research already provided an important result: through understanding the complex formation of scaffolds by freezing and crosslinking, we just recently developed a completely new protocol, which enables efficient sterilization together with porosity control, stability/degradability optimization, while speeding up the classical production protocol by almost four times. Such an achievement now opens up new opportunities for exploring the cell-material interaction in a much more defined and controlled way.

Virtual Electromagnetic Compatibility Lab Project

Centre of Excellence NAMASTE

Institute TC SEMTO – Technology centre for circuits, components, materials, technologies and equipment for electronic

Jožef Perne, B. Sc.

Centre of Excellence NAMASTE defines the scientific and technological aims for the materials being researched. It deals with specific sensor applications, protective elements in electrotechnics, actuators and others. The process of vertically connecting materials with elements and products is clearly defined. The demands for electromagnetic compatibility and demands for resistance, robustness and safety have to be taken into consideration in order to achieve optimal results. Pre-defined goals in the fields of electromagnetic compatibility elements, parts and products can be achieved by target researches and the development of materials. The virtual electromagnetic compatibility (EMC) laboratory project improves the environment for measurements or tests and enhances problem-solving skills by connecting the knowledge, equipment and procedures in the field of EMC.

The aim of the project is to provide a database with measurements and capabilities of all the leading laboratories in the fields of EMC and security. This database could

be then forwarded to potential users. The database would include information about the availability and utilization of equipment, measurement procedures and the capacity of measurements. Additional information about a certain laboratory would be filled with user experiences, their problem-solving skills, resistance to EMC interferences, stress-tests resistance and security tests. With the shared knowledge of the laboratories and their personnel, the end-user will be able to, not only characterize their problem, but also to solve it.

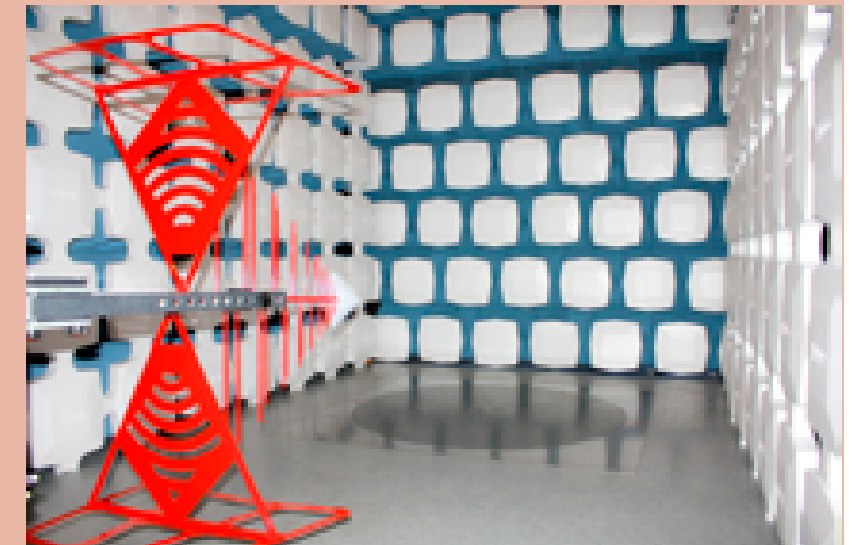


Figure 1: Chamber for assessment of an installation's compliance with EMC standards in the SIQ institute.

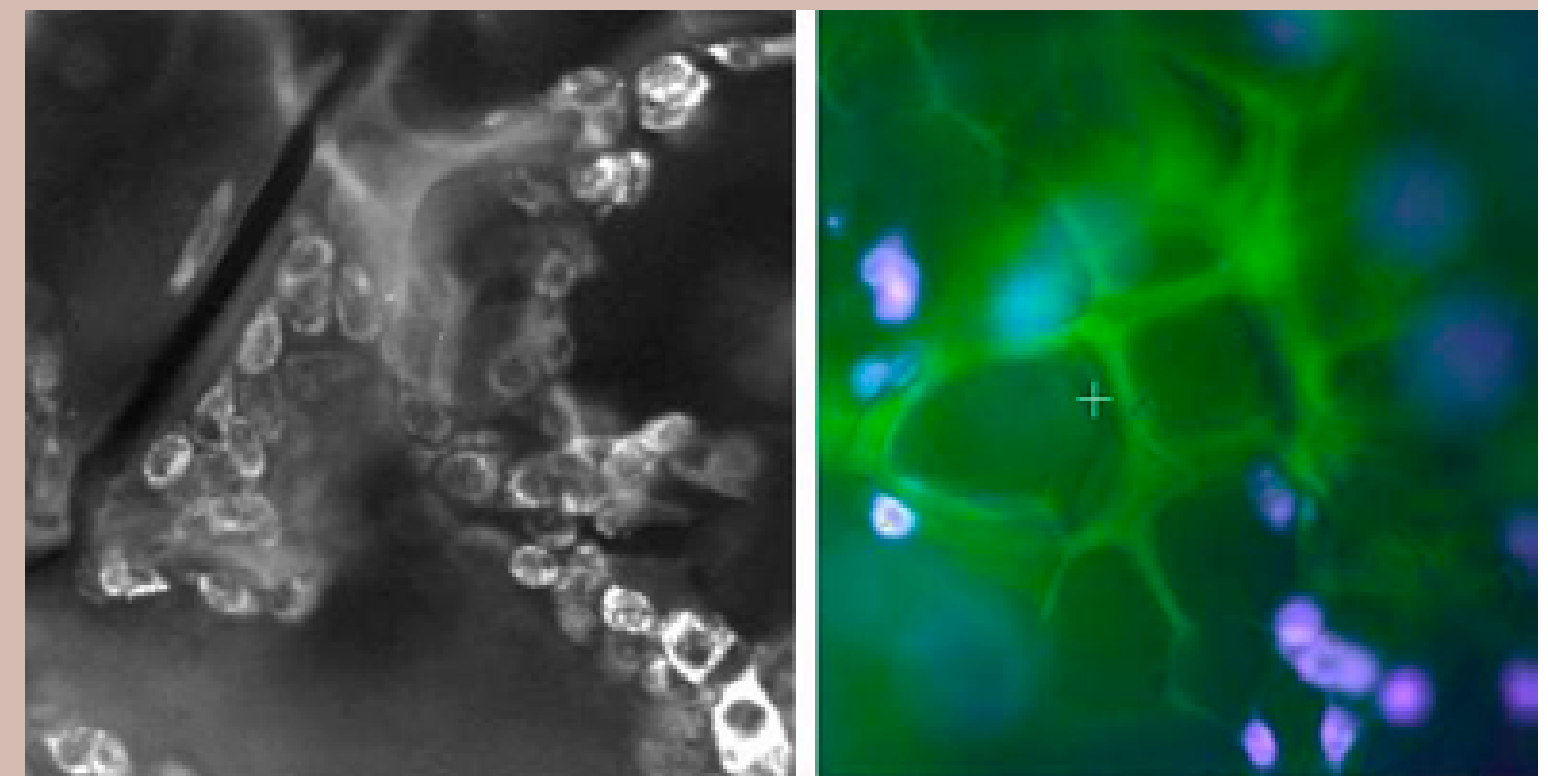


Figure 1: Exploring cell-material interactions through fluorescence microscopy (left) and fluorescence micro-spectroscopy (right), where color-coded signal reveals the local molecular environment changes, both in the material and the cell.

CoE and CC

The Competence Centers

- The CC ACT
- The CC BDI
- The CC SURE
- The OPCOMM
- The CC TIGR
- The CC CLASS

CC ACT

The Competence Centre for Advanced Control Technologies

The Competence Centre for Advanced Control Technologies is a research-development centre focusing on new developments in control technology (automation and informatics). Control technology is a hidden technology, embedded in almost every product and production process, but highly responsible for its proper and efficient operation. As it is constantly influenced by advanced technological solutions and always required in new application areas, control technology is an ever-relevant technology with highly profitable investments that have multiplicative effects on the economy.

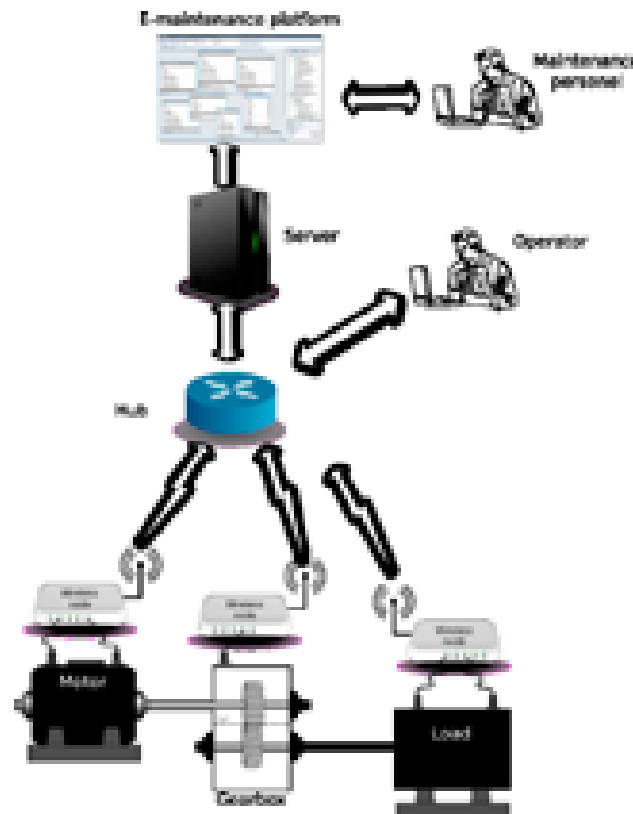
RECOGNISING CONTROL TECHNOLOGY as a core topic of mutual cooperation, Slovenian academic and industrial partners in this field have a long tradition of cooperation, originating in technology network process control technology, which has also initiated the formation of the CC ACT consortium with the following goals:

- to bring together a critical mass of R&D expertise from industry and academia in advanced process control in order to position Slovenia among the prominent European control-solution providers,
- to foster innovative R&D that will exploit state-of-the-art information and communication technologies for better process control, embedded systems operation and the rational exploitation of energy resources,
- to build up a portfolio of new methodologies, tools, building blocks and platforms of mutual benefits for the partners that will raise the quality and versatility of the overall control design cycle, adaptivity to changing requirements in the market, reliability and the efficiency of implementation and maintenance.

The CC ACT consortium accomplishing the above-mentioned-goals includes different partners:

Automatic condition monitoring of process equipment (R&D 5)

- academic institutions responsible for research, development, transfer, dissemination and putting into effect new knowledge, methods and components in the control-technology domain,



- high-tech engineering companies, which are the co-developers and users of control technologies as well as the developers of technical prototypes and demonstration projects in the industrial environment,
- end-user companies cooperating, above all, in the definition of requirements for the new knowledge, technologies and services required; they are the users of the results of R&D, and they represent the polygon for testing technical solutions and demonstrating their operation,
- ARI centre, responsible for the organisational and technical management of the CC ACT as well as the dissemination, internationalisation and promotion of project results.

The consortium partners have identified prospective R&D topics in six priority domains: advanced control; remote and distributed control; production control; control for efficient energy consumption and a clean environment; automatic condition monitoring of process equipment; and fusion control. Some specific objectives of the CC ACT within these priority domains are as follows:

- to develop a set of prototypes of new-generation products, technologies and services for advanced process control for the benefit of target industries and niches in which Slovenia is likely to act as an important global player in the future,
 - to deliver solutions for cutting-edge technologies, such as the experimental fusion reactor ITER, ultra-light airplanes and smart grids for efficient energy management,
 - to assess the designed prototypes on a suite of demonstration projects on various plants, brought by industrial partners, i.e. in the chemical and construction industry, the manufacturing of intelligent process equipment, ultra-light airplanes, and power engineering.
- Overall, the programme is expected to result in more than twenty innovative products (building blocks) and technologies for the control of complex systems with high added value and great promise for penetration of the global market.

Dr Zoran Marinšek, Head of CC ACT:

“The Competence Centre for Advanced Control Technologies (CC ACT) is currently the largest cooperative project underway that is organised and managed by the Technology Network Process control technology (TN TVP). With a tradition of connecting industrial companies in the field of process control technology and research institutions (RIs) under a common strategic orientation since 2000, the TN TVP has orchestrated a number of R&D projects, aimed at developing new technologies, solutions, services and products.

CC ACT connects a total of 17 partners, 4 academic RIs, 7 engineering companies (service providers) and 5 production companies (users of the process control technologies). Together, they have set up an ambitious R&D program that is shaped into 7 R&D projects, as presented in some detail in the other contributions from the CC ACT in this magazine.

While maintaining the strong primary objective of the Centre, focused on the results to be achieved through R&D projects, a complementary emphasis has been put on the activities related to the strategic management and further development of the Centre. These activities are allocated to the ARI Centre, which is the leading partner in the CC ACT consortium. Besides the overall management, these activities encompass the dissemination and systemic marketing of the project results, with a separate emphasis on the spill-out into educational programmes and on early go-to-market support. The latter is further emphasised through international networking activities, with the objective of placing the CC ACT both horizontally into R&D networks and vertically into the international market.”



Dr Zoran Marinšek



ARI Centre, Leading partner

Dr Vladimir Jovan, Head of ARI Centre

The Development Centre for Industrial Automation, Robotics and Informatics (ARI Centre) was founded in 2000 by 14 major Slovenian production enterprises, together with expert groups from the areas of automation, robotics and informatics at both Slovenian Universities and the Jožef Stefan Institute in Ljubljana. The Centre ARI acts as a meeting point for the current needs of Slovenian production enterprises and the offer of various specialised development and engineering groups in the areas of industrial automation, robotics and informatics. The main activities of the centre are the acquisition and maintenance of knowledge and skills relating to particular areas of industrial automation, robotics and production informatics; the identification and management of new, relevant projects from the above-mentioned areas; and various other services for the founders of the centre and other users. Centre ARI has now been involved in over 30 research, development and implementation projects.

The realisation of the project Competence Centre for Advanced Process Control (CC ACT) is the Centre ARI's most demanding and challenging project at the moment. For this reason, a specialised team of experts has been engaged for the project management, administration, promotion and the dissemination of the project results. We believe that an efficient realisation of this project will strengthen the existing collaboration of project partners and contribute to the competitiveness of all the partners in the international market.

R&D1

Development environment and components for implementation of advanced control

Prof. Dr Igor ŠKRJANC, Project Manager

The objectives of the first, i.e. the largest, part of the project, are the creation of a development environment for the design, rapid prototyping and the implementation of advanced control methods, adaptation and system supervision. The key idea is to design a development environment that will enable simple access to real plants via OPC (OLE for Process Control), an efficient controller structure design and a direct online validation on the target plant. Moreover, the environment should be independent of the control hardware, i.e. it should be applicable to a wide range of process platforms. This is believed to be a novel concept in the international control community. The environment is expected to help the designers of control systems in integrator companies as well as the process personnel in industry to substantially reduce the time needed for the development cycle and improve performance monitoring. It will enable the implementation of advanced control methods that outperform classical approaches. The environment will be composed of two major parts:

- the design part, which will serve for the configuration of object-oriented simulation schemes for various purposes (e.g. simulation, identification) along with the preliminary model-based control design;
- the rapid-prototyping part, which will enable real-time experiments, including data acquisition, self-tuning, the assessment of advanced control on industrial problems and the easy implementation of the solutions on the target hardware.

The development environment will consist of the control module with user-friendly interface, the configuration module, the modules for simulation, identification and self-tuning, the module for adaptation, the module for system supervision, the module for design of advanced control algorithms and the module for the management of experiments.

The second part of the project will be focused on the extension and improvement of the tools for batch and semi-batch processes in the chemical, bio and pharmaceutical industries. The requirements for the final product are simplicity, openness, adaptability and the efficiency of communication with other devices in control systems. In the third part of the project, the user-friendly automation development technology and tool

Involved partners:

- ◇ University of Ljubljana, Faculty of Electrical Engineering
- ◇ Jožef Stefan Institute
- ◇ INEA
- ◇ Kolektor Sinabit
- ◇ GOAP
- ◇ Metronik
- ◇ Pipistrel
- ◇ Danfoss

will be investigated and realised for more efficient and faster implementation of the automation in different areas, such as batch processes, intelligent buildings and, for example, HVAC systems. The system for the self-tuning of the autopilot for ultra-light aeroplanes will be developed in the fourth part of the project, which leads to the simple implementation of such systems in small aeroplanes. The key concept of the last part of the project is to develop an intelligent component for control design, the intelligent valve as embedded systems, which can be easily implemented into the control loop in different control systems.

Danfoss Trata

Samo Krančan, R&D Manager at Danfoss Trata d.o.o.



Danfoss Trata d.o.o. is a world-leading producer of equipment for district heating systems. The company is a competence centre for the development and production of mechanical controls for district heating systems in Danfoss A/S from Denmark. The development and production scope of the company includes mechanical pressure controllers, thermostats, heat exchangers, valves, and electrical actuators for valves.

We decided to cooperate in the competence centre CC ACT in order to strengthen our cooperation with local research institutes, especially with the Jožef Stefan Institute in Ljubljana, as well as with other organisations in the local area that

use and develop similar technologies to our own. The result of our cooperation in the competence centre will be the next generation of algorithm for the oscillation limitation of electric actuators that are used in systems for heating, ventilation and air-conditioning. The algorithm itself helps the electronic controller to reduce energy consumption in these systems, as well as increase the lifetime of all the mechanical components in the system. We will also develop a new solution for a thermostatic element that will incorporate a new concept of control which ensures accurate control combined with a high speed of response. This solution will also contribute to the improved energy consumption of the system.

Oscillation limitation has already brought us some competitive advantages in the market, since the solution brings about energy savings. An improvement to the solution will ensure that our advantage is maintained and increased.

Pipistrel – the freedom of flight

Pipistrel was established in 1987 as the first private aircraft producer in the former Yugoslavia. As a pioneer of alternative aviation, the company was one of the first to open up flying to the wider public. In its 24 years of existence, Pipistrel has manufactured over 1000 advanced, light aircraft, motor-gliders, hang-gliders and self-launching gliders.

The “Sinus” aircraft became the world champion in 2001 and achieved a world-record flight around the globe in 2004. The “Virus SW” model claimed two consecutive NASA challenge victories in 2007 and 2008. Pipistrel won the European Business Award in the Innovation category in 2010.

The company also focuses on alternative means of propulsion and places great importance on preservation of the environment: the Taurus Electro aircraft is the world’s first two-seat, electric aircraft and it is produced in a state-of-the-art, energetically self-sufficient facility – currently the greenest building in Slovenia.

Pipistrel’s ambition is to maintain its leading position as the world’s most advanced designer and producer of light aircraft. In aviation, there are no short cuts – only the best, safest and most advanced aircraft are good enough. That’s why we invest all our available resources into research and development. We reward the innovative activities of our employees.

Ivo Boscarol,
General
manager and
founder

Our motto is: set your goals high, and then be confident enough to reach them!

The field of aviation resembles that of pharmacy – you have to invest heavily into research and build connections with other institutions for decades to gain trust and knowledge, which then pays off in the long term. That’s why we make use of any opportunity to network and cooperate.

Within the competence centre for modern control technologies, we act as one of the research and development partners involved in the demo project of developing an autopilot for light aircraft. We expect that through this development we will acquire the knowledge and technologies to allow us to commercialise the above products.



R&D2

Technologies of web, remote, and distributed control

Bojan Likar, MSc, Project manager:

The aim of the project RRP2: Technologies of web, remote, and distributed control is to develop new and improve existing technologies and components for web, remote and distributed control systems and methods for communication between various platforms, based on modern communication and web technologies. Studies and analyses of rapidly evolving systems for web, remote and distributed control are planned, and will serve as the foundation for new components, services and technology specifications. The synergy between partners is expected to be achieved through the research and development of new components, the integration of new technologies and validation on demonstration objects and a laboratory pilot system. The expected results will facilitate the easier remote control of processes supported by web technologies, where the process data and information are accessible to the operator in real-time, with the support of various functionalities, such as data storage, process operation analysis, operation comparison between different user settings, and social networking services (e.g. help desk, services, user profiles).

The general project goals are:

- a survey of state-of-the-art technologies and services of web, remote and distributed control systems, concept design, and the development of highly available and reliable products for the monitoring of distributed systems based on modern communication protocols,
- an overview of existing technologies, specifications, demands and solutions for the development of a web-based training and testing environment intended for operators and system integrators in the field of web, remote and distributed control,
- the design and development of new components (hardware and software) for web, remote and distributed control systems,
- the development of new services for web, remote and distributed control, such as data-storage portals, tools for analysis and process optimisation, remote control, online remote programming and system maintenance and social network interfaces.

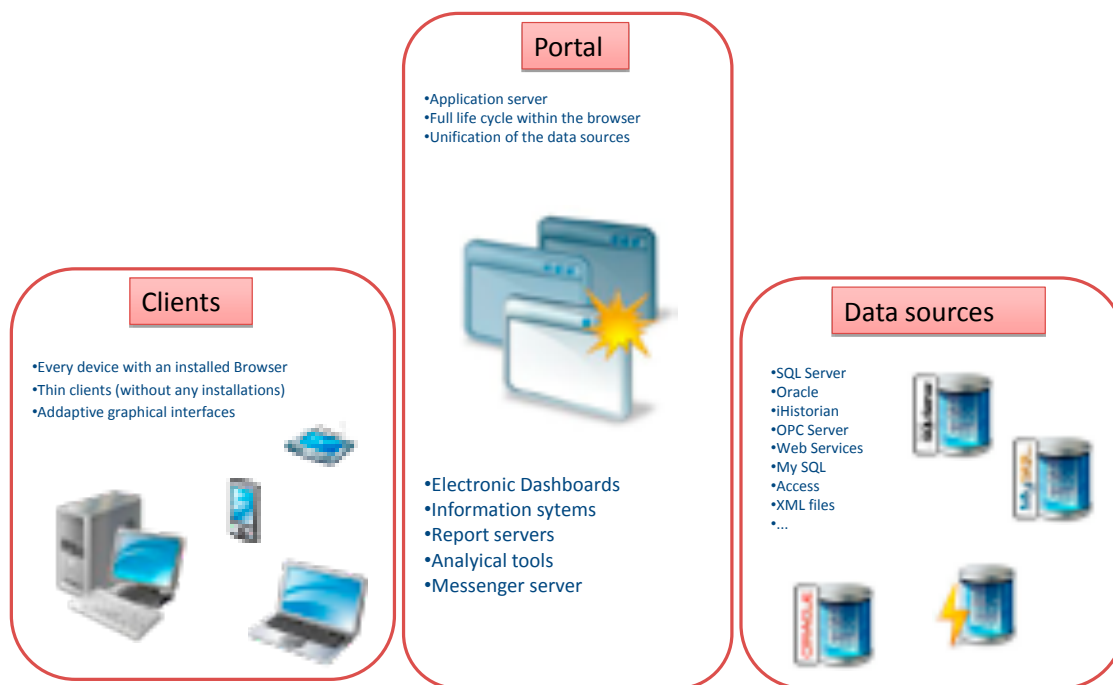
A high market potential for the implementation of developed solutions is foreseen in commercial infrastructure systems like water distribution systems, sewer systems, heating distribution, gas distribution, mobile network base-stations, systems for energy production from alternative sources, charging stations for electric cars, etc. The supervisory solution for remote and distributed control will have many novelties and advantages by supporting new web technologies, data-management techniques, business intelligence

Involved partners:

- ◇ University of Maribor, Faculty of Electrical Engineering and Computer Science
- ◇ INEA
- ◇ Metronik
- ◇ Kolektor Sinabit
- ◇ GOAP

with professional optimisation and analysis modules for distributed systems, the detection of potential hazards, energy optimisation, social networks and user profile data exchange, etc. The results will enable the use of publicly available, Ethernet-based commercial networks (GPRS, UMTS, WiFi, xDSL) and other general web-based tools for business intelligence and management.

Development and Application Portal



R&D3

Production management through built-in models

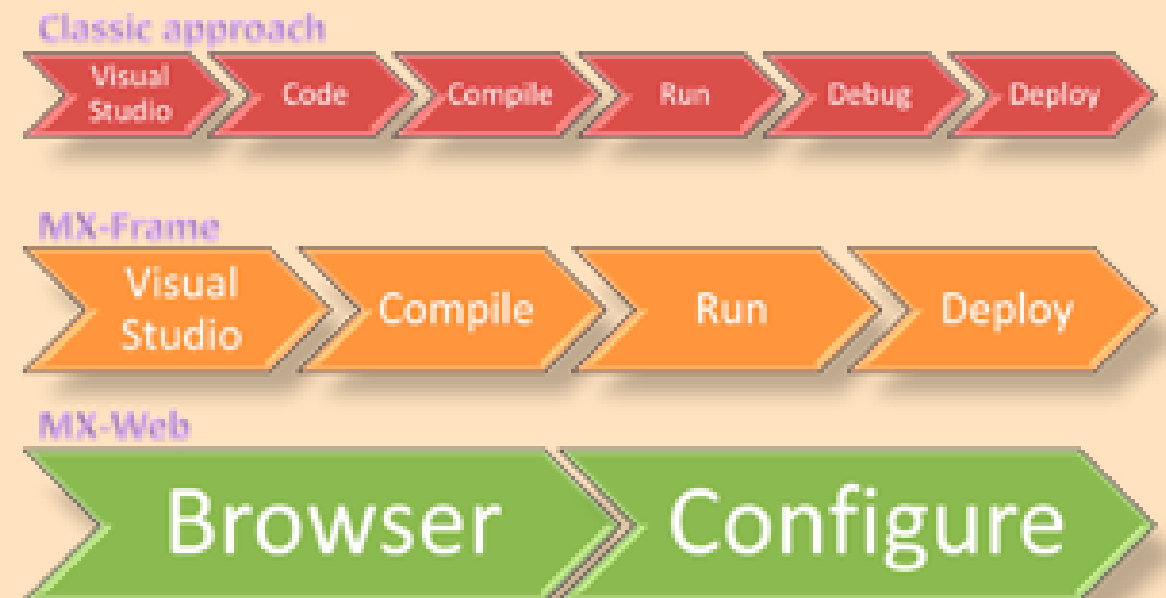
Tomi Zebič, MSc, Project manager

Manufacturing companies strive to achieve a high level of automation, which usually leads to cost reductions and increased effectiveness. As markets are undergoing globalisation, automation alone, however, is far from sufficient to ensure an adequate competitive edge. Production must also be flexible and must operate at an optimum level in terms of costs. The basis of achieving these goals is computerisation. The usual production systems enable micro-planning, management and the monitoring of production, and can gather together numerous

Involved partners:

- ◇ Jožef Stefan Institute
- ◇ University of Ljubljana, Faculty of Electrical Engineering
- ◇ INEA,
- ◇ Metronik
- ◇ Kolektor Sinabit,
- ◇ HELIOS
- ◇ Trimo

the key economic indicators and models for the prediction. The foundation for the preparation of the models is comprised of realistic production data from two companies, Trimo and Helios. At Trimo this data has been gathered in the MePIS production information system, built by Metronik; at Helios the data has been gathered in the Kolektor Sinabit MES system. The definition of parameters and models is undertaken by the Faculty of Electrical Engineering and the Jožef Stefan Institute. Once defined, the key performance indicators and models will be implemented in both manufacturing companies. At Helios, Kolektor Sinabit will establish a technological data-acquisition system that will also enable the calculation and display of KPIs. The management models will be built into the system in line with the theoretical basis of the project. In this way, Helios



The figure above shows a comparison between the traditional approach, involving the use of standard programming tools, and the new MX WEB approach. As can be seen from the image, the system has been designed so as to allow an extremely simple adaptation, without any need for programming.

manufacture-related and, especially, technology-related data. This data can then be either displayed or stored for subsequent analysis. Unfortunately, neither of these methods allows for flexible production management for the purpose of achieving cost optimisation.

This project will attempt to solve the issue of optimum and flexible production management. The initial idea is based on the fact that the production manager must be offered certain current key performance indicators (KPIs) and predictions for these parameters in the future. The prediction of indicators based on appropriate built-in models can significantly improve production management. Simply put, this requires the implementation of production intelligence.

This project also closely links theory to practice. In the theoretical part, the objective is to define



seeks to optimise the production of their mixer machines.

Trimo has several lines on which they produce façade panels and roof panels. Their production is managed by means of the MePIS system and monitored through the KPI Manager system, which enables the display of KPIs.

This system will be replaced with a new one based on MX WEB, which was developed by Metronik. It is completely configurable, allowing a high-quality, dynamic and fully available (web) display of parameters, model prediction, and simple production management.

Content-wise, this project will attempt to define the most important economic key performance indicators. Analyses have shown that these parameters are greatly influenced by micro-planning the distribution of work orders. In order to optimise production costs, Inea will establish a system of planning with learning clusters. Through the appropriate dynamic classification of products, we would like to reduce the number



of cases that require a change of tools on the production line, and thus substantially reduce production costs.

In short, this project will establish a system of intelligent production supported by the most up-to-date technological approaches. The project will then be evaluated in two realistic economic environments.

R&D4

Optimisation and control for rational use of energy and cleaner environment

Marijan Vidmar, MSc, Project manager

The aim of the project is to provide solutions to top-priority problems of global concern related to the growing deficit of energy resources, pollution and climate change. Advanced control solutions, together with the new technologies, will be used for the efficient use of traditional and alternative energy sources, and to reduce pollution, such as waste production and air emissions.

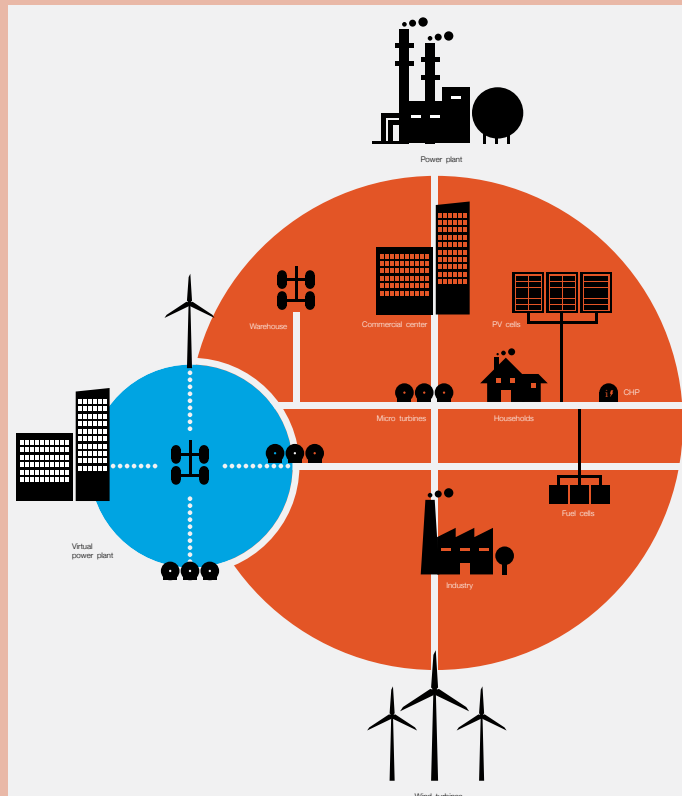
In the segment of energy consumption, the emphasis will be on the efficient use of energy at the level of small industrial and residential clients. In particular, heating and cooling systems that represent a significant load for the environment due to their wide use will be optimised. Model-based optimisation methods will be developed for the purpose of the optimal coordination of the individual heating and cooling components. The system will automatically respond to different disturbances and limitations, such as building occupancy, the intensity of internal heat sources and external influences (temperature, moisture). It will ensure a comfortable environment, optimal energy consumption and, consequently, lower emissions. In relation to efficient energy use, smart-grid technology will also be integrated. In general, the technology of smart grids implies lower loads

for electrical grids, helps to reduce bottlenecks, gives the opportunity for the increased integration of renewable energy sources and enables higher levels of safety and reliability of operation. While this technology is largely developed for larger consumers, there is also an emerging possibility for its implementation with small prosumers (i.e. small production plants), where the high investment costs currently limit its use. Therefore, the aim of this project segment will be the development of a cost efficient platform with embedded advanced control algorithms that could be incorporated into smart grids. The innovation of the solution is envisaged in the integration of various functionalities into a single, low-cost unit.

Involved partners:

- ◆ Špica
- ◆ INEA
- ◆ Jožef Stefan Institute
- ◆ Metronik
- ◆ Kolektor Sinabit
- ◆ GOAP
- ◆ RACI

The project also covers two activities that are important in the context of environmental protection. The first activity addresses the anaerobic digester for waste processing, where an advanced control module will be designed to optimise its operation, i.e. increase biogas (energy) production and reduce the amount of waste for disposal. The second activity addresses the quality assurance of the monitoring system based on emission sensors, which will be used for efficient air-pollution monitoring and control in different industries.



Trimo

Since its formation in 1961, Trimo has established itself as one of Europe's leading companies developing original and complete solutions for steel buildings, roofs, façades, steel constructions, containers, and sound and insulation systems.

Expert knowledge, openness, reliability and a focus on the future are the basic components that have taken Trimo around the world. Today Trimo sells its products and services under its own brand name across more than 50 countries worldwide. Trimo's customers are the most famous names in retail and high-tech industries such as automotive, aerospace, food and beverage, pharmaceutical and the like... Trimo has established a sales network in almost 30 countries and has production facilities in Slovenia, Serbia, Russia and the United Arab Emirates.

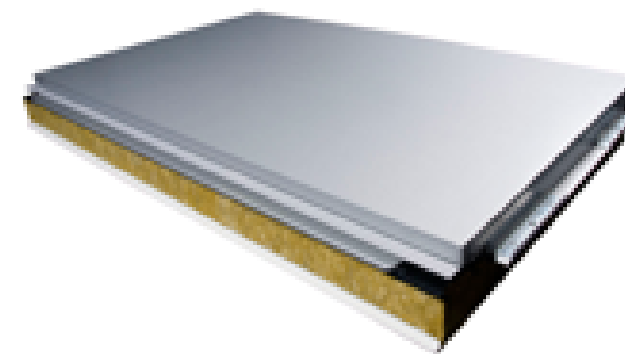
Reputations are fragile and are often won and lost with service, or specifically, the ability to continually meet or exceed customer requirements. For this reason, the heart of Trimo beats to the sound of innovation, where the ever more demanding needs of customers are addressed through research and development. The fostering of strong relationships ensures that the customer and Trimo are engaged in dialogue throughout the entire specification process from concept through to completion. "No task impossible" will find us always going that extra mile to ensure complete and total satisfaction and our on-going technical and support services are the best in the industry.

Success today does not necessarily guarantee success tomorrow – continuous investment in new technology, markets, customers, processes, R&D and training, however, does. For this simple reason Trimo has ploughed literally millions of Euros into new production facilities, state-of-the art technology and staff improvement and training.

The production in Trimo is automated and has relied on information technology for several years. This makes it possible for us to run the business efficiently. By participating in the Competence Centre we hope to find a way to establish a control system that will lead to an additional improvement in production efficiency. The objectives are a reduction in energy consumption, a better exploitation of technologies and an increase in the efficiency of the employees. The contributions of Trimo to the Competence Centre are our experiences as well as the lessons learned so far, particularly with respect to applications.

This will help the other partners in the Centre to efficiently test the results of their investigations in an industrial environment.

The modular façade Qbiss One intertwines the purity of architectural form and comprehensive technical solutions. With its emphasised joint the Qbiss One is the right answer for projects where simple, accomplished forms combined with functionality and fast assembly are required. Qbiss One is distinguished by the unique rounded corner element. This is a unique solution, enabled by the highest automated technology and patented solutions.



Denis Stepančič
R&D Director, CIO

ArtMe Façade design uses new façade surface reshaping technology that enables the architect or designer to complement the façade cladding with a preferred design. ArtMe receives Red Dot Product Design Award 2010 – One of the most prestigious design awards in the world and the only one from the field of fire-proofed roofs and façades.



HELIOS, Ltd. Dejan Bajželj, Roman Pirnat:

Helios, a producer of paints, varnishes and synthetic resins, is a member of the Helios Group and a leading producer of coatings in South East Europe. The group has more than 2500 employees in more than 30 companies, operating in 14 countries. With our knowledge, experiences and hard work, we follow our vision – to become one of the ten leading producers of paints and varnishes in Europe. Our efficiency is reflected in our business excellence and our continued fulfilment of the expectations of all our stakeholders: owners, employees, business partners and the community. With our operations we continually reinforce our image as a reputable company that brings great pride to its employees, as well as to the immediate and wider social environments. The two main reasons for joining the Competence Centre are our previous successful cooperation



with some partners of the consortium and our wish to create business links that will allow us to stay in touch with the advanced technological solutions applicable in the field of automated production processes. In the past, our company initiated a MES project, focusing on the production of water coatings in a new production unit; however, the project was halted during the economic crisis. Our involvement in the Competence Centre will allow us to upgrade and expand our set objectives. The implementation of the MES in our production will allow an efficient micro-planning at all the resource levels, a reduction of inter-phase controls arising from a better control of technological parameters, and the efficiency of all logistic events. In addition, our long-term objective is the development of “paper-free” business operations. After a successful introduction of the MES in the water unit, the same technological solution will also have to be implemented in the other production units.

R&D5 Automatic condition monitoring of process equipment

Prof. Dr Đani Juričić, Project manager

The aim of the project is to develop a prototype of a versatile, yet low-cost, platform for the automatic, online condition monitoring of rotational drives. Rotational drives are ubiquitous items of equipment, present in almost all branches of industry, transport and power engineering. During operation they are exposed to inevitable mechanical loads (especially bearings and gears), which lead to the onset of faults, which then gradually evolve into failures. Serious problems can occur if a failure brings about unexpected interruptions and downtimes in the production process. The implications can range from pure production losses, reduced efficiency of the production, up to heavily destroyed equipment or even casualties. Surveys made by several professional bodies have revealed that the prevailing reactive and

Involved partners:

- ◆ Litostroj Power
- ◆ INEA
- ◆ Jožef Stefan Institute
- ◆ University of Ljubljana, Faculty of Mechanical Engineering

the diagnostic results to the operators and maintenance personnel, as well as store the information in process and maintenance databases. The system will be applicable to a wide range of industrial drives. It will be accompanied by a versatile environment for the purpose of designing the target diagnostic applications. The implementation will be easy and free of unnecessary wiring, thanks to the applied MEMS micro-sensors and wireless communication networks. The power will be supplied by special energy harvesters, which once implemented, will require no maintenance effort. Finally, the goal is to get all the functionality highlighted above at a fraction of the current costs.

periodic maintenance techniques are economically notoriously inefficient. However, there is significant room to cut costs while raising the quality of asset maintenance. This provides the major impetus for the underlying project, the final result of which is expected to be an intelligent system able to monitor the health of the machinery in a completely automatic way. The system will be able to detect and isolate incipient faults at an early stage, communicate

Litostroj Power

Borut Rihtaršič, Business Processes manager

Litostroj Power manufactures water turbines, as well as equipment for hydroelectric power stations and pumping stations. The company's activities range from design, manufacturing, installation and commissioning to servicing. The company's marketed products and services are the result of its own development. A high level of functionality, top quality, and the long useful life of the equipment are at the forefront of the company's efforts. Turbine manufacturing is one of our traditional niches. Unexpected equipment breakdowns can lead to partial or complete disruption of the production process; damaged or destroyed equipment can have a potentially major influence on a project. However, maintenance is an important



and indispensable process, and overall maintenance costs are surprisingly high. Nevertheless, maintenance processes are either reactive (post mortem) or preventative in special cases: however, both are outdated and inefficient. The main motivation for the project is to seek new technology that will allow lower maintenance costs and reduced costs due to unexpected interruptions of the production process. Litostroj Power will play a key role during the definition of the requirements and the integration of the diagnostic system as well as in the process of defining an experimental protocol for the evaluation of a diagnostic system.

R&D6

Efficient fusion-power-plant control system

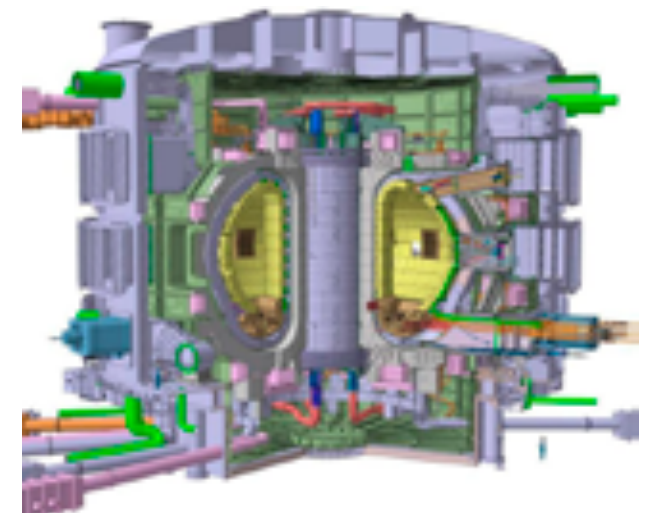
Damjan Golob, Project Manager

The project goal is to develop new, embedded systems methods and techniques for plasma-control applications in existing experimental fusion reactors and especially in ITER (the first reactor with a positive energy balance, currently under construction at Cadarache, France). ITER will use a Synchronous Data Network (SDN), which will distribute synchronously more than 5000 values (diagnostic sensors, real-time cameras) between 150 embedded stations. Several distributed control loops will be able to access these values, when control algorithms will provide the settings for actuators with a feedback rate up to 1 kHz. Our aim is to develop the relevant methods for controlling the plasma (electric current and position of the plasma). In the process of plasma control, we will test several control methods (multivariable and predictive). The advantage of these methods, apart from resulting in a stable and relatively fast response, is the modular structure of the controllers with an inherent anti-windup protection scheme. This is a crucial advantage over the existing schemes, since it can be successfully used within distributed systems. In order to develop control algorithms, knowledge from the field of modelling and simulating systems will be used to calculate suitable plasma models. On the basis of the models developed, a decision will be taken on the appropriate multivariable and predictive controllers. Significant attention will be paid to reducing the sensitivity of existing algorithms to changes in the sampling time. This will involve taking sampling time as one of the additional parameters in the algorithms. Because of the large number of control loops, the control algorithms will need to be developed in a modular manner. The modular control design will be achieved by additional inputs and outputs, which will represent the

Involved partners:

- ◆ Cosylab
- ◆ Jožef Stefan Institute
- ◆ INEA

executable controller states and will not increase the control-algorithm complexity to a large extent. Various methods will be used to configure the parameters of the controllers. Our solution will be based on Gigabit Ethernet communication and will perform the appropriate modifications and verify the performance on an experimental device. A conceptual design of the network interface cards and switches will probably be required to achieve the goal. We will also cooperate with the end users, i.e. laboratories for experimental fusion physics, particularly of the ITER, JET (UK) and KSTAR (S. Korea), with which we already have several joint projects and collaborations. Our goal is to develop a uniform, technical solution that complies with these requirements.



ITER: the world's largest Tokamak (source: www.iter.org)

Competency Centre for Biotechnological Development and Innovation

The Competency Centre for Biotechnological Development and Innovation (CCBDI) works in the area of food and health. It is active in research in the fields of probiotics, functional foods and dietary supplements, and other products used to improve the health of people and animals.

The CCBDI is a strategic partnership between leading industrial partners and outstanding research institutions, which together constitute a necessary and sufficient critical mass of industrial innovation and scientific excellence at an international level.

The strategic partnership is based on combining corporate strength in the form of excellent awareness of market requirements in the fields of functional food and health with leading development companies and public research institutions that have complete mastery of the most advanced and sophisticated methods for developing and analysing new biotechnological processes. It is designed to ensure that partners collaborate in the development of innovative corporate products and services that are internationally competitive, while additionally strengthening R&D excellence at the collaborating research institutions.

Development activities at the CCBDI are divided between three projects, the priorities and objectives of which are complement one another and together form a comprehensive response to the issue of healthy living and the impact of diet on health. The individual projects are highly connected in both methodological and thematic terms, and complement one another.

The Probiotics and Health project is developing expertise in the area of probiotic organisms. There is a very long tradition of probiotic micro-organisms being used in the human diet. Probiotics are live micro-organisms that have a proven beneficial effect on health. The most common are the bacteria in the *Lactobacillus* and *Bifidobacterium* genera. These micro-organisms have the ability to survive in the digestive tract and are an important part of the natural flora of the gut, which protects us against inva-



Dr. Mateja Štampelj, (the first) Director of CCBDI

sion by gastrointestinal pathogens. Probiotics have numerous other potential clinical applications in the prevention and treatment of various diseases.

The main objective of the project is to identify and optimise probiotic strains for various specific indications and evaluating their effects through clinical testing.

The partners in the project are Medis, Acies Bio, the Biotechnical Faculty and Clinres Farmacija.

In the Functional Foods project, we are developing new approaches in the development of functional foods.

Functional food is defined as food that can be proven to have one or more beneficial effects on the body, either by improving the state of health or wellbeing, or by reducing the risk of disease. Dietary supplements are a major segment of functional food. These products are designed to supplement the ordinary diet, and are a concentrated source of a particular nutrient or combination of nutrients or substances with a physiological effect. A variety of functional ingredients can be added to food, such as vitamins, antioxidants, probiotics, fibre, unsaturated fatty acids, phytosterols, enzymes and plant extracts. The main objective of the project is to develop new dietary supplements that will help to prevent diseases of the heart and circulatory system, to improve *Lactobacillus* and *Bifidobacterium* e gastrointestinal functions and to have other beneficial effects on the body. Specific newly developed dietary supplements will also be clinically tested, as the results of fundamental clinical testing will form a suitable basis for the development of innovative formulations and final products. Only functional foods whose efficacy is confirmed by means of clinical studies and whose quality is fully controlled will constitute products with high added value in the future. The partners in the project are Medis, Acies Bio, the Biotechnical Faculty, Clinres Farmacija, Mlekarna Celeia, Vitiva and the National Institute of Biology.

The Active Ingredients in Human and Veterinary Medicine project is developing new approaches and technologies for optimising the production of biologically active ingredients in order to ensure safety in food production and provide support treatment for people and domestic animals.

Medicine and modern livestock farming depend on the use of various biologically active agents such as antibacterials, antifungals and antihelminthics. These compounds are often of microbiological origin, and are produced by means of biotechnological processes. The industrial generation of active ingredients uses industrial micro-organisms that have a strongly enhanced ability to biosynthesise the desired active ingredient. Methods based on repeating cycles of random mutagenesis and selection have traditionally been used for the preparation of industrial strains. These methods have proven to be very successful, having raised yields of the

target metabolite by factors of several hundred.

The main aim of the project is to combine genomics and comparative transcriptomic and proteomic analysis into a systemic biological approach, and to identify the key metabolic changes that occur during the random improvement of industrial strains, irrespective of the type of product or productive micro-organism. Such an understanding is a prerequisite for developing new approaches to strain improvement that will no longer be based on random changes and selection, but instead on the targeted reprogramming of key metabolic pathways (metabolic engineering) on the basis of the findings of systems biology.

We will also use a systemic approach to analyse probiotic strains, thereby increasing the understanding of their metabolism and beneficial effects on health, which at the moment have not yet been fully explained. The project will allow for the transfer of the most advanced methods of systems biology.

The partners in the project are Acies Bio, the Biotechnical Faculty, the Jožef Štefan Institute, the National Institute of Biology and Lek Veterina.

The CCBDI links leading research institutions, major companies with strong, expansive sales networks inside and outside Slovenia, and smaller, innovative companies that are leading players in their specific area of work. The collaboration between the research institutions and the commercial partners combines conceptually complete knowledge, expertise and technological infrastructural capacity, from initial research via development, the industrialisation of technologies and clinical testing, to the development of final products, the cycle from development to product being completed by fundamental analytical support and monitoring. There is a high mobility of personnel between all the partners, and a high level of employability at the commercial partners for researchers who have completed training at the partner research institutions.

CCBDI

Medis d.o.o.

Dr. Mateja Štampelj, R&D director: "Medis is a pharmaceutical company supplying the markets of central and south-eastern Europe with carefully selected and tested drugs, nutritional supplements and medical equipment.

Since its establishment in 1989, Medis has opened subsidiaries and branches in Hungary, Croatia, Serbia, Austria, Portugal and Bosnia and Herzegovina, and also has a presence in the Czech Republic, Slovakia, Bulgaria, Romania, Montenegro, Macedonia, Kosovo and Albania.

Medis offers its partners in the pharmaceutical industry a range of marketing services such as market research, strategic planning, registration, promotion, sales, warehousing and distribution. In the last year, it has also developed a specialism in R&D services. The company employs 250 people, most with degree-level qualifications in pharmacy, chemistry, medicine and other natural sciences.

Medis is involved in the CCBDI as a coordinator of industrial research within the Probiotics and Health project and the Functional Foods project. During the competency centre project we aim to develop at least three new products in the area of probiotics and functional foods, which we will bring to the markets

where we already operate, and also to new markets. In this way we aim to consolidate and strengthen our market share, and to establish new partnerships."



Biotechnical Faculty (Institute of Dairy Science and Probiotics)

Dr Irena Rogelj: "The Biotechnical Faculty is part of the University of Ljubljana, which was established in 1919. The Biotechnical Faculty research group involved in the CCBDI consists of researchers from the Institute of Dairy Science and Probiotics, whose research covers different aspects of nutrition, milk production and processing, the quality and safety of milk and dairy products, quality assurance, and the development and control of probiotic products, including probiotic functional food and food supplements. In addition to analytical methods used in analysing milk and dairy products (IR spectroscopy, fluorescent microscopy, GC, HPLC, SDS-PAGE), the research group is well acquainted with the traditional microbiological methods and basic molecular techniques (PCR-DGGE, RAPD-PCR, RT-PCR) needed for typing, detecting and screen-

ing bacterial strains, particularly lactic acid bacteria, bacteriocin-producing strains, and probiotic bacteria. The Institute of Dairy Science and Probiotics was one of the first in Europe to have an accredited method for determining the number of probiotic micro-organisms in probiotic products according to the SIST EN ISO 17025:2005 standard. In recent years the research group has worked intensively on modern methods for the detection and study of



bioactive peptides. The group has a long-standing relationship with the food industry in the development and control of functional foods, and with the pharmaceutical industry in the development and control of probiotic dietary supplements. Participating in the project represents a new opportunity for intensive interaction with industry, with a view to transferring our know-how into the development of new products and intensifying our research work."

National Institute of Biology

Dr Špela Baebler, research associate: "The National Institute of Biology (NIB) is a public non-profit research institute. The mission and core activity of the NIB is basic and applied research, in various areas of biology (microbial ecology, plant and animal physiology, etc.), environmental sciences and medicine (molecular and genetic research), such as biomedicine, systems biology and biotechnology. The

institute has about 130 employees, across five research departments, two of which are involved in the CCBDI, and an administrative unit. The Department of Biotechnology and Systems Biology has expertise in the use of systems biology tools for the study of the physiology of plant-pathogen interaction and drug development and production, and in the development of novel diagnostic methods for the detection of plant and other pathogens and their diagnosis. The Department of Genetic Toxicology and Cancer Biology has key expertise in genetic toxicology, and focuses on exploring the mechanisms of

genotoxicity of dietary carcinogens, natural toxins and manmade pollutants.

With our long-standing experience of collaboration with the pharmaceutical industry and food industry, it was a logical step to join the competency centre in this field in order to transfer our research findings into industrial applications. We hope that by joining the CCBDI we will deepen our collaboration with industrial partners, and contribute to the successful implementation of the centre's goals."



Dr Špela Baebler, research associate

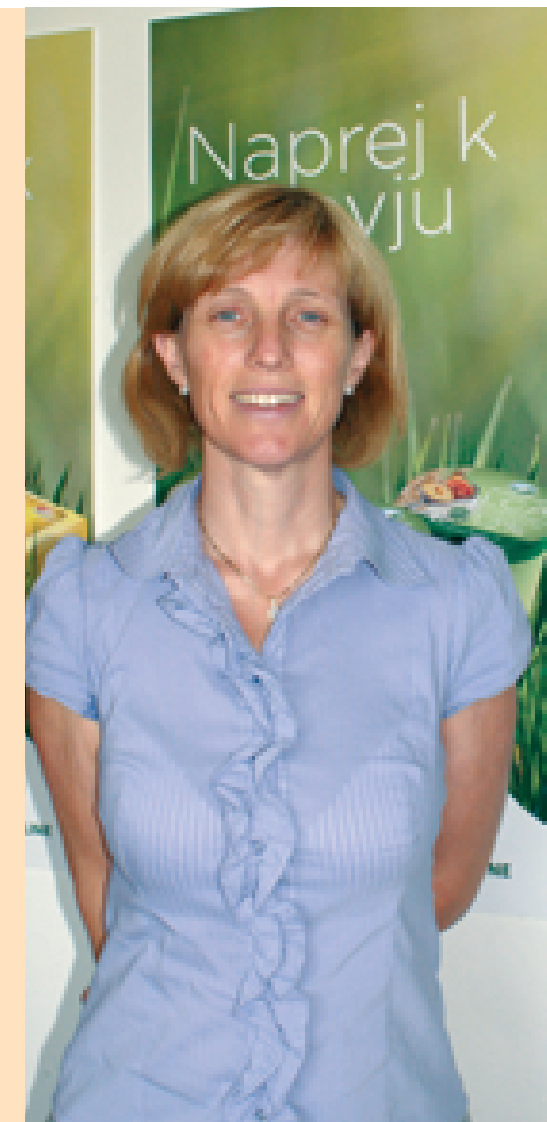
Mlekarna Celeia d.o.o.

Alenka Krajnc, head of development and technology: "Mlekarna Celeia has more than 70 years of experience in the dairy industry. We are the second-largest dairy in Slovenia, with a broad, diversified product range marketed under the Zelene Doline (Green Valleys) brand. The company employs 184 people. In 2010 we purchased 90 million litres of raw milk from Slovenian farmers, and our annual turnover was 51 million. Our product range comprises semi-hard cheeses (70% of the total), fermented products such as yoghurts and creams (20%), and fresh milk, butter and fresh cheese (10%).

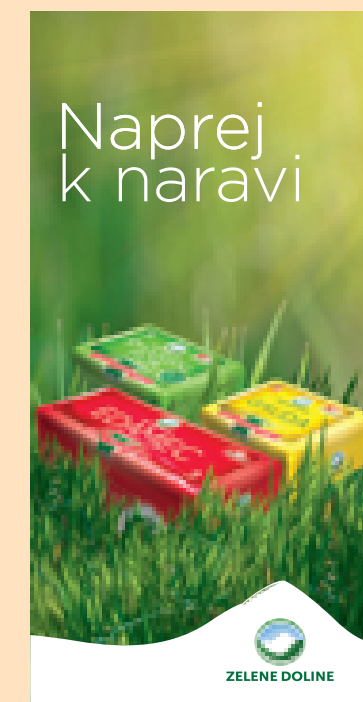
The CCBDI is a strategic partnership between industrial partners and research institutions. It is an association of companies with market know-how in the food and health segment and leading public research institutions with complete mastery of the most advanced and sophisticated analytical methods. These were all factors in Mlekarna Celeia's decision to join the CCBDI, which is the very first project of its kind for our company.



Our expectations are high, and development-oriented. Joining and working in the CCBDI will ensure the development of innovative and competitive functional foods, such as probiotic products with new components. We will also undertake clinical research on existing probiotic yoghurt in order to confirm its efficacy for the human body. Another important element in our decision to join the CCBDI is the acquisition and exchange of R&D experience."



Alenka Krajnc, head of development and technology





Vitiva d.d.

Dr Majda Hadolin Kolar, head of quality assurance and the applications laboratory: "Vitiva is the largest natural rosemary extract producer in Europe, and is located in north-east Slovenia, close to the Austrian border. Vitiva started in the early nineties, and moved to a new location in 2003 thanks to our constant business growth. Our proactive approach in the development of products, processes and analytical methods has enabled us to acquire a very rich, diverse product portfolio. Our advantages include a market-driven R&D department, flexible multipurpose production alongside a dedicated facility, and committed health-conscious consumers who understand the importance of natural ingredients in food, cosmetics and nutraceutical products."

We joined the Functional Foods project because we are aware that the rosemary extract that we are already producing exhibits many beneficial positive effects on human health, and we know that its efficacy could even be improved in combination with other extracts. With the new knowledge that we acquire during the project, we will strengthen our area of production of extracts for the nutraceutical industry. In addition, the positive results of clinical studies will provide valuable support to the marketing of these extracts for companies that produce functional foods and dietary supplements."



Longer shelf life and better meat products-naturally

SUBJECT

Processed meat products are exposed to oxidative degradation more than fresh meat due to a much longer shelf life. Slicing compounds this problem even more.

Meat products' fat content range from 6 % (lean hams) to 30 %, and fat spoilage known as rancidity, changes the flavour profile to a great extent.

Unwanted oxidation changes of fat and fat soluble components can be significantly reduced by using oil-soluble, water-dispersible and heat stable natural rosemary extract formulations from the VivOX® family of products.

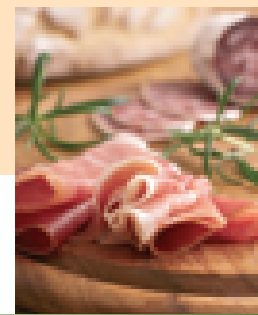


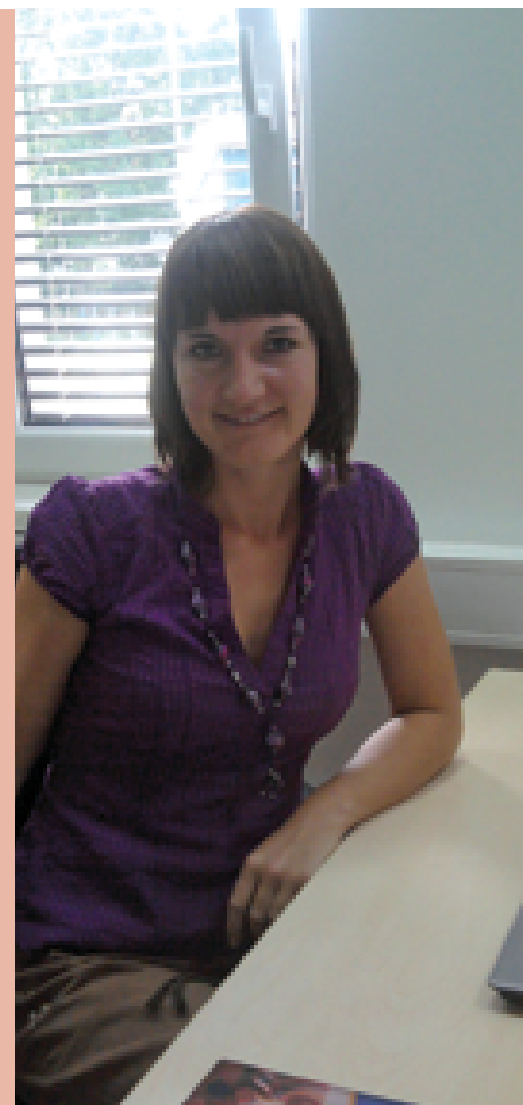
Table 1: VivOX® Meat Application Areas

TYPE OF PRODUCT	INGREDIENT	USAGE LEVEL	APPLICATION
<ul style="list-style-type: none"> • Ham • Salami • Sausages (dry, fermented etc.) • Mortadella • Bologna (similar types of cooked sausages) • Frankfurter • Hot dogs • Fried products (i.e. schnitzel, nuggets) • and more 	VivOX® 4 (301931)	According to EU directive 2010/69/EU	For injection: dissolve into injection brine, mix well For tumbling: mix with seasonings and apply in the product Mix with actual seasonings and add directly to the blender Dry blends: mix with seasonings (if applicable) or / and add directly to the blender / mixer / mincer For batter: mix with bread crumbs/seasoning and proceed as usual For spraying: mix with seasoning / liquid and apply to the product

*In addition to VivOX® 4 (301931) Vitiva is offering other customized grades that fit specific product needs and processing conditions

Lek Veterina d.o.o.

Mateja Ratiznojnik, veterinary drugs associate: "Lek Veterina d.o.o is a small company based in Lipovci near Murska Sobota in the north-eastern part of Slovenia, where agriculture is the main source of living. Our employees are skilled technicians, technologists and animal nutrition experts. We focus on the production and sale of premixes, mineral vitamin mixtures, nutraceuticals for animals and veterinary products for improving animal health, and our 25 years of experience are being shared with veterinarians, farmers, agricultural advisers and other agricultural experts in Slovenia and in other countries in central and south-eastern Europe. Familiarity with developments in animal nutrition, health and welfare, and the variety of feed additives on the market that can be homogeneously mixed into feed mixtures enable us to tailor our products to the demands of our customers. We were kindly invited into the CCBDI partnership, and responded immediately and positively to the invitation. It is the first time for us to participate in such a consortium, and will enable us to undertake joint R&D projects. We also aim to gain additional experience for the purpose



Lek Veterina is traditionally known as quality producer of premixes and compound feed for all species and categories of farm animals, wild animals, aquatic animals and pets.

Knowledge is our tool for completing our range of products and caring for our environment, what we have proved with compliance to Environmental standard ISO 14001.

We are the first certified producer of organic compound feed in our country.

Our approach to farmers and other interested clients is open and professional and our products target to a better performance in all areas of farming.

of developing our own products for increasing competitiveness, thereby strengthening our reputation in Slovenia and abroad. We are well aware that collaboration with such advanced representatives of the Slovenian commercial sector can bring out only the best. From our participation in this project we expect to strengthen our own research value in the veterinary field and to gain technological competitiveness, particularly in the field of animal nutrition. Our expertise in nutritional supplements for feed and our familiarity with the veterinary market will help us to lead the development of new active ingredients for use in veterinary feed and medicine. Should the final results of this project prove very positive, we do not rule out the commercialisation of certain products."



Clinres Farmacija d.o.o.

Alenka Šmid, head of clinical research project: "Clinres Farmacija is a contract research organisation (CRO) established in 2000 by Dr Dunja Vujić Podlipec when our first office was opened in Ljubljana, Slovenia. Since then the Clinres Farmacija Group has expanded, and is now present in Slovenia, Croatia, Serbia, Macedonia, Bosnia and Herzegovina, Singapore, Hong Kong and Bangkok. Clinres Farmacija provides the biotechnology, pharmaceutical and medical device industry with a wide range of services related to clinical development and all aspects of the registration process for new medicinal products and medical devices, including medical writing, clinical monitoring and project management, data management and biostatistics, global clinical resourcing, quality assurance, regulatory affairs and pharmacovigilance services. In addition to our extensive experience in oncology, we have conducted clinical trials in several therapeutic areas including gastroenterology, nephrology, pulmonology, neurology, endocrinology/metabolism and psychiatry. We have joined the CCBDI to provide our partners with a competent team of professionals to plan and conduct clinical testing of new functional foods, probiotics and food supplements currently under development. By joining the CCBDI we will expand and strengthen our expertise in the clinical development of probiotics, functional foods and food supplements. We also believe that we will establish and strengthen business relations with our partners in the CCBDI and will continue to collaborate on future projects."

Jožef Štefan Institute

Dr Marko Fonovič, research associate:

"The Jožef Stefan Institute is Slovenia's leading scientific research institution. It is also the largest, with over 930 employees. The institute covers a broad spectrum of basic and applied research, and its primary mission is the effective dissemination of knowledge to the

benefit of Slovenian industry and society. The Department of Biochemistry and Molecular and Structural Biology is one of the largest departments at the institute. Its research focuses on protein biochemistry, structural studies and the determination of enzyme pathways at the molecular level. In order to better pursue these goals, we have recently established and equipped a state of the art proteomics laboratory that allows us to use mass spectrometry for protein studies. In the course of our research we routinely use this approach for qualitative and quantitative analysis of proteins in complex biological sam-

ples. Given that this methodology has enormous potential for application in the design and optimisation of biotechnological processes, it was a completely natural decision for us to join the CCBDI. We have already established good collaboration with some of the partners at the CIPKeBiP centre of excellence, and we believe that working together at the CCBDI will strengthen these connections. We are convinced that our know-how will benefit other partners at the CCBDI, while our collaboration with industrial partners will enrich our expertise and have a positive impact on our work."



Acies Bio d.o.o.

Directors Dr Enej Kuščer and Dr Hrvoje Petković: "Acies Bio is a biotechnology company whose research primarily focuses on pharmaceutical, food and environmental biotechnology. Acies Bio collaborates with some of the largest pharmaceutical and food companies inside and outside Slovenia, providing them with full R&D support, from idea conceptual-

isation through research to product development. Key areas of expertise in Acies Bio's industrial R&D collaborations include metabolic and biosynthetic engineering, strain improvement, bioprocess development, and synthetic chemistry. Acies Bio also has a strong internal R&D pipeline in drug discovery, based on biosynthetic engineering, further extended by synthetic and semi-synthetic approaches. The company's main research facilities are located at the Brdo Technology Park, near Ljubljana, Slovenia, where it has over 400 m² of state-of-the-art biotechnology laboratory facilities. Its role at the CCBDI comprises designated R&D activities in all the main areas of the proposed programme, namely Probiotics and Health, Functional Foods, and Active Ingredients in Human and Veterinary Medicine. In the Probiotics and Health project and the Functional Foods project it mainly provides R&D support to the project coordinator, Medis d.o.o., with strong interdisciplinary collaboration between the academic and industrial partners. Acies Bio is the lead/coordinating partner in the Active Ingredients in Human and Veterinary Medicine project, where advanced approaches in systems biology (genomics, transcriptomics, proteomics, etc.) are pursued in order to develop new technologies for optimising industrial and probiotic strains on the basis of the findings of systems biology. Furthermore, the aim of this project is also to apply this knowledge directly in the development of new industrial strains and bioprocesses for the biotechnological production of active ingredients with anti-parasitic activity for use in veterinary medicine."



CC SURE

Advanced Systems of Efficient Use of Electrical Energy

Without the introduction of the active power network concept, Slovenia will not achieve the accepted targets concerning the **increase** of the share of renewable energy sources, energy efficiency and reduction of emissions.

Nowadays, in the field of production, distribution, transmission and the use of electric energy we witness great, almost revolutionary changes. These are partly resulted as the consequences of extraordinary technological opportunities (progress in information communication technologies –ICT, automation, electronics etc.), mainly due to the needs of a diminished disposability and higher prices of classical energy sources, higher consumption and the introduction of new, distributed sources, problems with an introduction of large energy objects in the environment and the decrease of CO2 emissions. The efficient use of energy does not only mean the optimisation of efficiency, but also the possibility of more efficient energy usage organisation in terms of time. Additional changes will appear as the consequence of the numerous increase of electric vehicles (the need for adequate infrastructure – charging stations and additional electrical energy sources). Users will play a more important role in the future, they will adopt actively their energy usage to the states in the power network and as owners of small production units they will act as electric energy providers on the energy market. In such circumstances classic electric power networks cannot satisfy the requirements of a reliable, safe and economic supply of electric energy anymore; that is why their evolution into the so called active power networks (i.e. smart grids) will appear. Real industrial revolution is opening up by this transition. And it will affect the majority of the economy and the society as whole. Without the introduction of

the active power network concept, the accepted targets concerning the rise of the share of renewable energy sources, energy efficiency and reduction of emissions will not be achieved by Slovenia.

The competence centre programme “Advanced Systems of Efficient Use of Electrical Energy” (in short: CC-SURE) primary aim is to establish the active power networks concept (so called smart grid concept) through a comprehensive approach by including the production, distribution and the usage of electric energy. This will

enable the verification of partners’ solutions and confirming the suitability of the newly developed products from the field of advanced systems for the efficient use of electric energy. This programme will permanently encourage partners’ cooperation and ensure the formation of development potential and competences of Slovenian companies and research institutions in the field of energy efficient solutions and products, which are suitable to be employed in active power networks of the future; and thus will assure decisive advantages to the cooperating partners regarding potential competition on the global market.

The consortium is balanced and combines key Slovenian actors from the field of power engineering and electric energy, research institutions, industrial partners and distribution network management. The CC-SURE’s added value will be resulted in partners who produce individual building blocks and will synergistically cooperate in the development of system solutions where the individual building blocks are joined into a functional entity.

The critical mass, which will be able to create globally competitive knowledge and the integrated systems which are needed to act in this growing market, can only be assured through transdisciplinary networking of different scientific and technological fields. And that is exactly what the structure and partnership of CC-SURE assures. On the one hand, it will enable the development of system-oriented solutions and enable a soft inclusion of distributed energy sources, and on the other hand it will enable the development of user-oriented solutions from the end-consumers energy efficiency’s point of view.

The basic aim of the CC-SURE programme is to build up the active power network concept which will be based on new technologies and will be tested in parts of the Slovenian power net-

work. The precise evaluation of new concepts in real environments will enable the industry partners the testing and final specification of newly developed solutions for active power network components. As a part of the programme, several demonstration projects of active distribution power network solutions, such as the systematic efficient use of energy, the virtual power plant, the upgrade of the control system for the existing distribution network and the automatic demand management for households will be implemented. These solutions will enable the inclusion of distributed resources and systematic efficient use of electric energy with the simultaneous consideration of the production, transmission and end-consumers. The testing of concepts and algorithms for the efficient use of energy, based on the measures of automatic demand management in connection with active power networks and smart homes, will become feasible. This includes the research, demonstration and the most suitable technological implementation of energy-efficient consumer loads in the sense of household appliances (cooking appliances, fridge-freezers and washing machines) and air-water

heat pumps, which will be connected to the electric power distributor via the intelligent network.

This project is also designed for gathering knowledge from the field of advanced energy efficient electric drive converters, which will enable the energy efficient, from the materials’ point of view optimised and environment friendly production of electric power converters. This includes the development of drive systems for household appliances, hand-held tools, industrial technology in the field of ventilation, compressors and pumps, as well as explosion-proof applications in chemical, mining and petrochemical industry. The advanced solutions will enable the efficient use of energy from the electric power distribution network and in the case of powerful industrial drives the efficient energy management via intelligent networks also.

Consequently the specific objectives of the CC-SURE programme are:

◇ building up the active electric power network concepts (Smart Grid), which will be based on new technologies and will be tested in parts of the real electric power network,

- ◇ implementation of a demonstration range for the systematic efficient use of energy (public and industrial networks, charging stations for electric vehicles),
- ◇ implementation of a demonstration range for the virtual power plant’s functioning,
- ◇ implementation of a demonstration range for the upgrade of the distribution’s network control system,
- ◇ implementation of concepts and algorithms, and demonstration range for the automatic management with household demand through Smart Home solutions,
- ◇ development of components for power networks, which are the main building blocks for the implementation of systematic solutions of active power networks,
- ◇ development of primary and secondary elements for distribution networks,
- ◇ development and implementation of energy efficient user loads in the sense of domestic appliances (cooking, cooling, freezing and washing appliances) and air-water heat pumps, which will be connected to the distributor through the active power network,
- ◇ development and implementation of energy high efficient electric drive converters and electro mechanic converters in the sense of industrial loads,
- ◇ development of advanced energy efficient controlled electric drives,
- ◇ establishment and/or empowerment of long-term mutual links among consortium partners,
- ◇ establishment of efficient results dissemination and the promotion for the improvement of national and international recognisability of the CC-SURE and its partners,
- ◇ implementation of sustainable forms of cooperation in the field of CC-SURE.

CC SURE



TECES - Research and Development Centre for Electric Machines

TECES was founded in the year 2001 as the joint goal of its founders, which was the establishment of an efficient system for linking companies and research institutions in order to strengthen the competitiveness of the Slovenian industry of electric drives.

Providing world-class research and development (R&D) infrastructure, particularly personnel with specific skills to solve complex problems and complete solutions in the field of energy-efficient drives and converters, represents a heavy financial and investment burden to small and medium-sized enterprises (SMEs).

Therefore TECES, with advanced R&D infrastructure and highly skilled staff, can provide the much-needed development support from the idea to product development for various clients both at home and around the world.

TECES can fill the gap in the lack of adequate R&D infrastructure of these SMEs, by providing highly qualified personnel as well as providing state of the art hardware and software.

In line with its mission TECES implements different activities and projects on the basis of the needs of Slovenian companies and worldwide market, to strengthen its role as a competent partner in developing high-tech

products and solutions in the field of energy converters, electric drives, power electronics, energy efficiency and use of renewable energy sources. In the project CC-SURE, TECES is taking part as the coordinator and project holder, it directs its activities in gaining knowledge in the field of advanced energy-efficient converters and conversion systems for renewable and alternative energy sources that effectively respond to current operational needs



Matej Gajzer, M.Sc., Managing Director TECES

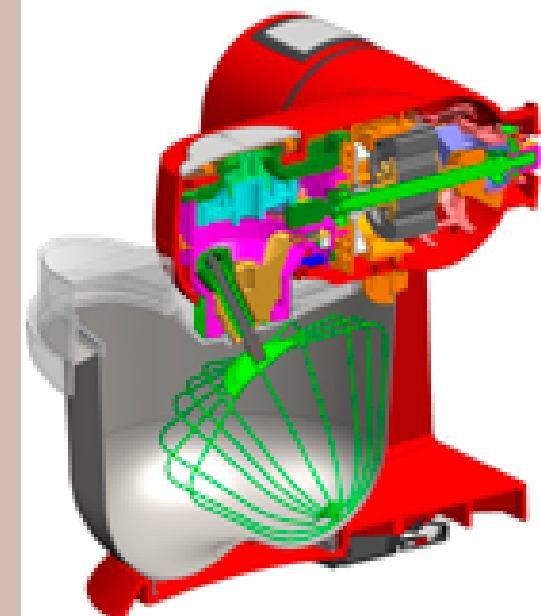
and in cases of excess energy on the customer side also act as generators of electrical energy.

Expectations of the successful implementation of the CC-SURE project are to strengthen the participation of Slovenian companies and research institutions under TECES coordination and strengthening TECES role as a competent R&D partner in the development of high-tech products.

BSH Hišni aparati d.o.o.

Small kitchen appliances have been produced for 40 years at the current location of BSH Hišni aparati d.o.o. Since 1993, the company has been part of the international concern BOSCH AND SIEMENS HOME APPLIANCES GROUP, currently third in its branch worldwide and the market leader in Western Europe. During this time, BSH Hišni aparati d.o.o. evolved from the device assembly to the modern centre for the production and development of small motor kitchen appliances for preparation of food and thermic appliances for preparation of beverages. Our products are presented on the market, mainly under the Bosch, Siemens and Ufesa brands.

BSH Hišni aparati d.o.o specialises in the development and production of smaller household appliances with power drives and thermal appliances. With an average of 13 international patents per year we belong to one of the most innovative companies in this part of Slovenia. Within Competence Centre SURE we offer to partners support from its operating field and the possibility of proving developed concepts from the small household appliances



sector. Within this partnership information on small appliances with motor drives and thermal appliances will be disseminated together with the joint use of equipment and premises where the equipment is situated. This will also help our partners to get established on foreign markets, where we are already present.

Within the Competence Centre SURE we aim to develop a new generation of electro-mechanical transformers with high efficiency. Special focus will be devoted to the whole assembly of the driving unit and not just on individual components in order to develop a new type of brushless DC motor as well as of AC motor, together with the adequate electronics and optimised transmission gears.

The MUM8 kitchen machine is the core of our optimisation. The modification MUM8 kitchen machine is the core of this project.

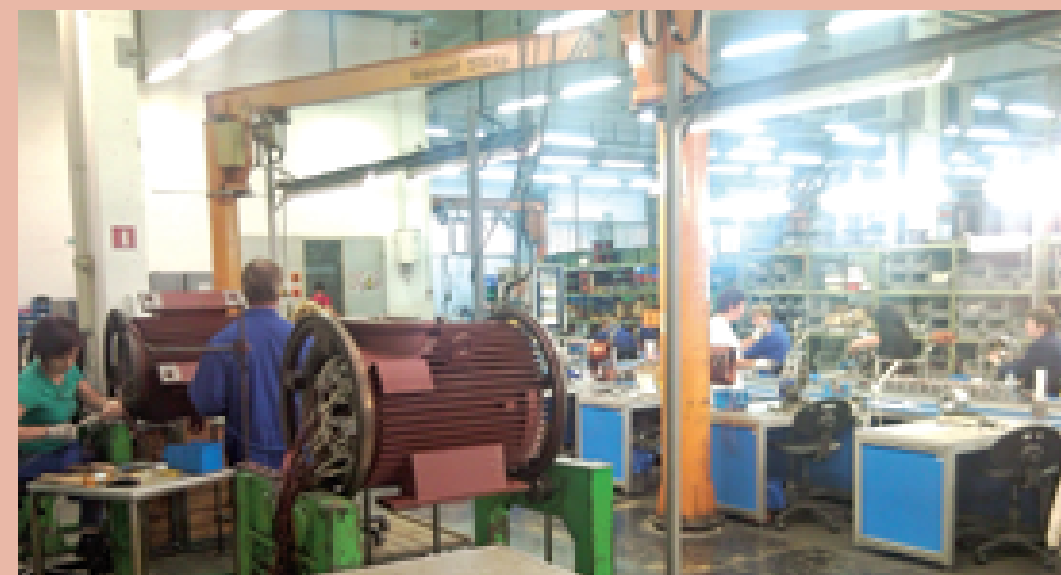
The components and configuration on of the electro motor are depicted on the cross section of the machine MUM8.

BARTEC VARNOST d.o.o.

The company was established in 1958. From the foundation to the present day we have been engaged in development and production of Explosion protected electrical devices. Today it employs over 1400 people, including BARTEC VARNOST Zagorje ob Savi. BARTEC Holding has 20 companies in Europe and outside Europe in USA, Singapore, Japan and China. Primary objective of company is protection of electrical equipment and components for safety of human and environment. By merging BARTEC VARNOST in Zagorje in BARTEC Holding, the mother company has complemented range of products with flame proof motors produced in our company. Our production range is dominated with production of various flame proof motors and components along with mining equipment designed to meet in the European quality with highest knowledge in area of explosion protection. Our mission is seen in modernization of our production range with adaption to customer's needs. This is achieved by effective management of strategic management, rational and optimum operation of the organizational structure.

As manufacturer of electric motors and electrical equipment, components, systems and projects supporting services for hazardous areas it is our primary concern for environment, facilities and human security. Arising from this vision comes our primary objectives which are embedded in business processes of our enterprise. The objectives and tasks along with development opportunities of BARTEC VARNOST we arising from the development strategy based on know factors of the environment, achieving the set tasks

Assembly Department



and movement in commodity markets. With our capabilities and skills we want to keep up with trends in the field of human security, environment and facilities.

BARTEC VARNOST cooperates in the development of flameproof motor of above standard dimensions in accordance with the latest flameproof protection standard EN 60079-0:2009. Special attention shall be directed towards the development of a highly efficient system, which shall beside the requirements regarding flameproof protection also achieve high yield leading to lower energy consumption.

Together with their partners, BARTEC VARNOST shall develop a highly efficient electric motor of above standard dimensions with high market competitiveness, and high added value.



Winding Department



Mr. Milan Jevšenak, M.Sc., CEO

ELES, Elektro - Slovenija, d.o.o.

According to Slovenia's Energy Act ELES is responsible for operation, development, construction and maintenance of the national transmission network. The transmission network together with distribution system and power generation comprises Slovenia's Electrical Energy System (EES).

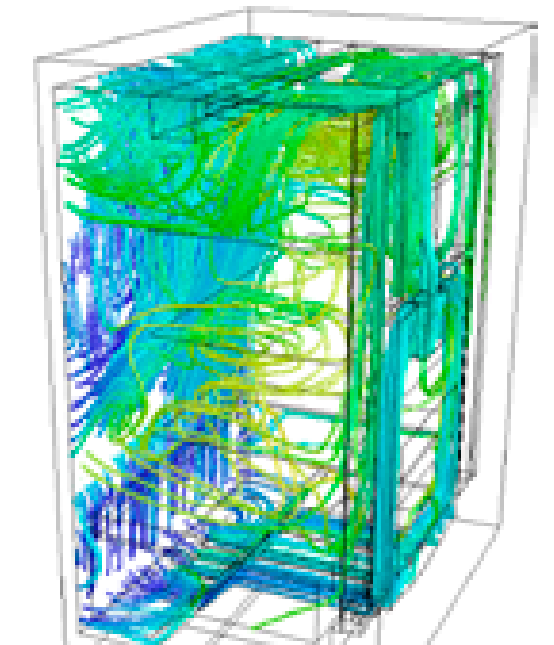
ELES participates in the efforts for efficient use of electricity, demand side management and Smart Grids by promoting these topics in the National Action Plan for Energy Efficiency and Renewable Energy Sources, Transmission Network Development Plan and Strategy on the Development of the Electric Power System of the Republic of Slovenia.

Within the Competence Center Programme "KC-SURE Advanced Systems of Efficient Electricity Use" ELES has a guiding and consulting role based on its international experience with transmission network operation inside ENTSO-E and participation in other European projects and associations.

The Competence Centre implementation will enable ELES to introduce the concepts of active networks. This is important as the future networks will have increasingly high share of distributed energy sources, deal with increased volatilities and require stronger participation of consumers in the network operation.

Gorenje is developing energy efficient home appliances and systems

The core of Gorenje's know-how and innovation in development of new products is generated in-house, within the research unit working in over 20 labs to conduct measurements, calculations, and analyses. In addition to our own development, new knowledge and ideas are spawned through cooperation with institutions of knowledge and our business partners. The network of employees working in research and development throughout the Gorenje Group includes approximately 300 experts. A team of 150 researchers forms the Gorenje Research Unit, one of the largest of its kind in Slovenia. One of the focal points in Gorenje's R&D efforts is energy efficiency of our appliances and the use of environmentally friendly materials. Teaming up with research institutions and industrial partners within competence centers will allow us to gain new knowledge even faster in order to develop competitive products with high value added. Within CC-SURE, Gorenje is participating in



two R&D sub-projects: Active Electric Energy Network Solutions; and Adaptive Energy-Efficient Home Appliances and Systems.

Taking part in CC SURE will allow us to develop home appliances with improved energy efficiency relative to those currently available in the market. The goal is to develop innovative technologies for a family of compact cooking appliances and technologies for automatic cooking, highly efficient refrigerators and freezers, and advanced washing algorithms that will provide lower water and power consumption; in addition, the possibilities of optimizing individual parts of the air-water heat pump will also be examined. At the same time, these products will be connectible into intelligent networks, thus additionally contributing to rational use of power.

National control centre



Hidria Rotomatika d.o.o.

Hidria Rotomatika, a part of Slovenian international Hidria Corporation, is focused on development and production of high-tech solutions for automotive and HVAC industry, such as: electric motors, electronically commutated (EC) high efficiency fans and motors, high pressure machined Alu die-casted parts and systems, lamination, rotors, fine blanked parts and motorcycle components. Hidria Rotomatika employs more than 1,500 employees at 8 production locations in Slovenia (Spodnja Idrija, Kranj, Jesenice, Koper), Germany (Vaihingen, Kleinglattbach) and Hungary (Budapest, Gyöngyös). Innovations for automotive and HVAC industry are developed in two state-of-the-art R&D centres: Hidria Institute Klima, which is focused on HVAC solutions, and Hidria Institute for Materials and Technologies, which is focused on innovative materials and technologies, simulations of die casting, stamping, fine blanking, development of prototypes and new technologies for HVAC and automotive industry.

Hidria Rotomatika's role in SURE

Hidria Rotomatika is active in sure as a partner of the TECES (Research and Development Centre for Electric Machines) consortium. Hidria Rotomatika's contribution to the consortium is in the vast knowledge of designing

and manufacturing of electric motors and rotors the company has gained throughout the decades. Hidria Rotomatika has already worked with some of the partners in SURE on other innovation projects connected with R&D and manufacturing problems and issues in the industry. Hidria Rotomatika already has experience from participated in public-private national and European projects.

Hidria Rotomatika's expectations from the SURE project

Hidria Rotomatika sees the SURE project as an opportunity to upgrade its development and research experiences with a more multidisciplinary approach, gain knowledge of processes in other industries and establish new, valuable contacts with companies and experts from the wide field of industry and academia. Hidria Rotomatika therefore sees the SURE project as a step in gaining new references and partners that will ensure its further growth on the global market.

INEA d.o.o.

INEA is one of the leading Slovenian companies in the fields of energy management, process control, automation and manufacturing informatics with own technology and solutions.

It was founded in February 1987 by the Institute Jožef Stefan, the leading research and development institution in Slovenia.

At the end of 2010, INEA employed 48 people in its branches in Slovenia, Croatia and Serbia. INEA's workforce is highly educated, with almost 90 % of the people holding professional technical qualifications.

INEA's engineering group has over 30 years of experience with Demand Side Management.

Participating in CC SURE and working together with Elektro-Slovenija, d.o.o. (ELES), transmission system operator (TSO) in Slovenia, is enabling us to develop our core Demand Side Management solutions into the Virtual Power Plant system focusing on pilot deployment of the system.

The TSO is responsible for the stability and safety of the transport energy grid, which is provided among other services by tertiary regulation of the network frequency.



Mr. Mitja Bizjak, project manager

The Virtual Power Plant system, a fully automated solution, will synchronically control the consumption and the production from distributed energy sources in the same way as classical power plants do. It will remotely manage electricity consumption and distributed generation across a network of industrial and commercial prosumers - consumer and producer sites.

The Virtual Power Plant system will increase the efficiency, safety and

reliability of the electricity transmission and distribution systems, remove the obstacles to the large-scale integration of distributed and renewable energy sources and effectively manage and balance the supply and demand in the electricity system.



INEA Virtual Power Plant Demonstration laboratory



Measuring instrument PowerQ4 Smart

Metrel d.d.

METREL is one of the world leading manufacturers and suppliers of electrical test and measurement equipment for the following applications:

- Electrical Installation Safety
- Electrical Machines and Portable Appliances Safety
- High Voltage Installation Safety
- Power Quality Analysis
- LAN Cabling Certification
- Indoor Air Quality and Sound Analysis

Metrel has major role in development of "PowerQ4 Smart" power quality analyzer specially designed for SmartGrids. He also provides equipment and measurements for other partners during SmartGrids components and network evaluation. Main expectation from partnership is to gain knowledge and experience in SmartGrid measurement field, which can be latter transformed into handheld measuring devices and used for SmartGrid commissioning and troubleshooting.

Kolektor Group d.o.o.

A large part of the Kolektor group program with its products and services is in direct connection with the field of effective usage of energy, may it be in distribution of electrical energy or through consumers of energy. Our competences, which we intend to fully utilize in the SURE Competence Center, extend to the field of transformers of electrical energy, low-voltage distribution boards, systems of control and surveillance, and drive systems. Within the Competence Center SURE project, in the area of distribution of electrical energy, Kolektor is responsible for:

- Development of the network control system which, thru dispersion and flexibility of providers and users, is becoming one of the key elements of the electrical energy network;
- Development of new types of distribution transformers, advanced distribution boards, RTU devices for control of transformer stations, and control system of energy transformers.

Due to the development of Smart Grid, the field of distribution transformers is to be renewed. Kolektor follows the development trends in this filed and integrates them into the conceptual construction solutions of distribution transformers of next generations. The topical issue to be dealt with and managed is, among other things, oscillation of voltage at the 0,4 kV level resulting from integration of dispersed sources of energy, such as the wind and solar power stations of lower powers. From the aspect of cost, solutions are not optimal yet, and shall be subject to future changes.

Within the CC SURE project and as a consumer of electrical energy; Kolektor is developing new solutions in the field of energy-efficient drive systems. Drive systems will enable communication with distribution networks and, depending on the network status and energy demand of the loads, shall operate either in the motor or generator mode.

Mr. Radovan Bolko, Kolektor Group CEO, points out that in such a complex project, cooperation with universities and other partners from the entire



Active part of a distribution transformer incl. regulation of voltage under load.

chain, acquisition of comprehensive know-how and information from the field, and integral insight into production, distribution and consumption of electrical energy, is of vital importance. This approach allows development of innovative products which are interesting for a wider European and worldwide market, for in the ordinary relationship between the customer and the supplier, we are provided only scarce information that can prove somewhat misleading. Our company deems engagement in this project so important also for the opportunity of realization of demonstration polygons representing significant reference for acquiring new market possibilities in the wider European resp. worldwide market.



Radovan Bolko, Kolektor Group CEO



Petrol d.d.

The PETROL GROUP is the largest Slovenian energy company, the largest group in terms of turnover, one of the largest Slovenian companies in terms of profit and one of the most successful business entities in Slovenia at the same time. With its clearly defined strategic orientation and development priorities it actively participates in shaping the Slovenian energy environment, currently also becoming an important player on the energy markets of the wider region of South-Eastern Europe. PETROL is particularly distinguished for the quality of its products and services, its great reputation, highly recognised brands and solid financial position. The company is engaged in four key business areas: sale of petroleum products and other merchandise; sale and distribution of gas; production, sale and distribution of electricity; ecology. Its entire operation is based on promoting business excellence or on following and respecting modern market demands in the service and environmental protection fields.

PETROL's highly motivated and business oriented employees feel a deep sense of responsibility towards their customers, suppliers, business partners, owners and the company as a whole; they meet their expectations through considering fundamental legislative regulations and ethical rules of the Slovenian society, through conforming to European standards and acting in accordance with the environmental legislation.

The Petrol Group:

- ◇ 33 companies,
- ◇ 10 countries,
- ◇ Retail network of 454 service stations as per 31.12.2011.
- ◇ Independence and flexibility in sourcing.
- ◇ Own storage facilities and optimal logistic network.
- ◇ Wide retail network of service stations in Slovenia and across SE Europe.
- ◇ Concept of convenience model of service stations.
- ◇ Comprehensive energy supply (gas, heat, electricity, energy and environmental solutions).
- ◇ Energy supply centre (one supplier of all kinds of energy).
- ◇ Reliable supply with long tradition.
- ◇ Stable dividend policy.
- ◇ Financial stability.

Sipronika d.o.o.

Short introduction of the company

Sipronika d.o.o. was established in 1995 by a team of highly qualified engineers with expertise in the research, development, design, production, installation and servicing of high-technology systems for power engineering and accurate time synchronization.

Since its establishment the company has recorded permanent and steady growth, as seen by its increased output and expanding sales, on both domestic and international markets.

A significant proportion of our resources are dedicated to training and the continuous education of our expert engineers, spanning the range from electrical and power engineering to computer science. We have confirmed our presence as a competent and reliable partner in numerous realized R&D projects, consortia and other completed activities.

At present our business has three main areas: distribution automation systems in power engineering, traffic information systems, and accurate time & frequency synchronization systems.

The role of Sipronika in the CC SURE consortium

Sipronika is the only micro sized partner in the consortium (9 employees), yet with its strong research & development and broadly experienced team in power engineering it contributes valuable expertise in the automation of medium voltage (MV) distribution network.

Sipronika takes part in two CC SURE projects: RR1 (Active power network solutions) and RR2 (Power Network Components). In RR1 Sipronika works on active network concepts based on new technological solutions with a special focus on MV power distribution network. In RR2, on the other hand, Sipronika designs and develops systems solutions for active networks. The main goal is the development of a multifunction unit for supervision and

control of the MV network in compliance with the sound communication protocols of active networks.

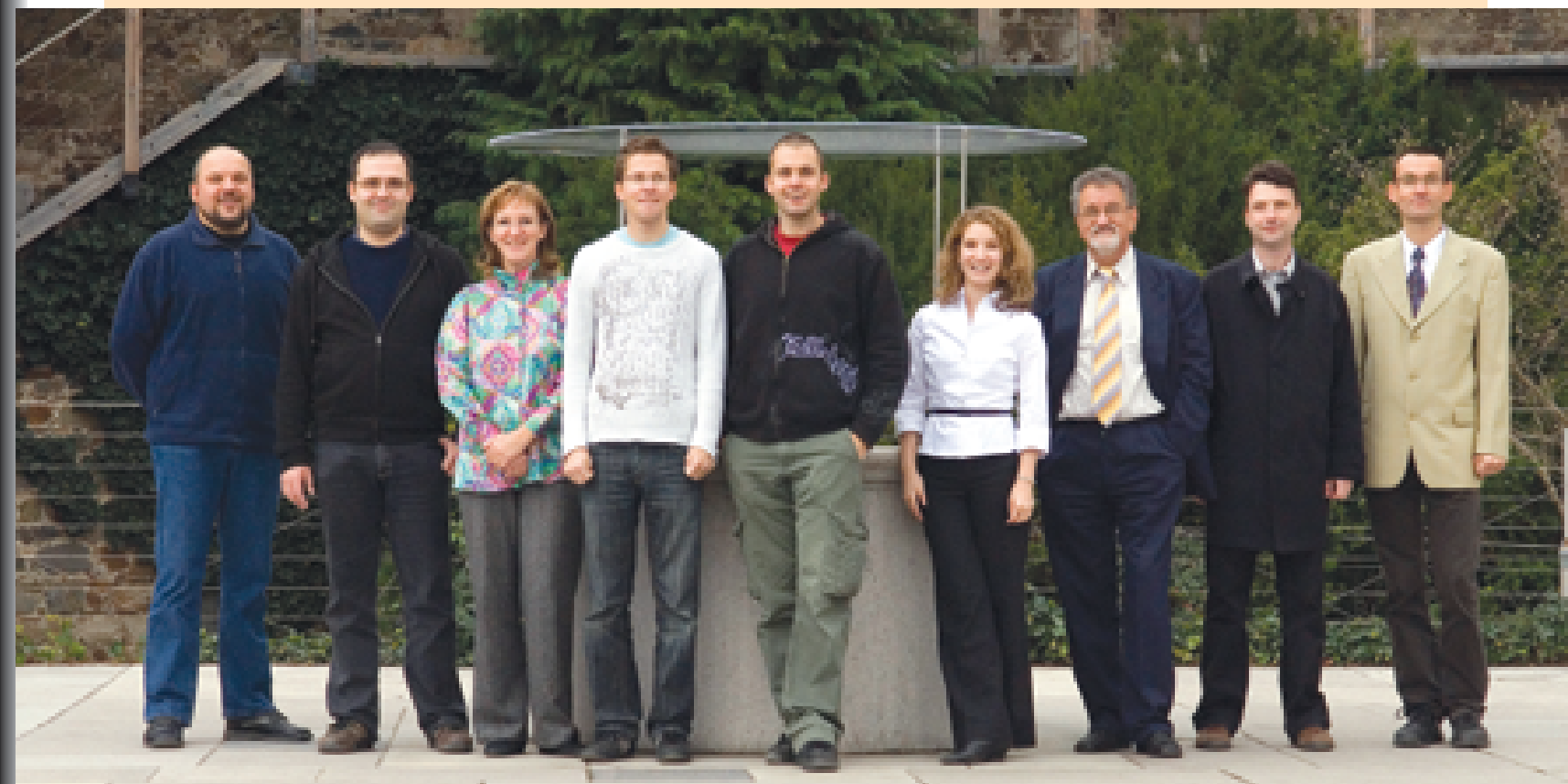
Expectations from the project and partners

Our main expectations from working in the consortium is sharing the common as well as complementary knowledge, efficient technical cooperation with other consortium partners, working on the improvement of standardization and compatibility of communication protocols, designing a prototype and testing it on an appropriate testing site.



Dr. Andreja Jarc, project manager

The team of Sipronika



Smart Com and the SURE Competence Centre

Smart Com is a high-tech SME and a part of a larger group of enterprises. Its core business is development and integration in the field of Information and Communications Technologies (ICT). Smart Com provides a complete set of services in the lifecycle of an integrated end-2-end ICT system: consultancy, design, development, integration, implementation, operation, support, and maintenance. Smart Com develops software solutions for the market and for internal use. It features an R&D group, which is registered with the national research agency; members of the group have a long track record of successful participation in large scale national and European R&D projects. R&D focus is currently on Smart Energy Grids, eHealth and eInclusion, and novel ICT infrastructures and services. Smart Com is an active partner in two major national R&D efforts in the 2011-2013 period, the



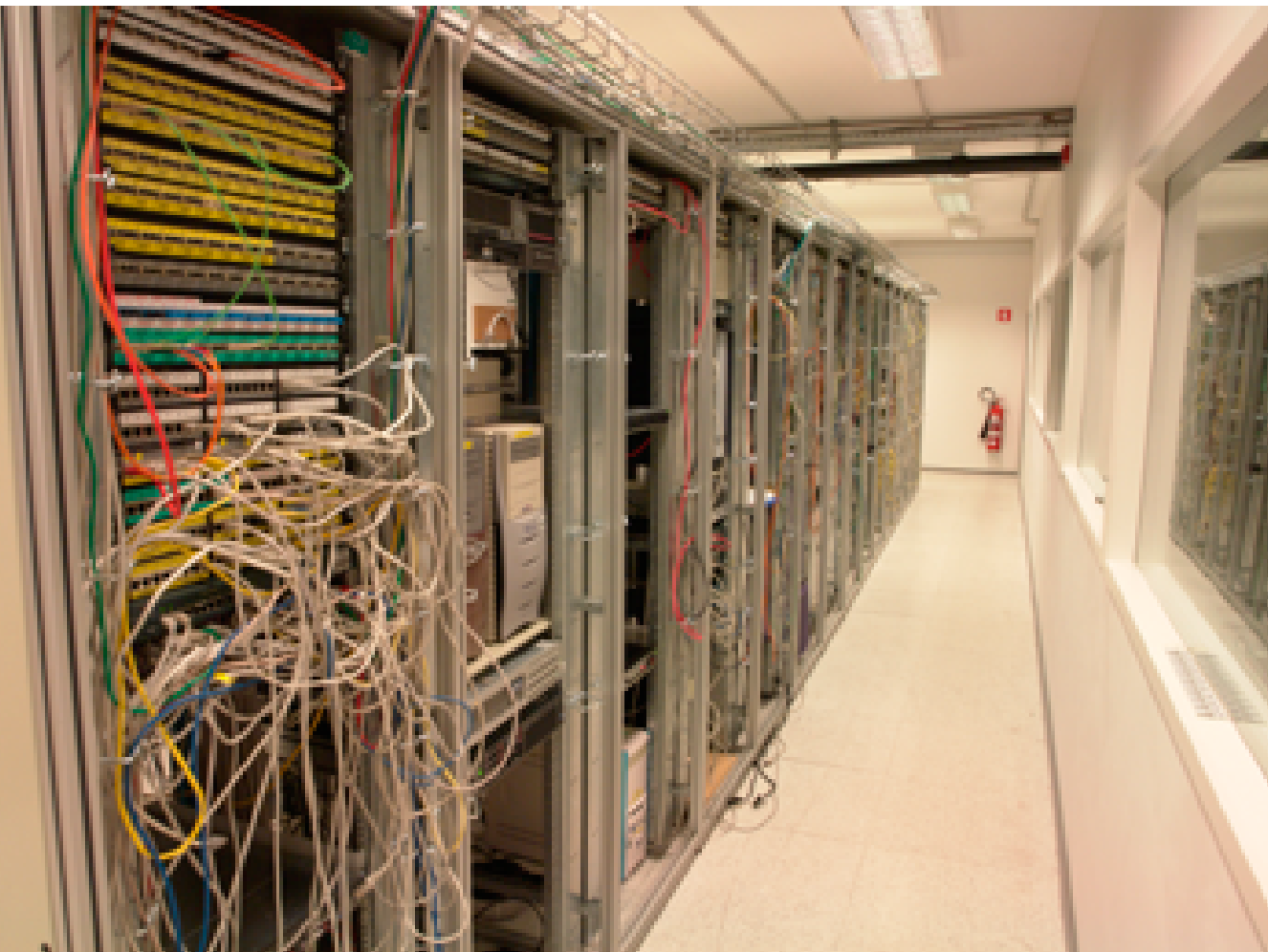
Arso Savanović, PhD, R&D Head, Smart Com

SURE competence centre on Smart Grids and the CLASS competence centre on Cloud Computing.

Within the SURE CC, Smart Com will employ its competences to contribute with R&D, prototyping and experimentation in two main areas, migration concept to Smart Grids and novel power network components. The former area comprises review of state of current power network and its subsystems, requirements analysis, design of advanced subsystems in support of Smart Grids, and testing of advanced subsystems in an experimental set-up, with Smart Com focusing mainly on the ICT subsystem of the power network. In the latter area Smart Com will mainly focus on the development of an advanced analytical and reporting system for Smart Grids and experimental evaluation of its prototype.

Smart Com finds the field of Smart Grids strategically important. As a result of participation in the SURE CC, Smart Com expects to foster existing and establish new partnerships with key stakeholders in the field, augment its solution portfolio for Smart Grids, and strengthen its market position and its position as a competent R&D partner both nationally and in a broader region.

Research and development laboratory, Smart Com



Motor at -40°C in the temperature shock test chamber

Domel d.o.o.

Domel d.o.o. is a global development supplier of accomplished solutions on the basis of electro-motors and their upgrades. We take an active part in the business of cleaning technique, ventilation systems, industrial applications, automobile industry, medicine and alternative energy resources.

More than 60 years of experiences on manufacturing of electric motors and around 900 employees are guarantee for achieving top performance of their electric drives. In the Year 2004 Domel has taken over the European leading position in the region of independent domestic air compressors. With more than 60 specialists (5 Ph.D; 8 M.Sc) Domel's core competences are knowledge and experiences about aerodynamic, electromagnetic, electronic, acoustics, rotodynamics and industrialization. Domel decided to retain a high level of competence, learning, innovation, responsibility and self-confidence which are the most important values for the fulfilment of our quality and business standards.

Domel is oriented towards special application where advanced technologies are needed. We are strongly focused on drives driven by electronically commutated - brushless motors for industry application, clean room technology, gardening equipment, HVAC systems and Fuel Cells as well. In year 2009

Domel developed the most efficient electric drive for battery driven gardening tools like chainsaw, grass cutter, hedge trimmer and is currently demonstrating the second generation of improved systems with high performance.

The main role of Domel in the project CC SURE is to develop and optimize the second generation of electric drive for battery driven gardening tools, to build first prototypes and test them under accommodate conditions in lab and integrated in the final appliances with world known brand name producer.



EC motor

University of Ljubljana, Faculty of Electrical Engineering

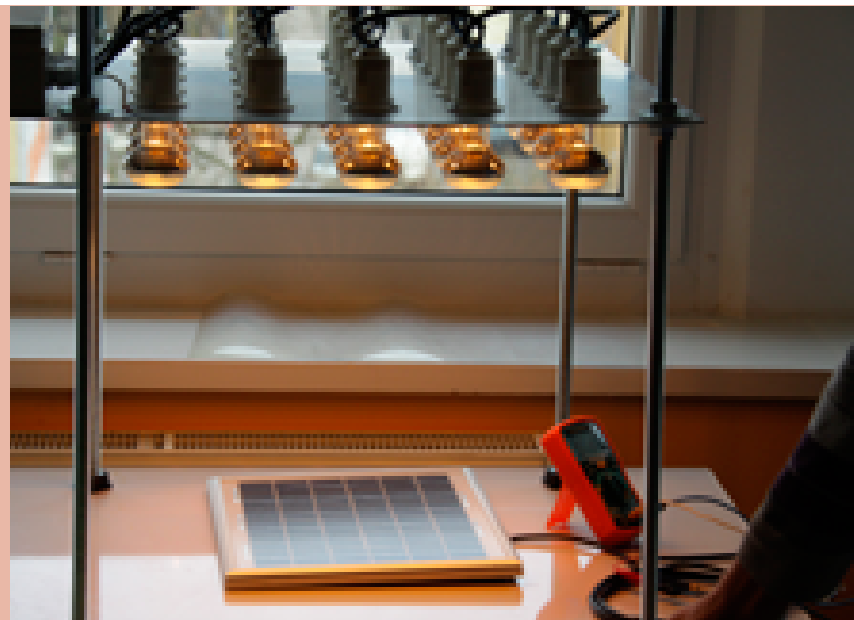
University of Ljubljana is the largest educational and scientific research institution in the Republic of Slovenia. It incorporates a large and concentrated research and development potential. Researchers successfully cooperate with the Slovenian industry, are involved in many research programmes of the European Union and carry out programmes and projects within calls of the Slovenian ministries.

UL FE is also one of the key research institutions in the field of active power networks. It is involved into domestic and international projects on this topic. It closely cooperates with companies for power distribution, power transmission and industry. The projects and research include effective integration of energy sources, participation of consumers in network operation, efficient use of energy and development of ICT technologies, which are all key elements of active networks. Within CC-SURE UL FE is the leader of the project Active power network solutions which is divided into two main parts: first part dealing with active network concepts and the second part with solutions. The main purpose of the project is to build active network concepts based on new technological solutions and to test these solutions in actual power networks. The evaluation of these solutions on field will enable industrial partners to test, verify and finely tune the developed components and concepts.

University of Ljubljana, Faculty of Mechanical Engineering

Our mission

The Ljubljana Faculty of Mechanical Engineering (FME) exists to create and disseminate knowledge that enables its students and research partners to competitively participate in the international scientific field and marketplace.

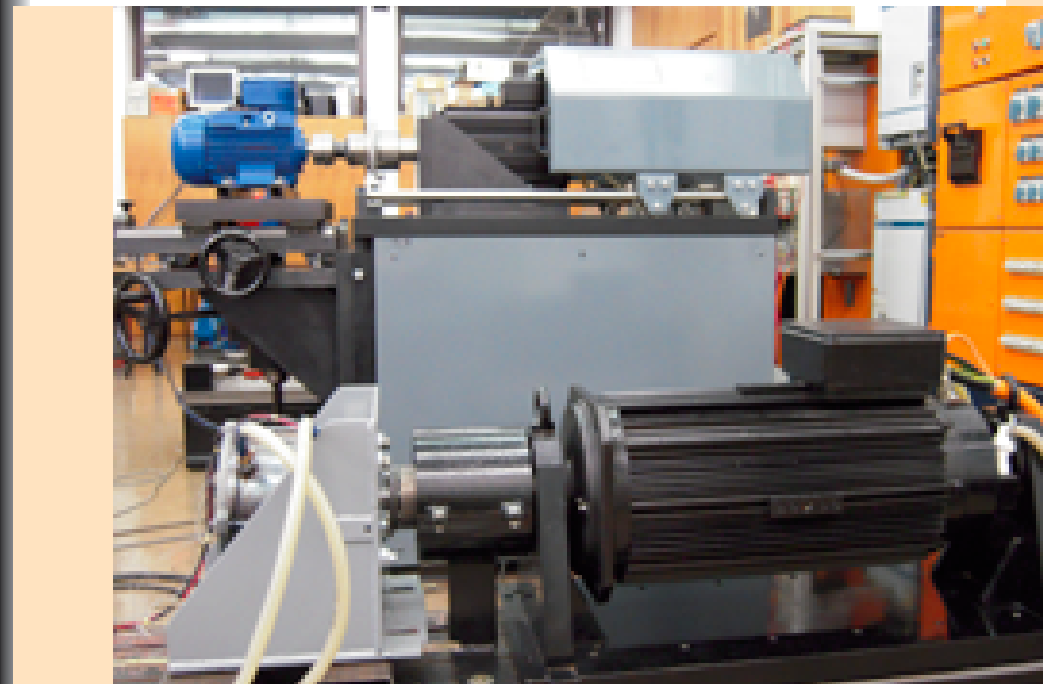


For UL FE is extremely important to test theoretical concepts in real networks and transfer lessons learned into new technology and also in the educational process. The project results will also enable the electricity network operators to plan mass implementation of active network concepts and evaluation of required investments. The implementation at demonstration sites will have large social significance in the development of business models, legal and regulatory frameworks, and sociology.

Our vision

The vision of the Ljubljana FME is to become the premiere teaching and research faculty for mechanical engineering in Slovenia and Southeast Europe while maintaining the highest educational and professional standards. With this the faculty will become be an even stronger magnet for the cooperation with Slovenian and international companies and research-and-development organizations.

The University of Ljubljana, Faculty of Mechanical Engineering practices basic, applied and development research, striving for excellence and quality of the highest standard in the fields of science.



University of Maribor, Faculty of Electrical Engineering and Computer Science

Faculty of Electrical Engineering and Computer Science, University of Maribor, is responsible for education and research in the fields of electrical engineering, telecommunications, computer science, informatics, mechatronics, industrial engineering, and media-communication sciences. Two institutes of the Faculty are involved into the CC-SURE, Institute of Robotics and Institute of Power Engineering.

Institute of Robotics is engaged in the design and modeling of mechatronic systems. Among the activities of its research team the work in the field of power electronics systems (different structures, control) and control of electric drives is particularly important, which is currently being upgraded with the work in the field of system integration and rapid control prototyping.

Institute of Power Engineering is active in the field of rotating electrical machines and electromechanical converters. It performs specific measurements and analysis of electric machines. It also analyzes the operation of machines operating with frequency converters and designs all types of machine for standard and special applications. For the design it uses its own software "emLook."

Within the CC-SURE Institute of Robotics will cooperate in activities of design of power electronics converter, where it will contribute to design as well as control. Institute of Power

Engineering will cooperate in design and evaluation of the flameproof drive system.

Through CC-SURE we hope to gain new competences and additional financial sources, which will allow more intense development in our priority fields. Connections established and/or strengthened with industrial partners will have a positive effect on operations as they will have more opportunities for cooperation on mutual R&D projects in the future.

CC BME

Competency Center for Biomedical Engineering

Biomedical engineering is one of the world's most promising and fastest growing industries. Rapid technological developments are being fuelled by breakthroughs in basic sciences and engineering, as well as by increasing global demand for more affordable, effective, and minimally invasive medical treatments.

From the very beginnings of the biomedical engineering industry, Slovene research institutions and companies have positioned themselves among the most influential in the world.

With a focus on global market leadership, 12 partners, supported by Slovenia's Ministry of Higher Education, Science and Technology, as well as the European Regional Development Fund, established an EU regional Competency Center for Biomedical Engineering (CC BME).



Mag. Zore Lukin, CC BME

The consortium's partners include key institutions of higher education, industrial representatives and experts in the field of biomedical engineering and medicine that wish to expand among their existing avenues of cooperation to achieve new levels of synergy.

The vision of the Competency Center for Biomedical Engineering) is to establish Slovenia on the global map as an incubator of highly innovative companies that build the most interesting biomedical devices in the world.

The long-term mission of the Competency Center is to foster the development of a large-scale research and development group consisting of corporate and academics partners from the multiple disciplines that relate to biomedical engineering. The aim is to assist in the development and maintenance of a critical mass of knowledge and the resources needed to facilitate the rapid transfer of research findings into practical, innovative and high value-added biomedical solutions.

Some of the long-term goals of the Competency Center for Biomedical Engineering are as follows:

- to achieve a greater concentration of investment in specific, high-potential areas of biomedical engineering, as identified by the consortium's partners;

- to achieve closer and more active cooperation between knowledge institutions and industry;
- to develop products and applications that reduce the invasiveness of medical treatments and increase the reliability and accuracy of diagnostics;
- to advance knowledge in the field of biomedical engineering in order to improve the quality and accessibility of basic health services;
- to foster the growth of new and existing regional high-tech enterprises.

The five projects of CC BME are:

MINMED: Minimally Invasive Medical Devices

The aim of the MINMED project is to develop new and innovative laser sources based on diode pumping, and new medical applications for the current sources in the fields of ophthalmology and dermatology. Two of the objectives of the project are the development of a new ophthalmic photodisruptor and the development of a new DualLight laser source for laser dermatology devices.

SmartMed: Smart Electromagnetic Medical Devices

The SmartMed project focuses on the development of a wide range of innovative sensors that sense the effects of electromagnetic waves on human tissue. The objective of the research is to control the electromagnetic parameters and consequently ensure selective treatment of the injured tissue, resulting in a less invasive impact on the tissue.

PhysiCoDerm: Enhancement of Cell Membrane and Skin Permeability for Transdermal Drug Delivery by Means of Physical Methods

The PhysiCoDerm project is concentrated on the development of new therapeutic devices and methods that are based on the effects of electric fields and ultrasound on cells. The research is aimed towards finding therapeutic methods that will allow the entry of active substances through the skin, into the skin cells and subcutaneous tissue.

SAMinZDRAV: Home Devices in Support of Independent and Healthy Living

The focus of the SAMinZDRAV project is to research the most appropriate component technologies for developing a system designed to unobtrusively

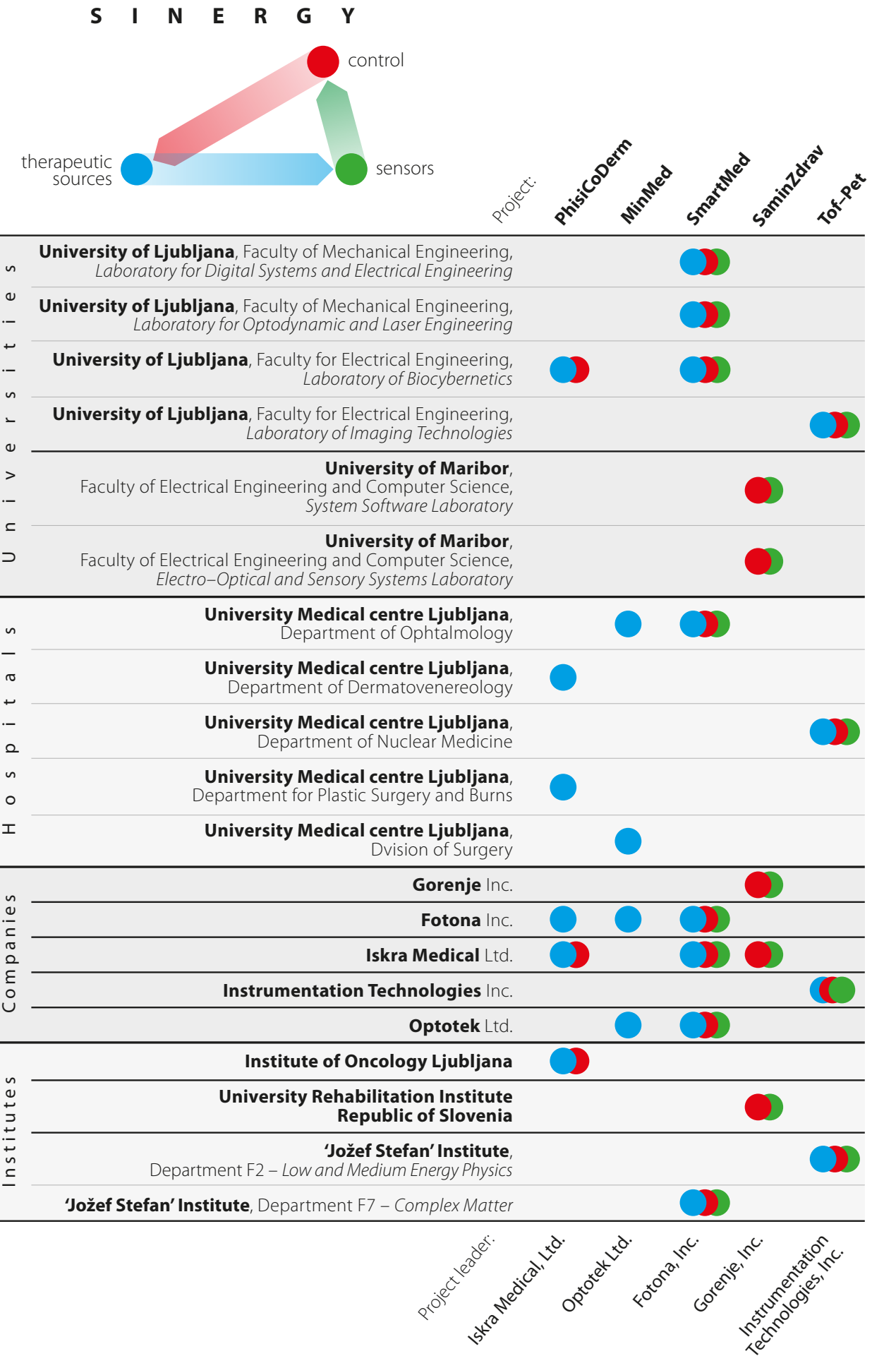
acquire and evaluate the parameters of functional health for an observed person and improve their opportunities for maintaining an independent and healthy life.

TOF-PET: The instrumentation for the scanner provides improved imaging technology in nuclear medicine. Positron emission tomography (PET) is an important diagnostic tool in oncology, neurology, cardiology, and for identifying inflammatory processes. The project aims to improve the quality of PET devices in terms of the signal-noise ratio by improving the time resolution of the devices.

Within five projects, over 120 researchers cooperate to accelerate the development of:

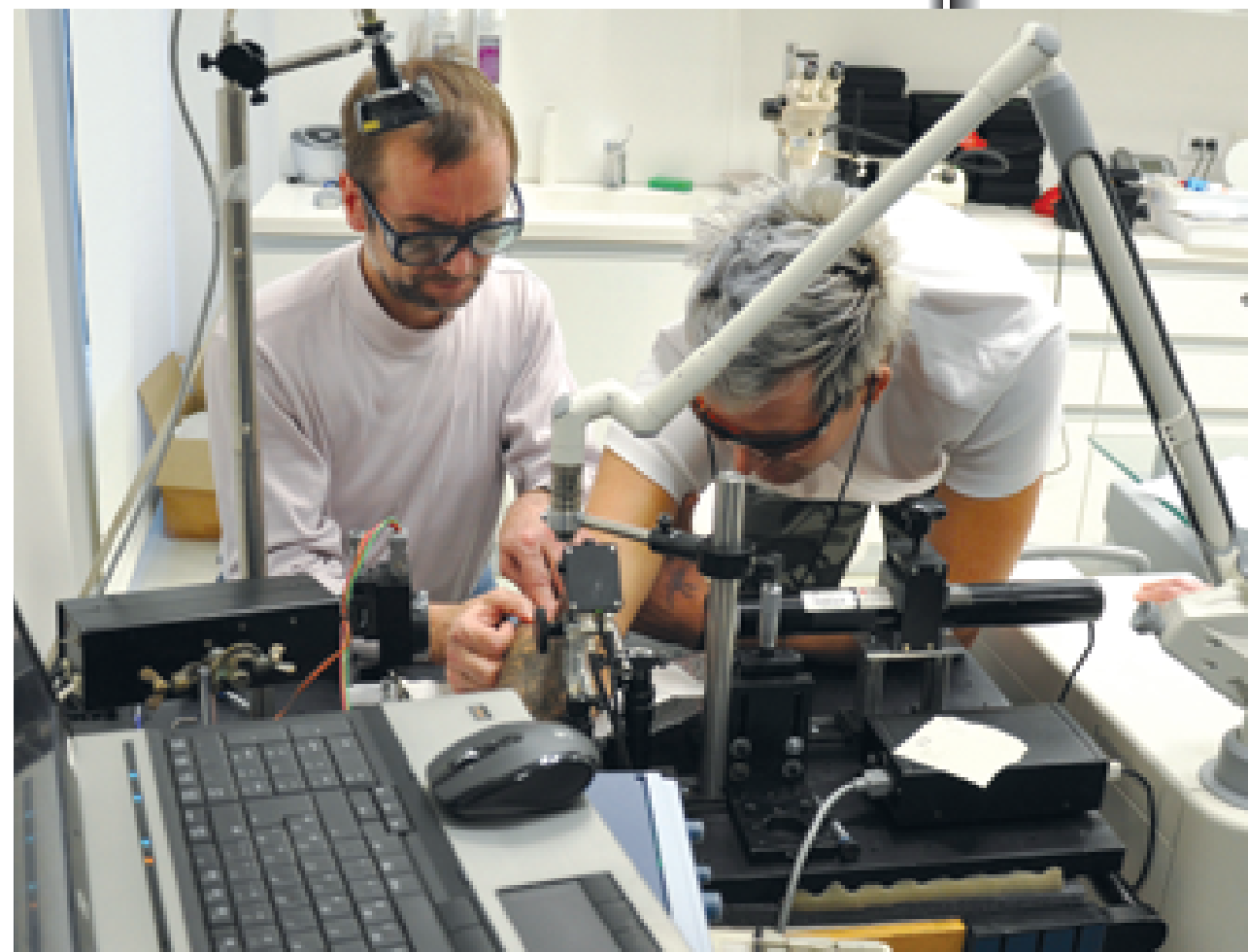
- new therapeutic sources,
- new or significantly improved monitoring and diagnostic sensors, and
- control systems for direct or remote control and supervision of medical devices, patients or therapeutic treatments.

By integrating knowledge and commercial expertise, the CC BME is committed to developing global market leaders.



FOTONA

Fotona is a pioneering, research-based, laser technology company, recognised as a world leader in the innovation, development and manufacture of state-of-the-art medical laser systems for dentistry, aesthetics and surgery. Founded in 1964, only four years after the invention of the laser, Fotona has been involved with lasers since their conception. Through its in-house development and manufacturing capability, its laser systems purvey quality, durability, reliability, ease-of-use and innovation. The company strives to provide cutting-edge, innovative, and high performance solutions that comply with the most stringent international quality and safety standards. Together with clinical experts it has developed numerous new laser treatments and is recognised as the world leader in Er:YAG and Q-switched laser technology. By 2011 Fotona had installed over 20,000 of its laser systems worldwide. It has a global distribution network spanning 60 countries. Fotona's medical laser systems offer an opportunity to provide treatments that are faster, less invasive and well accepted by patients. The company's aim is to fulfil the modern practitioner's needs by providing easy-to-perform and effective treatment solutions. Fotona's lasers complement and even improve the efficiency of other technologies in modern medical practice.



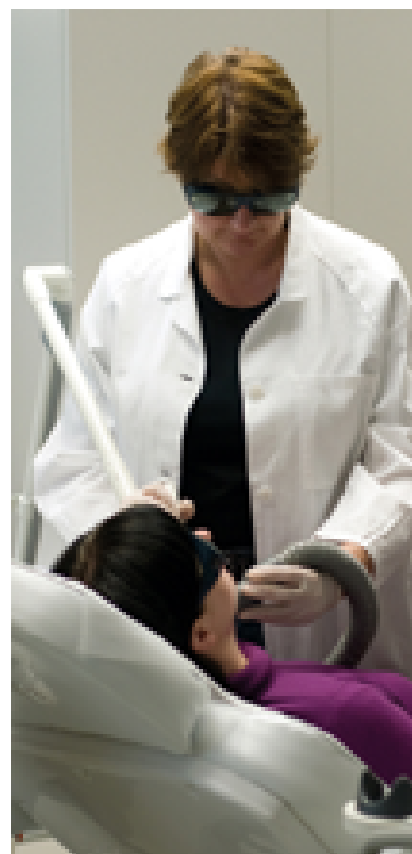
Development of medical laser systems.



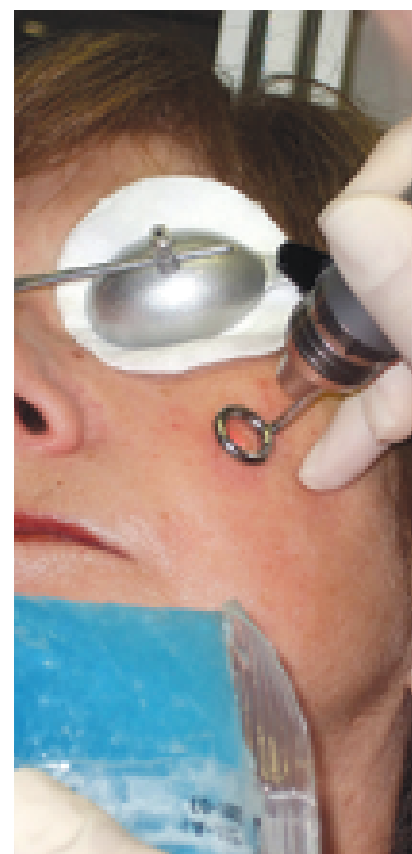
Dental laser treatment



Dr Matjaž Lukač, Fotona President



Aesthetics laser treatment



The Laser and Health Academy (LAHA)

The Laser and Health Academy (LAHA®) is a not-for-profit organization dedicated to the promotion of research, education and publishing in the field of laser medicine.

The Academy collaborates with industry, medical professionals and universities on projects aimed at the development and improvement of laser applications.

It serves as a platform for continuous education, with a focus on practical instruction and the demonstration of laser techniques and procedures, delivered through a variety of workshops and seminars by experienced lecturers.

The Laser and Health Academy is actively involved in developing lines of communication between all phases of laser technology development, for the following purposes:

- ◇ to improve treatment standards;
- ◇ to improve the effectiveness and efficiency of treatment;
- ◇ to ensure patient and practitioner safety;
- ◇ to further education, research and the development of applications; and
- ◇ to organise meetings to exchange ideas and methodology in key treatment fields.

The Journal of the Laser and Health Academy is an international journal which publishes original articles, (mini)reviews and case reports covering the latest in laser technology, the use of lasers in medicine, including the application of lasers in dental medicine, surgery, dermatology and in other fields of medicine.

The journal follows new trends and progress proven practice in laser technology, in use of lasers in medicine and related sciences, thus creating a unique forum for interdisciplinary or multidisciplinary dialogue.

In 2010 LAHA was selected to lead the Competency Center for Biomedical Engineering (CC BME) with a goal to become the central knowledge institution for applied research in the field of biomedical engineering in this part of EU.



Dr Maša Goršič, Director

INSTRUMENTATION TECHNOLOGIES, D.D.

Rok Uršič, founder and CEO: Instrumentation Technologies is the world leader in high performance beam instrumentation systems for particle accelerators. Its



state-of-the-art products and services are marketed under the registered brand name Libera and continuously revolutionise the end-user's experience and have created a completely new product category. Its products are used for diagnostics and beam stabilization at particle accelerators around the world (e.g. Light Sources, Hadron Accelerators, Free Electron Lasers and Energy Recovery Linacs).

The world's most prominent research institutions (e.g. CERN, the Stanford Linear Accelerator and the Shanghai Synchrotron Research Facility, amongst others) number among Instrumentation Technologies' customers. The company, which employs 55 people, 40% of whom have Master's or PhD degrees, has introduced a portfolio of products by working closely with world-class institutions both at home and abroad, and prides itself on being a recognised conduit between science and industry in Slovenia and globally, since many instruments have been developed in close cooperation with experts from the research institutes. There are 42 machines that use different Libera products worldwide. The experience of being part of the global Libera community is enhanced by a unique event – the Libera Workshop – where experts from around the world gather each year in Solkan, Slovenia to share their experiences of Libera products.



Rok Uršič

Jožef Stefan Institute, Department of Complex Matter

Boris Majaron

The main mission of Jožef Stefan Institute is generation and transfer of new knowledge in Natural Sciences, Life Sciences, and Engineering. By concentrating a critical mass of top expertise, equipment, and international connections, the Institute is a major scientific hub, connecting basic and applied research with industrial development and university level education. Synergetic effects arising from combining experimental and theoretical approaches across several scientific fields and disciplines are an important element of our success.

Research activities at the Department of Complex Matter spread from synthesis of novel nanomaterials to experimental and theoretical research of basic properties and collective effects in complex physical systems, from nanostructures to high-temperature superconductors, liquid crystal structures and biological macromolecules. Our Biomedical Optics group studies optical properties of various biological tissues and structures, as well as various physical processes that govern the response of specific pathologies to irradiation with pulsed laser light. To that end, we combine various optical spectroscopic and radiometric techniques with development of appropriate theoretical models and advanced numerical simulations. The acquired expertise is applied toward development of novel techniques for medical diagnostics, therapy and tomographic imaging, which exploit specific properties of laser-tissue interaction.



Prof. Dr Boris Majaron

Gorenje Group

Boštjan Pečnik, executive director of development:

"Gorenje d.d. is one of the leading European home appliance manufacturers with over 60 years of experience. Most products are manufactured under our own brands (Gorenje, Gorenje+, Atag, Asko, Pelgrim, Mora, Etna, Körting, Sidex, and Upo) and are sold on the European market. With exports taking up approximately 90% of total sales revenues, we are the Slovenian company with the greatest international presence.

Our development policies take heed of key global consumer trends such as the use of advanced information and telecommunications technology, environmentally friendly products and technology, as well as trends related to the ageing of the general population. Based on the knowledge obtained through cooperation within the CC BME, we are planning to develop home appliances that will allow elderly people and people with special needs to live independently and healthily for as long as possible; on the other hand, these appliances will be able to communicate with an intelligent network for the purpose of monitoring their health and independent lives. Gorenje has

taken a proactive role in the R&D project "SAM in ZDRAV" ("ALONE and HEALTHY") along with three consortium partners: the Faculty of Electrical Engineering and Computer Science at the University of Maribor, the company Iskra Medical d. o. o. and the University Rehabilitation Institute, Republic of Slovenia."



Boštjan Pečnik

Jožef Stefan Institute, Department of Low and Intermediate Energy Physics

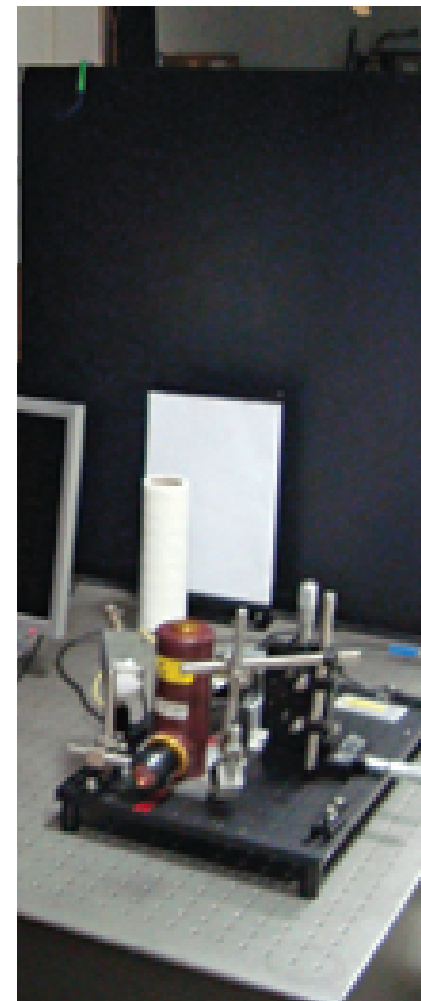
The Department of Low and Intermediate Energy Physics at the Jožef Stefan Institute focuses on basic and applied research in physics of molecular, atomic, and subatomic phenomena. Its principal instruments are beams of charged particles and photons that enable, via thorough understanding of the interaction of particles with matter, an incredible insight into the structure of matter at the atomic scale, which is the fundamental scale of chemistry of life. Due to the amount of expertise on physics principles involved, and on the workings of nuclear and particle detection systems, a

natural extension is our applied work in medical imaging techniques and radiotherapies.

Our laboratory specialises in custom-designed nuclear detectors and precise timing of events in such detectors, as well as in using them in the regime of extremely high count rates. This is achieved by careful modeling of detector physics that leads to algebraic manipulation of the measured signals in real time. Our success in this field is, to a large extent, due to the collaboration with scientists of the Department of Communication Systems at JSI and with the research teams at Gesellschaft fuer Schwerionenforschung in Darmstadt, Germany.



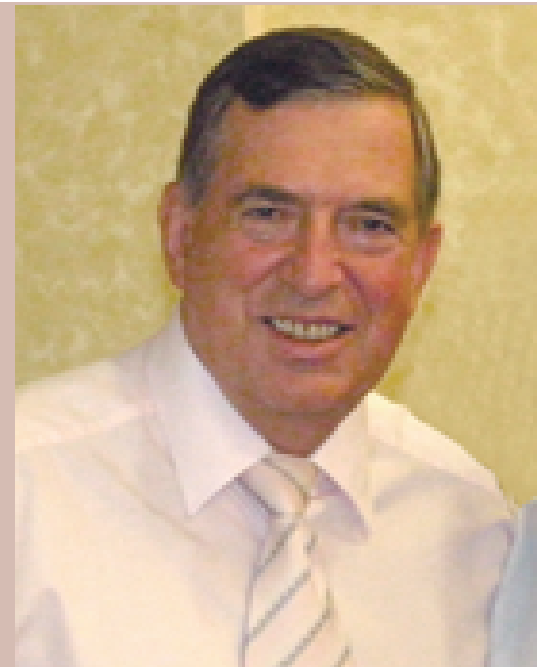
Dr Matjaž Vencelj



Iskra Medical d.o.o.

Jože Jelenc, Director: "Iskra Medical d. o. o. was founded only a few days after Slovenia declared independence. In 2011, the company thus celebrates 20 years of success. From its humble beginnings specialising in physiotherapy equipment, the company's range of services has expanded to cover rehabilitation, dermatology, medical cosmetics, wellness and other health-related fields. All of our devices are the fruits of our own research and development. They employ modern technologies such as multiprocessor control, colour touch displays, advanced sensors, and multi-layer printed circuit boards, amongst others. Three quarters of our products are sold on foreign markets. Our high product quality, reliability and know-how allow us to outpace our stiff competition and satisfy our customers."

The company's research and development activities cover the following fields:



Jože Jelenc

Iskra Medical d. o. o. is an innovative company that has always focused on research and development. We are constantly searching for new knowledge and new solutions, which we then implement in practice. In order to achieve these goals, we work with other companies and academic institutions, and are part of the I-TEHMED national technological platform.

The company's research and development activities cover the following fields:

We are proud to be an active, hard-working partner in the Competency Center for Biomedical Engineering. Within the Center, we perform research in the fields of intradermal and transdermal drug delivery, connectable domestic devices and smart electromagnetic medical devices.

At the same time, we are also expanding our research and development activities in the fields of low-frequency ultrasound and various thermal technologies.

The company's vision is to become one of the leading companies in ensuring a better quality of life. This will be achieved by manufacturing sophisticated, high-tech products and offering holistic solutions in specialised market niches. Strategically, the company plans to use all its available knowledge to create new technological solutions, new systems and new needs. The company's basic values are customer satisfaction, professionalism, innovation, teamwork and constant growth. "

University Medical Centre Ljubljana



Institute of Oncology Ljubljana

Prof. Dr Gregor Serša, Department of Experimental Oncology:

"The objective of our work is to develop new cancer treatment approaches, test them in clinical trials, and introduce them into clinical practice; in brief, the department deals with translational research. The research activities include preclinical or experimental oncology, covering the researches from molecular biology to cell cultures, and the in vivo research on tumor models in laboratory animals.

Extensive knowledge about the non-viral drug and gene delivery approach with electroporation has already been translated in introduction of electrochemotherapy into clinical practice in human and veterinary medicine. Gene electrotransfer is under development now.

Expertise in this field will enable also translation of novel drug delivery systems that are being developed in Center of competence. Drug delivery into and through the skin presents one of the very interesting targets, not only in cancer treatment but also in dermatology and cosmetic industry."

WE ARE PROFESSIONAL LEADERS IN HEALTH SERVICES BUT ABOVE ALL IN CARE, HUMANITY AND PERSONAL TOUCH

MISSION AND GOALS

Our principal aim is to provide quality care to patients from Slovenia and other European countries. The UMCL's organization and activities are geared at continuous improvement of our services, development and introduction of new methods of treatment, and transfer of knowledge to younger generations of health professionals. Our major objectives are to acquire European accreditation, implement a comprehensive system of quality assurance, and achieve international quality standards. We have close contacts with similar institutions in the European Union. Our wish is to create a favourable working environment for our employees and provide quality professional care to our patients.

Optotek d.o.o.

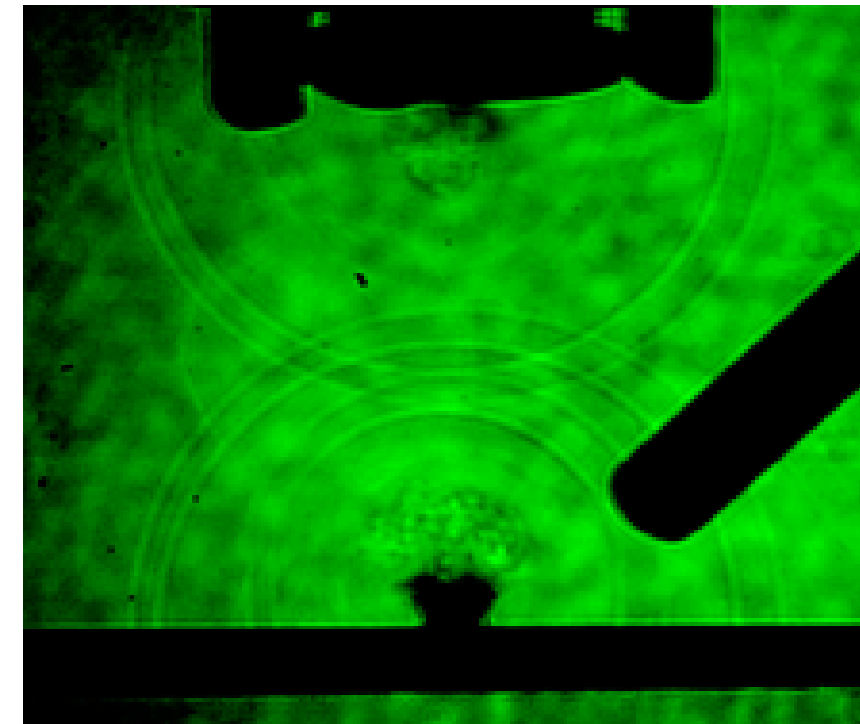
Boris Vedlin

“Optotek d.o.o. provides innovative optical and laser solutions for ophthalmological applications. Strong links between development and marketing helps the company to develop new products to meet the emerging needs of the marketplace. The ISO 13485 certified facility, combined with state-of-the-art products and competitive prices, offers a combination of performance and value without quality and safety being compromised. The company’s strategy is to continually develop new solutions, applications and products. We believe in fostering a creative and innovative atmosphere in the company for the purpose of maintaining effectiveness and continually improving processes and employee motivation. Optotek builds solid, impartial and respectful relationships with its customers, business partners and society by paying attention to their desires, requests and expectations. The equipment built by Optotek is used throughout the world, including instrumentation installed at the South Pole Station in Antarctica.

The Competency Center for Biomedical Engineering increases cooperation between industrial development and academic research. It strengthens the stream of technologies and novel medical applications provided by teams of engineers and ophthalmologists. New, effective and safe treatments are put into medical praxis ensuring “clear vision” and “preserved vision”. With its vast experience in ophthalmic lasers, Optotek has a clear vision of its mission – to preserve vision by delivering innovative tools and solutions to ophthalmologists worldwide. Designing and manufacturing User-friendly, Safe, Effective, and Reliable products is a key component in Optotek’s corporate philosophy.”



Boris Vedlin, MSc, director:



Faculty of Mechanical Engineering at the University of Ljubljana

Janez Diaci

The Chair for Optodynamics and Laser Applications (COLA) conducts basic and applied research in the area of laser material interaction and pulsed laser materials processing with a special emphasis on dynamic aspects of laser-beam surface interaction, which include the links between the laser material removal and the resulting material motion. The COLA researchers have developed a range of new methods to study these phenomena and their applications to advance pulsed laser processing. Various set-ups of the laser beam deflection probe (LBDP) have been employed to study shock and acoustic waves propagated in air above the irradiated surface. Piezoelectric (e.g. PZT) transducers and laser interferometers have been used to study ultrasonic waves propagating through the irradiated material. These techniques provide time resolved information at certain points in space. Alternatively, various fast imaging techniques have been used to acquire spatially resolved information on these phenomena at certain points in time.

Within the CC-BME collaboration, COLA and its affiliated Laboratory for Digital Systems and Electrical Engineering devote their expertise to development of innovative sensors that will open ways to improve medical treatments with pulsed lasers.



Prof. Dr. Janez Diaci

Laboratory of Biocybernetics in the Faculty of Electrical Engineering at the University of Ljubljana

The University of Ljubljana’s Laboratory of Biocybernetics contributes to the Competency Center for Biomedical Engineering (CC BME) with investigations into the influence of electric currents and electromagnetic



Prof. Dr. Damjan Miklavčič

fields on the physiological state of cells, tissues, organs, and the body as a whole. The aims of this research are to understand the basic mechanisms of bioelectric phenomena and to facilitate their use for therapeutic purposes. The group’s main focuses are cell membrane electroporation with its applications in biology, biotechnology, and medicine, as well as other physical methods allowing changes to cell membrane permeability, such as sonoporation and radiofrequency micropore creation. In order to gain an insight into the phenomena studied, the distribution of currents and fields within cell suspensions and tissues are determined analytically and numerically and the electronic devices for applications in these fields of research are developed. Over the last five years, the group’s members have published over 50 papers in SCI journals. In the last ten years, the group has contributed to: the development of a clinical electroporation prototype – a device for electrochemotherapy and gene therapy in patients, the establishment of standard operating procedures for electrochemotherapy and gene therapy, and the development of a system for skin gene electrotransfer for gene therapy and gene vaccination, which delivers gene material and electric pulses through hollow needle microelectrodes. The funding of the Competence Centre of Biomedical Engineering will make an essential contribution to the research of drug delivery onto and through the skin by means of electroporation, sonoporation and radiofrequency heating. Continuous contact between the consortium’s members will contribute to closer collaboration and the transfer of knowledge between those involved in basic research and in developing applications.

The University Rehabilitation Institute, Republic of Slovenia

Robert Cugelj

"The University Rehabilitation Institute, Republic of Slovenia is the country's main national health institution and offers comprehensive rehabilitation services to people with disabilities in motor functions and of work abilities. The institute carries out rehabilitation programs and is responsible for the balanced development of all health and other professional branches related to the issue of rehabilitation at a national level. The Institute treats around 15,000 patients a year, including over 1,900 treated in hospital wards with a total capacity of 200 beds. Several specialized and sub-specialized clinics for screening, rehabilitation diagnostics and the therapy of patients with severe

- ◇ Centre for prosthetics and orthotics;
- ◇ Outpatient rehabilitation services;
- ◇ Research and development;
- ◇ Rehabilitation engineering;
- ◇ Pharmacy.

The healthcare activities are aimed at providing inpatient and outpatient care for the patients of the institute. Modern patient care at the institute tends towards outpatient diagnostics. The therapeutic services of the institute are working towards shorter hospitalization and outpatient treatment. The institute as a healthcare institution at the tertiary level carries out scientific research in the fields of medicine, rehabilitation engineering, as well as in the psychosocial field and in the field of employment. It has about 50 employees who are registered as researchers or associate researchers at the Slovenian Research Agency. Scientific research is carried out within individual organizational units and within the research department, which offers professional, technical and logistical help to other departments in the preparation and implementation of research and dissemination of its results.

The SmartHome iRis presents a good value medical and rehabilitation environment offering a suitable test bed for research. The project within the field of independent and healthy living of people at home deals with providing parameters in real time to report on the current status of the monitored population of elderly people, people with disabilities in various everyday tasks, as well as during sleep. For that purpose sensor components and integrated devices foreseen by the industrial partners are being developed.

Our medical experts will carry out comparative analyses, which will require a specially adapted user interfaces to control the test environment and relevant interventions for independent living (prevention or therapy in the form of advice or guided activities, a chronological overview of the measured health parameters, alarms in case of emergency situations). It is envisaged that medical experts can also observe the parameters transmitted from the developed components and simultaneous measurements with standard medical equipment in supervised conditions at URI-Soča.



Robert Cugelj,
MSc, General
Director

impairments and disorders of the locomotor's system and resulting disabilities operate at the institute. Approximately 90% of the patients come from the Republic of Slovenia and the remainder from abroad. The expert staff at the institute comprises excellent teachers in medical, technical and social fields throughout its 50 years of development. From an organisational perspective, the institute's activities can be categorised as follows:

- ◇ Clinical hospital for physical medicine and rehabilitation;
- ◇ Centre for vocational rehabilitation;

Imre Cikajlo,
PhD, A/Professor, Research & Development,
Project coordinator at URI



**Prof. Dr
Damjan
Zazula**

Faculty of Electrical Engineering and Computer Science (FERI) at the University of Maribor

In terms of the number of students, the Faculty of Electrical Engineering and Computer Science (FERI) is the largest faculty at the University of Maribor. The research achievements of its eight institutes, comprising a total of 39 research laboratories, are also exceptional. The FERI takes part in four Competency Centers.

The Competency Center for Biomedical Engineering, comprises two FERI laboratories: the System Software Laboratory (SSL) and the Electro-Optical and Sensor Systems Laboratory (EOSSL). The two laboratories participate in the project SAMinZDRAV.

The SAMinZDRAV project pursues the development of new devices and methods for the unobtrusive monitoring of persons and their vital functions in their home environments. The main objective is to develop a computerised system that will support elderly people and help people with disabilities to live independently in their homes. It is based on the iGorenje system of connected household appliances, and enhances it through the use of sensor devices and algorithms to process the data acquired by these devices. It also means that Gorenje's appliances will be adapted for the unobtrusive acquisition of information on users' psycho-physical condition, the state of

their cardiovascular system, visible signs of disease or other abnormal conditions in their living environment. Data will be transmitted wirelessly to a computer server. Specialised software will be developed to analyse the data and extract functional health parameters. These will be monitored remotely over a computer network by a GP. At the same time, the system will autonomously detect critical situations and alert the emergency medical team of these, should they arise.

The SSL and EOSSL research the potential for optical sensors to detect the vital signs of persons monitored, such as heart rate and breathing during sleep. These are combined with known sensors for the measurement of dynamic forces, temperature and acceleration, and with different types of light sensors and digital cameras. Microcontroller circuits and system software are developed for the control and management of these sensors. The most important research leads to the creation of new algorithms for the extraction of medically relevant information from the measurements taken by the sensor.

Both laboratories have a long and distinguished record of scientific achievement and are closely involved in international research projects. The EOSSL has obtained a global reputation in the field of biomedical optical sensors as it has, thus far, been granted six U.S. patents and seven patents pending. The SSL has the greatest influence in the field of decomposition algorithms for compound signals, such as bioelectrical signals. In this area, it is currently involved in 5 research projects of the 7. European Framework Programme, two of which are coordinated by the SSL.



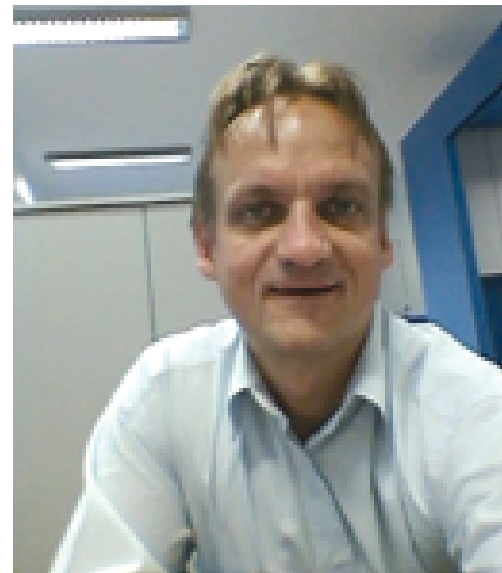
Opcomm Competence Centre

Community and business meet the Internet of Things

Opcomm drivers and challenges

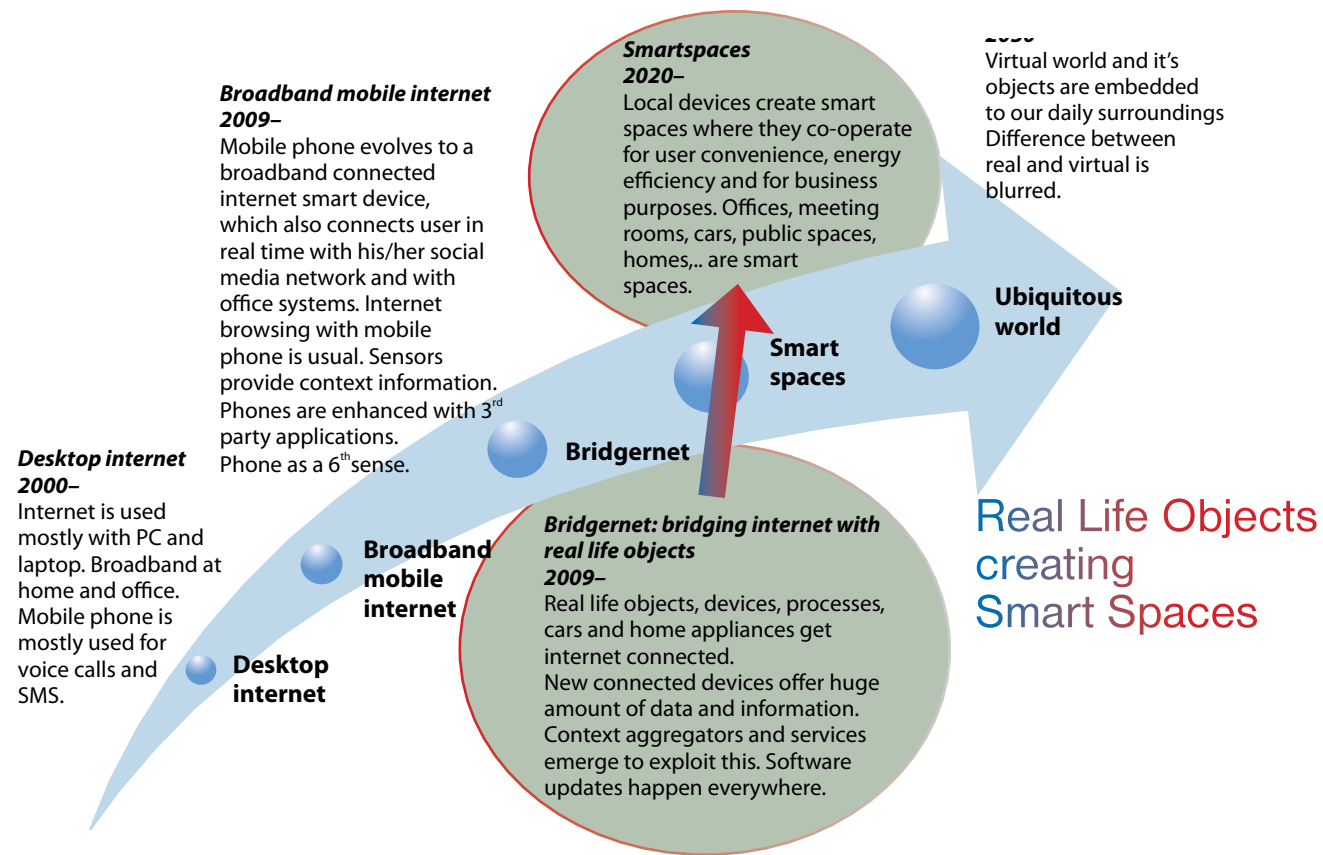


"Global trends in the ICT industry are shifting from general principles towards being more focused and user-oriented. According to the current situation and trends, specific technologies are in focus which will serve as the base for "cloud" products and services between 2015 and 2020. We are focusing primarily on the Internet of Things and its role in creating value for business and society. Therefore, our main goal is to create prototypes that will eventually be ready for the market and drive the need for the competences and services Opcomm would offer in the future."



Tomaž Vidonja, M.Sc., CEO Opcomm

We are providing the meaning and business value of devices and people connected.



Picture 1: ICT Evolution Source: Roadmap for Communication Technologies, Services and Business Models 2010, 2015 and Beyond, Tekes, 2010)

We have identified three major drivers (Figure). However, the most important challenge is to help communities, and especially SMEs, to take advantage of technologies that are complex and quite expensive, and use them for sustainable and balanced growth. In this respect we see a very important role to be played by the Ministry of Higher Education in further supporting the Competence Centre's development. Not least to facilitate the technology transfer and go-to-market for Future Internet

Technologies' products and services "Made in Slovenia".

- Low BroadBand & HiSpeed Internet Adoption
- Billions of devices connected in Internet
- Overflow of data and information
- Open Access Networks
- New Business Models
- Alternative operators
- Interoperability
- IoT Architecture
- Domain/segment specifics
- Context Data Analysis
- Meaning & Value Creation
- Personal & Business Life

cations for different industries and purposes.

The aim of the Occapi Platform is, on the one hand, to collect, unite, integrate, accommodate and store data from a multitude of devices and, on the other hand, to upgrade them with data from other bases and the Internet, to analyse and process them in order to make them more commercially useful, and other applications and services. The term "device" encompasses various network devices, sensors, meters, personal, medical systems, intelligent cards, smart terminal equipment, smart house devices, etc. The modular nucleus of the platform will ensure key functions for activities in the distributed and open environments:

- ◆ authentication
- ◆ data access authorisation/control
- ◆ semantic tagging and data
- ◆ browsing
- ◆ data analysis
- ◆ data mining
- ◆ data visualisation

Advanced analytical tools based on machine learning for the processing of large quantities of data in real time will improve its usefulness. The Platform will function as an intelligent data broker, ensuring open application interfaces for controlled access to data and functions within the platform and thus providing horizontal integration between various domain fields.

Occapi - an enabling platform

All our efforts, competences, experiences and technologies will eventually result in Occapi - our common platform. It will be used as a development and service providing framework for IoT based appli-



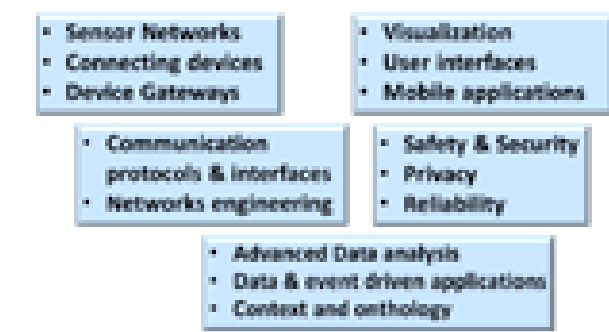
Viz: Kompetenčni center OpComm, 2011

Our competences

We believe one of the key elements for success is keeping programs simple. This is why our program structure consists of four R&D projects, as depicted in Figure 2.

We focus primarily on the common platform (RR1), which has been upgraded with two vertical application domains (RR2 and RR3). As this platform will also

be used in the future for many other vertical segments and applications, it is critical to also include our strategic partners - often referred to as stakeholders - in the program. They are Telekom Slovenije, Iskratel, AMIS and Xlab. They all provide important information for qual-



ity research and design and work to help us verify and test the prototypes in the final phase of the program.

<http://www.opcomm.eu>

Our Opcomm Competence Centre heavily relies on international connections and cooperation and we offer our competences to other partners in Slovenia and abroad. The competences related to IoT are grouped into a few themes in order to cover complementary research areas (Figure 3).

We established three activities dedicated to raising the Competence Centre program to the next level of research and industry cooperation. The first is an innovative environment based on open innovation principles and integrated with social networking tools used for internal knowledge transfer. The second is technology transfer designed as a formal process to take care of the technologies

we develop at the Opcomm Competence Centre in a transparent and efficient manner. Last but not at least is our young talent incubator, which consists of activities to engage and motivate the best and most proactive young researchers and entrepreneurs.

Follow us on www.opcomm.eu!

Partners and their role in the Opcomm Competence Centre ICT Technology Network Institute (ICT TN Institute)

Stanko Šalamon, Executive Director:

"As the founder of the Opcomm CC program, our Institute plays the leading role of program co-ordinator. We co-ordinate and manage the program as a separate and independent project. We provide the facilities, equipment and human resources necessary to perform the activities in working package A, in line with the work plan agreed. Besides project management, the ICT TN Institute is in charge of the operation and provision of the external resources and services needed for the performance of other activities within working package A, encompassing information and the dissemination of knowledge, activities related to the marketing and commercialisation of the Competence Centre's results,



Stanko Šalamon, Executive Director

<http://www.ict-slovenia.net>

Cosylab

Klemen Žagar, Senior Systems Architect: "Cosylab is the leading partner in the RR1 project (Smart Access) and is responsible for its coordination and realisation. Its R&D activities encompass the aggregation of data traffic and intelligent access segments, relying on its competencies in the fields of real time high-performance communication, the capture and distribution of large quantities of data, and the programming of FPGA, DSP,



various microcontrollers and CPU for telecommunication purposes and distributed software systems. In the experimental development phase, Cosylab will make an important contribution to the quality of integration and verification of prototypes using experience gained from work carried out in cooperation with the world's foremost accelerators and fusion reactors (e.g. the EU, the US, Canada, Japan, Australia, Korea and China)."

Klemen Žagar

<http://www.cosylab.si/>



Andrej Jarc

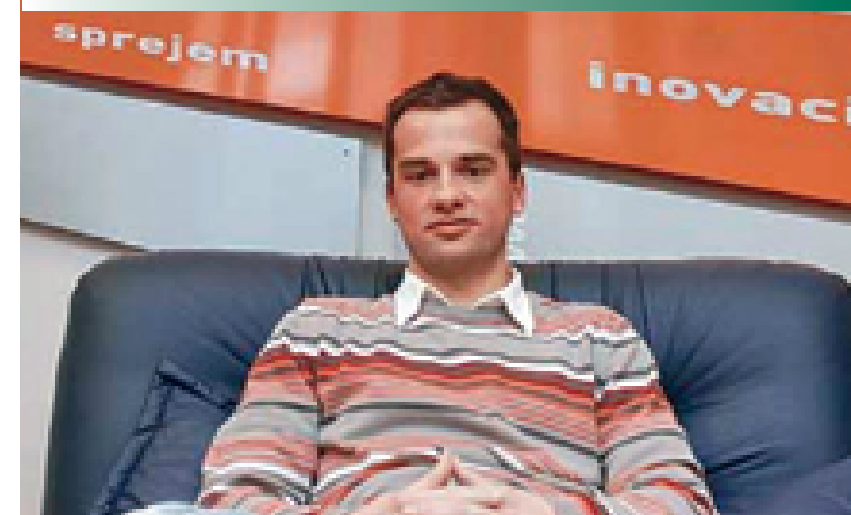
Globtel

Andrej Jarc, EU Project Coordinator and Regional Sales Manager:

"In the framework of the RR1 project, we cover network aggregation technologies and connections between wireless/mobile and fixed networks, enabling an invisible transition between those technologies for the users and the making the creation and use of universal applications possible. The company draws on its vast experience in the field of high-frequency wireless communication and sensory platforms in security and other fields."

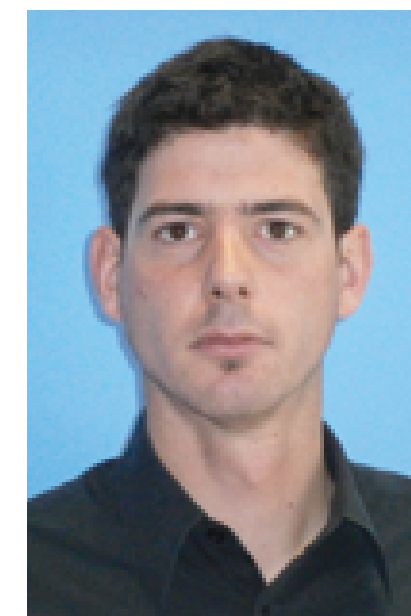
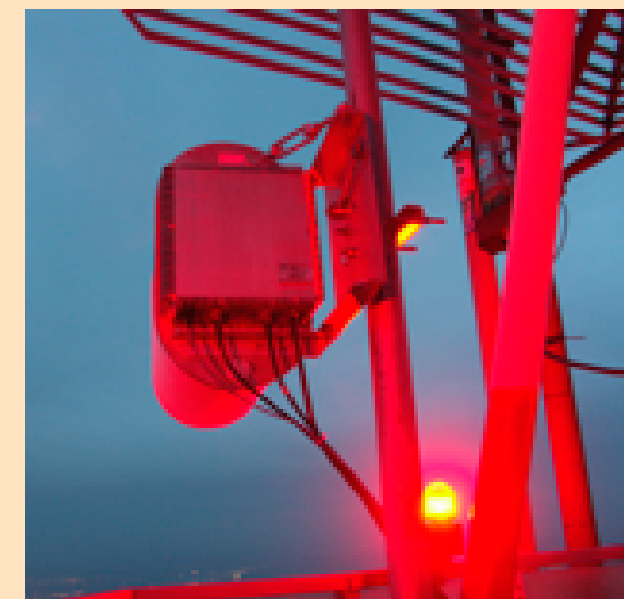
<http://www.globtel.si/>

<http://www.inova.si/>



Inova IT

Simon Jurič, CEO: "We're a dynamic high-tech company. Our role within the Competence Centre will focus on R&D activities within the RR2 project, covering innovative user interfaces on mobile devices; in the RR3 project (Common Platforms), we will cover social networking technologies and user connections. Inova will benefit from its rich experience in developing the various mobile applications and mobile platforms it gained from working with globally recognised telecommunication companies such as the BT Group."



Špica International

Gašper Pintarič, Executive Director:

"We are Slovenia's leading provider of information systems and business solutions based on automatic identification technologies (RFID, biometrics, barcodes), which represent an important element in M2M and IoT. At the Competence Centre we are the leading partner in the RR2 (Smart asset and time management) project, working on prototype solutions for efficient object management based on the use of large quantities of sensor data and thereby transforming everyday objects into "smart things". The company will capitalise on its core competencies in the field of mobile computing solutions for logistics and asset management, as well as in the field of working time management."

Alpineon

Jerneja Žganec Gros, Ph.D., Owner and CEO:

"We are a high-tech RTD performing SME with core competencies in speech technologies, speech recognition, synthesis and translation, voice portal applications and SMS/ electronic mail readers. We work as a research organisation within the framework of the Competence Centre with the concession for providing public services in research activities. Within the RR3 (Open platform) project, we play a key role in the

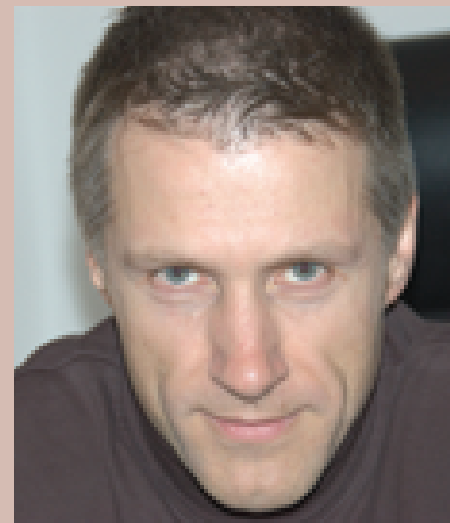


planning and development of the sub-system for open communication platform management providing user authentication and access authorisation using voice-prints."

<http://www.alpineon.com>

UL FRI - The Faculty of Computer and Information Science, University of Ljubljana

Marko Bajec, Ph.D., Associate Professor and Project Manager: "We have core competencies in IT. The Competence Centre benefits greatly from our expert knowledge in SOA (Service Oriented Architecture) and business processes, anomaly detection, advanced data analyses, data based learning, data visualisation, computer system design and optimisation, and human factor modelling. We play an important role within the RR1 project (Smart Access) in the conceptualisation of smart networks as well as in the research and analysis of alternative technologies for smart access, and within the RR3 project (Open Application platform) where we are responsible for the development of scalable and flexible event driven architecture. Within the framework of the integration and prototyping project, the Faculty will contribute its competencies in the field of system performance and reliability analysis."



<http://www.fri.uni-lj.si/>

UL FE - The Faculty of Electrical Engineering, University of Ljubljana

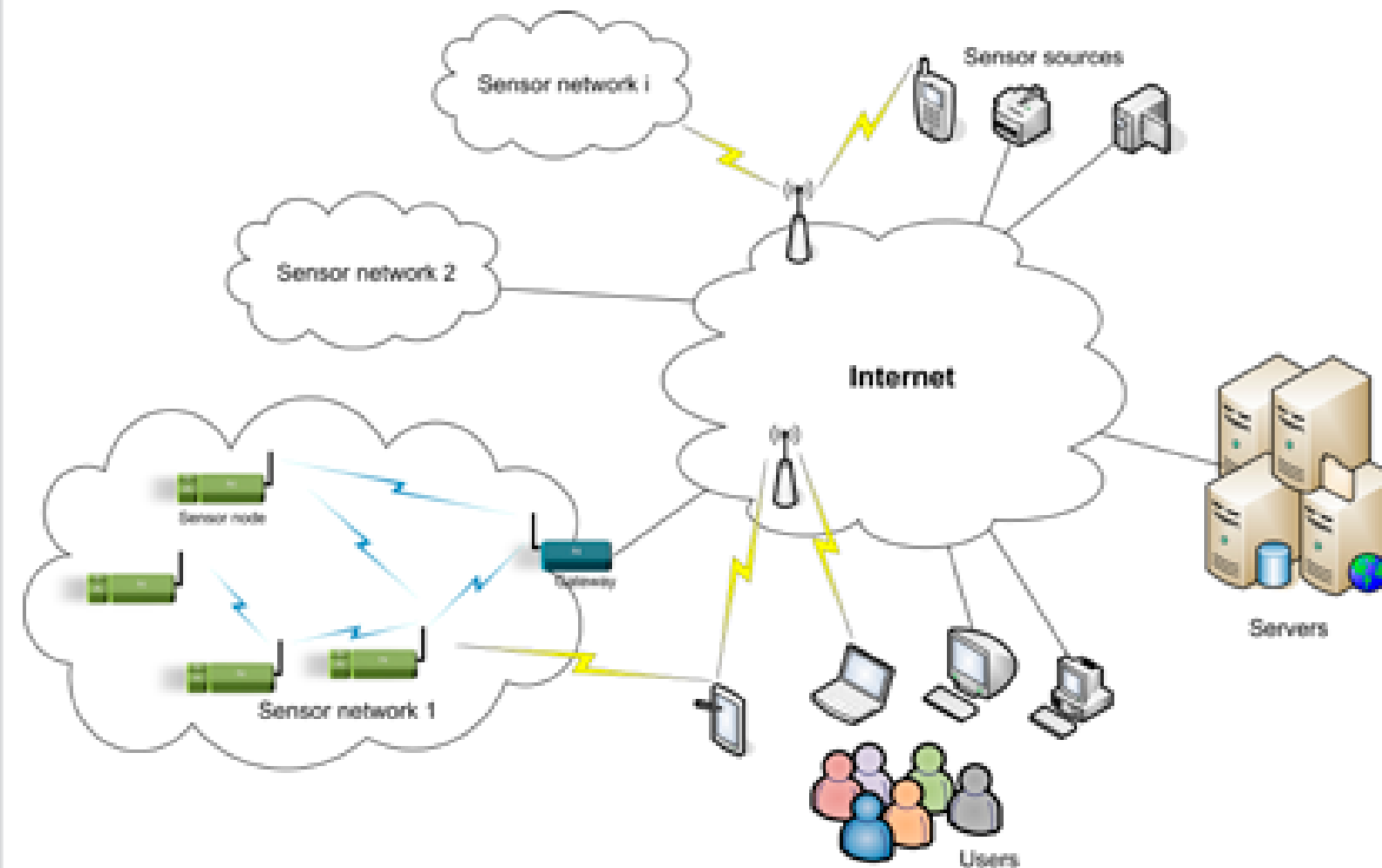
Andrej Kos, Ph.D., Vice-Head of the Laboratory for Telecommunications:

"We are the leading partner in the RR3 "Open Platform" and RR4 "Integration" projects. Together with Partner FRI, we are the main designers of the core platform architecture and open interfaces, capitalising on our abilities and experience in the field of modern communications, especially our expertise in telecommunications systems, interfaces, protocols, application servers and platforms, networking and wireless technologies, mobile communications, access tech-



nologies, data analysis and multimedia services. We will also contribute to the conceptualization and design of intelligent service architecture in the RR1 "Smart Access" project and to communication interface design as part of the RR2 "Smart Asset and Time Management" project. Subsequently, in a later phase, we will manage the development of the prototypes and co-ordinate the complex process of integrating various R&D projects into prototypes and their verification. Besides research contributions, we are also providing part of the ICT infrastructure and testing facilities, which are required for the integration of project results into working systems."

<http://www.fe.uni-lj.si>
<http://www.ltfce.org>



IJS - Jožef Stefan Institute

IJS - Jožef Stefan Institute

Mihael Mohorčič, Ph. D., Head of the Communication Systems Department:

"Through the participation of the departments of Communication Systems and Artificial Intelligence, our institute plays a key role in the Competence Centre, in the RR2 project through capturing data streams from different operating environments, enriching them with metadata and providing them to the platform, and in the RR3 project by performing advanced analytics for knowledge extraction and supporting novel applications on top of the platform. The Department of Communication Systems takes advantage of its considerable international experience in the area of wireless communications and



Mihael Mohorčič

<http://www.ijs.si>

sensor networks in order to develop high-performance sensor nodes supported by semantic technologies to provide advanced functionalities such as the automatic discovery of sensor resources and their composition in virtual sensor networks. To this end, we will also make use of our expertise in the fields of routing algorithms and communication protocols so as to ensure that sensor devices with limited capabilities operate in an energy efficient manner."

Maja Škrjanc, M.Sc., International Project Manager & Researcher

"The Department of Artificial Intelligence is mainly responsible for the development of an advanced analytical environment for the platform, which will integrate machine learning methods based on data with methods based on predefined knowledge. To this end, we rely on our competences in the fields of machine learning, knowledge capture from text/web/stream mining, analyses of graphs and social networks, natural language analysis, Web2.0 social networking analysis and semantic technologies."

<http://www.ijs.si/>



www.telekom.si

Telekom Slovenije, Ljubljana

Zoran Vehovar, VP/CTO: "As the leading provider of state-of-the-art electronic communication



Zoran Vehovar, VP/CTO

services on the Slovenian market, we see machine communications and the Internet of Things as a great opportunity for our company. Our recent merger with Mobitel put us in an even better position in the market for new developing services such as M2M (Machine to Machine). In this respect we are highly engaged with the Opcomm Competence Centre, especially for the purpose of developing innovative and advanced new services for our business and resident users, together with hi-tech companies and research institutes."



Amis d.o.o., Maribor

Boštjan Košak, CEO

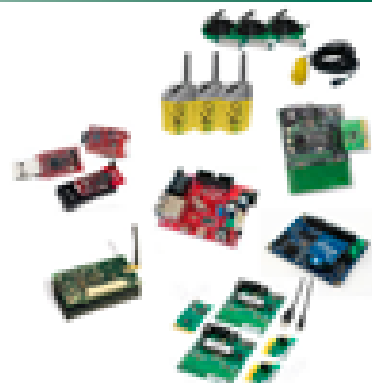
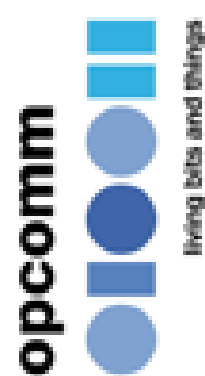
"As the leading alternative provider of integrated communications in the field of Internet, TV and telephony, we are closely involved in the activities of the Opcomm Competence Centre. Our objective is to make significant investments in staff training and state-of-the-art technology even more efficient. In the coming years, we will be in a position to provide our users with



Boštjan Košak, CEO

a full range of new innovative services in Internet access and services and the next generation of digital TV and voice recognition."

<http://www.amis.net>



Sensor network

Opcomm's most important strategic partners

Xlab d.o.o., Ljubljana

Gregor Pipan, CTO: "We are an IT development company with a strong research base in distributed systems, cloud computing, grid networks and peer-to-peer (P2P) networking. This makes us a perfect fit for the Opcomm Competence Centre. Together with Opcomm's partners we are engaged as a strategic partner in the development of the Internet of Things communication platform, which will be implemented in computer cloud as PaaS - Platform as a Service."



Gregor Pipan

www.xlab.si

Iskratek, d.o.o., Kranj

Željko Puljić, Chief Technology Officer: "The Opcomm Competence Centre is a great opportunity for us to cooperate with leading global companies



Željko Puljić

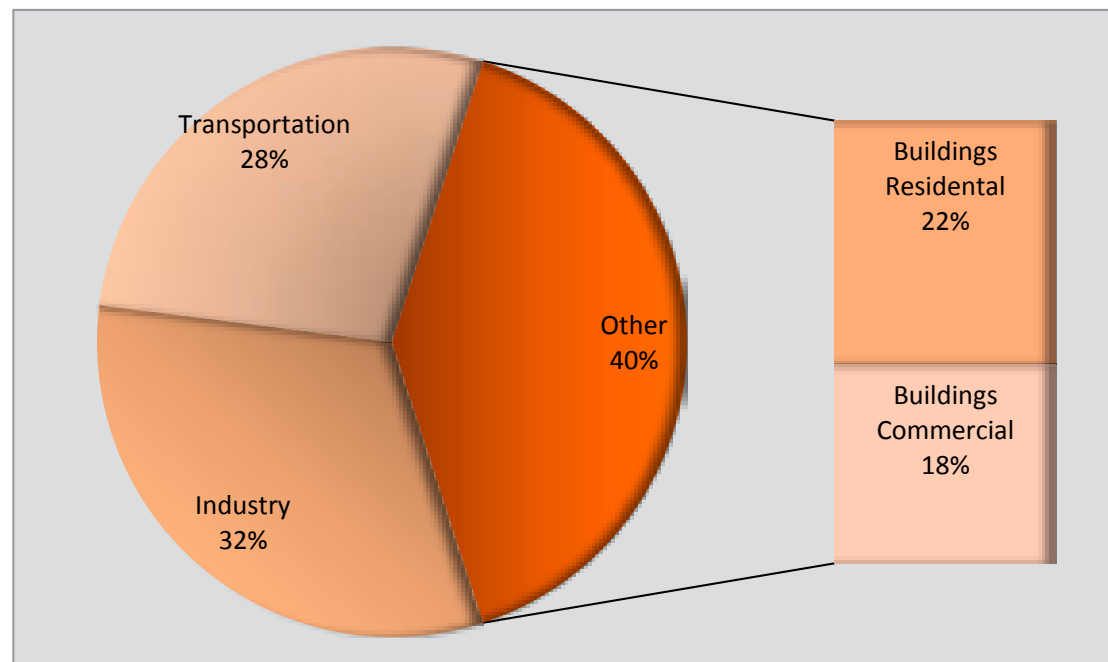
and research institutes in the Internet of Things. Our customers are searching for new and advanced solutions for the Future Information Society. Therefore, as a result of recent research activities of the Opcomm Competence Centre, by 2013 we will be delivering innovative products based on integrated intelligence in broadband access and aggregation networks. These products represent new business development opportunities for infrastructure and service providers and give content providers (over-the-top providers) a guaranteed high standard of service and quality bandwidth on-demand, which results in an improved experience for the end user."

<http://www.iskratel.com/>

CC TIGR

Competence Centre for Sustainable and Innovative Civil Engineering

Nowadays almost a half of all the energy produced in Europe is spent on heating, cooling and ventilating buildings, whether they be residential, commercial or industrial. Due to this and the fact that the share of RES (renewable energy sources) out of total energy use amounts to a mere 5 per cent, the field of sustainable construction is seen as one of the key areas for R&D in the future.

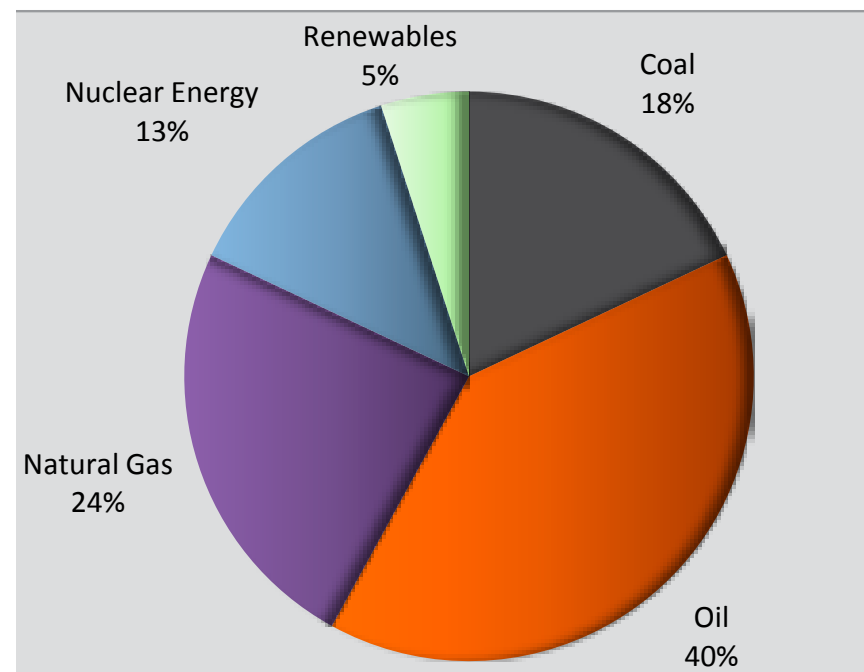


Use of energy by sector

Sustainable construction is defined by the European Commission as the “interlinked activities of researchers, investors, construction companies and industry, services and other stakeholders for the purpose of achieving sustainable solutions that take environmental, socio-economic and cultural views into account.” Sustainable construction is therefore much more than just the efficient use of energy in buildings and the use of natural construction materials.

Sustainable construction is a complex process that must be addressed in its entirety. At the same time, we strive to develop

The share of RES out of total energy use in the EU amounts to barely 5%



key competences in the fields that enable us to develop innovative solutions and achieve a competitive advantage on the global markets. The Competence Centre puts environmental issues such as the use of natural resources at the forefront of its work.

Of the three basic natural resources (energy, water and materials), the Competence Centre puts the most emphasis on energy and energy-based emissions. This is an acute problem that is not only strictly environmental in nature, but is also of economic and strategic importance. The so-called Energy Triangle sets three basic assumptions regarding energy management: reducing energy needs, the use of RES and economic dealings with RES (or non-renewable energy sources).

When **water management** comes to mind, a similar triangle may be applied: reduced water supply demand, the use of RES, and efficient water management. The Competence Centre puts particular emphasis on the recycling of waste

water in buildings. Reducing the need for water is the result of the sewage system installed in the building and a consequence of changed behaviour rather than being down to the building design itself. This, however, exceeds the remit of the Competence Centre as it extends beyond the domain of efficient water management, although the question itself will be addressed during the course of the Competence Centre’s activities.

The **use of natural resources** is addressed at the Competence Centre through two perspectives: an assessment of the environmental parameters of the products developed. This is done by the LCA – the Life Cycle Assessment (ISO14040) – method and through developing possibilities for the construction industry in terms of integrating waste material in new buildings. Materials are now divided into natural and synthetic groups since these classifications cannot withstand critical assessment. As an alternative we use the LCA methodology, which can prove the advantages of some natural materials (such as wood, for example) through measurable results. Our Competence Centre does not just handle materials that are used in our products, but also other solutions. One example is wood – a natural material has great importance for a densely forested country such as Slovenia. Although our consortium does not include partners from the furniture industry, we do plan to establish cooperation with two suppliers who can help us measure the characteristics of wood.

Socio-economic issues are present in the Competence Centre in two respects. Firstly they are included in



Tanja Mohorič, Manager of the TIGR Competence Centre

Competence Centre partners:

- ◆ Helios TBLUS
- ◆ Hidria Rotomatika d.o.o.
- ◆ Primorje d.d.
- ◆ TKK Srpenica d.d.
- ◆ Trimorje d.d. and
- ◆ University of Ljubljana
- ◆ Faculty for Architecture
- ◆ Faculty for Civil and Geodetic Engineering
- ◆ Faculty for Chemistry and Chemical Technology
- ◆ Faculty of Mechanical Engineering
- ◆ Institute for Chemistry
- ◆ Slovenian National Building and Civil Engineering Institute

The TIGR Competence Centre is developing its role as a meeting point for any entity that either possesses or is looking to develop its competences in the field of sustainable construction, with a special emphasis on the role of innovation and creativity.

the preparation of a directive or a study that aims to provide an answer to the question of what the current and future demands of building residents actually are. Secondly, socio-economic issues are also present through the development of business models that are aimed at facilitating the successful marketing of partners’ products in the EU.

Cultural views are not normally the focus of the Competence Centre’s activities but are nevertheless considered important. They are present in the previously mentioned directive, which includes the perception of cultural differences in different ways of living.

PRESENTATION OF LEAD PARTNER – The TIGR Competence centre

(Zavod za trajnostno in inovativno gradbeništvo – the Institute for Sustainable and Innovative Civil Engineering)

The TIGR Competence Centre (TIGR) is a private institution whose main task is to connect competences and partners in the field of sustainable civil engineering practices for the purpose of initiating joint projects: the creation of a common Competence Centre, the management of joint activities, the joint development of global market competitiveness, and the search for new high-tech knowledge from the field of sustainable civil engineering practices. The CC TIGR is the pivotal communication point in Slovenia for all partners whose goal is to create new, innovative solutions in the field of sustainable civil engineering.

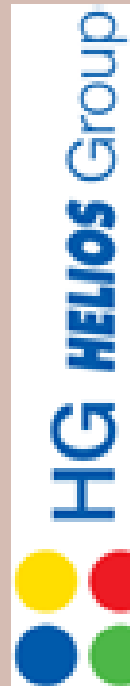
Helios Group

The Helios Group is the leading manufacturer of protective coatings and colours in South-East Europe with over 2,400 employees in more than 30 companies, and subsidiaries in 17 countries. Our vision is to develop and market intelligent, user-friendly and high-quality products that enhance the look and prolong the use of objects.

As a part of TIGR, Helios aims to develop new, innovative products for solar powered systems, wood construction and fire protection coatings for steel components.

Our spectrally selective dyes have been given the Puch Award and are also a high-tech solution in global terms.

The spectrally selective coatings, when integrated in façade elements, enable the collection of energy from the sun which, in turn, will facilitate the innovative use of RES.



Water based anti-fire composites help to protect against out of control fires in the same way – or even more efficiently – than products already available on the global markets which are based on organic dilatants. This will also lead to drastic reductions in emissions from organic composites. Wood protection coatings with improved photochemical and water resistance can lead to improved durability for construction elements when compared with existing solutions available now on the market.



Primorje d.d.

The Primorje Group is an experienced provider of high quality construction services. The company offers high-end knowledge, vast experience and versatile efficiency for different construction tasks – from high-rise buildings to low constructions – and we provide investors with competent investment project leadership. Primorje d.d., the mother company of the Primorje Group, employs 960 people, with the whole group having more than 2,000 employees.

The Primorje Group's R&D activities are conducted in the new purpose-built centre IN PRIME in the technologic park in Ajdovščina. The centre houses the

Primorje Development Institute, which researches and designs new construction materials and technologies.

The work of the Primorje Group in the CC TIGR encompass activities carried out in two working groups. The first is a working group that deals with the recycling of construction waste and its use in the development processes of new concrete mixtures.

RISP (Razvojni inštitut Skupine Primorje) – Research Institute of the Primorje Group in Ajdovščina



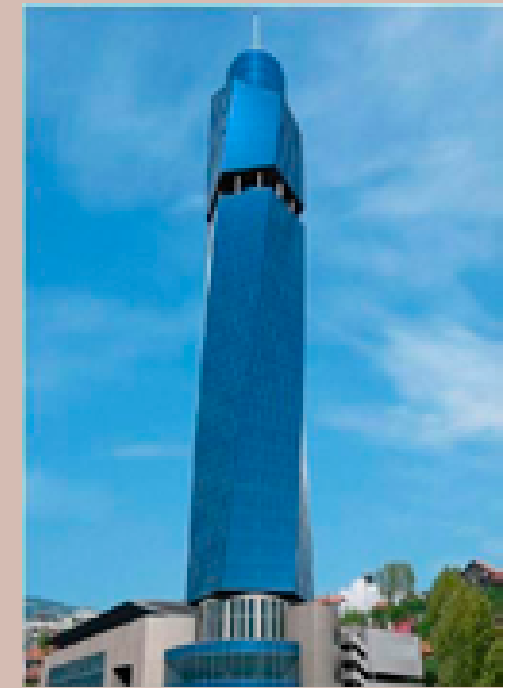
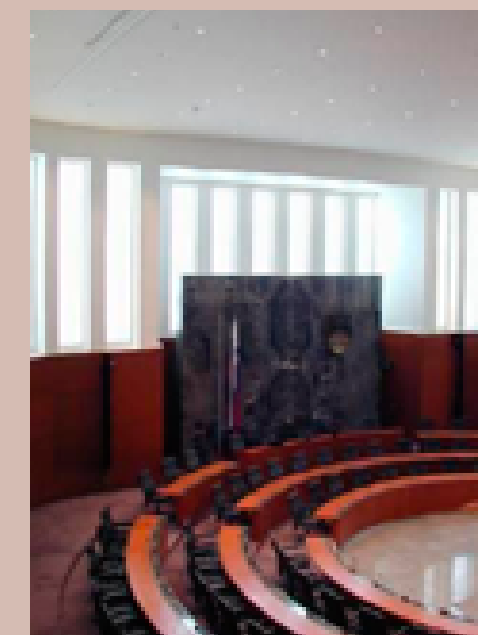
Hidria Rotomatika d.o.o.,

Hidria Rotomatika d.o.o. is a part of Hidria Corporation. It focuses on the development and production of high-tech solutions for the automotive and HVAC (heating, ventilation & air conditioning) industries with components and systems. With the support of Hidria Institute Klima, Hidria Rotomatika develops many new and innovative solutions for more sophisticated and energy efficient components in combination with renewable energy sources.

With prominent references such as the Olympic Hall in Athens, Arena Beograd, Buckingham Palace in London, Kristalna palača (Crystal Palace) in Ljubljana, Twist Tower Avaz in Sarajevo, the Slovenian Parliament, Sacher Hotel in Vienna and many others, it is a competitive provider for the most technically demanding solutions on the European and global markets.



Hidria Institute Klima



Olympic Hall in Athens, Twist Tover Avaz in Sarajevo and the Slovenian Parliament

We research the effects different base materials such as cement or plain rock material have on the final mixture of a specific type of concrete. Through this we strive to create new eco-friendly concrete mixtures. We plan to research the long-term effects on durability and the recycling possibilities of new eco-concrete mixtures.

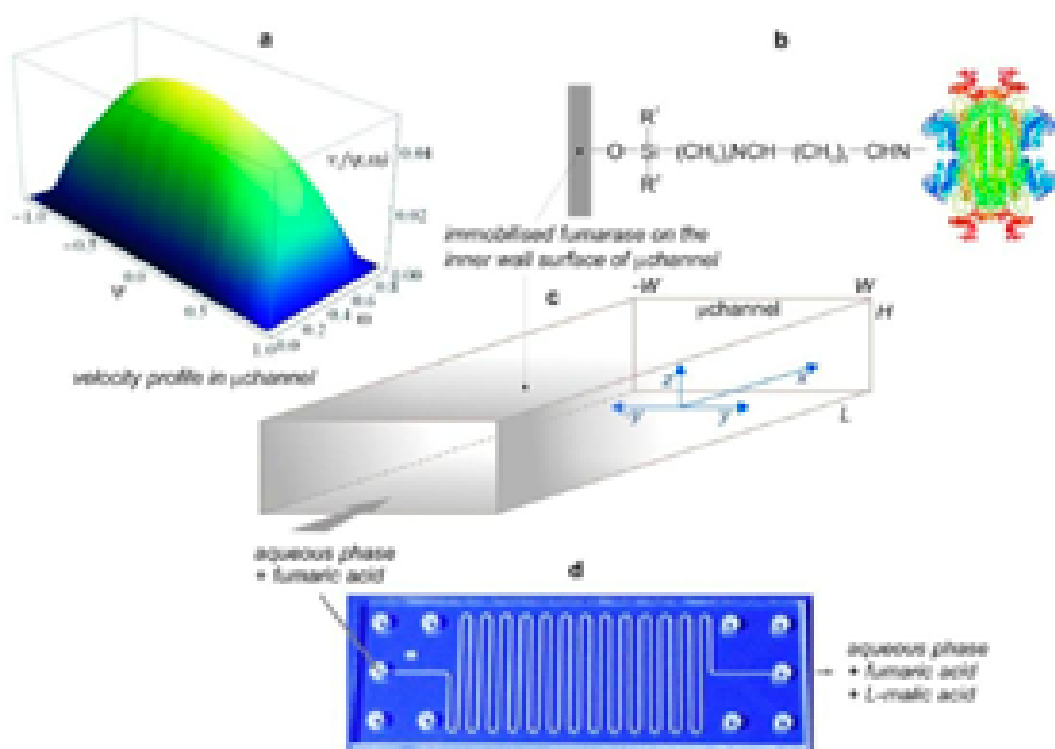
Primorje is also actively involved in the TIGR CC's energy sources working group. Our activities in this field deal with the formulation of directives for energy independent buildings, with an emphasis on construction from pre-fabricated construction

elements and façades from pre-fabricated panels that also include elements for the use of RES (e.g. photo-voltaics, inverters and reflective dyes).



University of Ljubljana, Faculty of Chemistry and Chemical Technology, Microprocess Engineering Research Laboratory

A substantial number of publications demonstrate each year how, through the miniaturization of equipment, chemical processes can be optimized to yield higher product purity at shorter residence times in comparison to classical systems. Process intensification through the use of micro reactor technology is a new concept in chemical engineering, which aims to reduce capital and energy costs as well as environmental impacts by reducing the size of the chemical plant. Further benefits include moving from batch to continuous processing, utilizing intensive reactor technologies with high mixing and heat transfer rates and the potential for providing flexibility in a multiproduct environment. Micro process engineering utilises chemical reactors with internal dimensions of less than one millimetre. Because of the small amounts of chemicals required, micro scale systems are especially suitable for reactions with highly flammable, toxic and explosive reactants, for the elimination of by-products, and for achieving maximum conversion and energy utilisation. Owing to the high surface-to-volume ratio in micro channels, heat transfer is very efficient and reaction temperatures in micro reactors can be regulated by effective heat removal or application. All these benefits allow us to achieve optimal conditions for a specific chemical or biochemical process.



Research topics in the Microprocess Engineering Laboratory: transport phenomena; mathematical modelling (the Lattice Boltzmann methods, etc.); ionic liquid synthesis; biotransformations; downstream processes; integrated processes; and nanotubes Synthesis in microreactors.



TKK Srpenica d.d.



TKK Srpenica (TKK) is an internationally renowned and recognised company with a sixty-year tradition in the production of washings, polyurethane foam, additives for concrete mixtures and sanitation material. TKK is a leading company in its fields of expertise in South-East Europe, has 200 employees, and has revenues of EUR 400 million (of which 80% derives from foreign markets – the company exports to 45 different countries). TKK offered its R&D capacities for the TIGR CC in cooperation with the Institute for Chemistry, the Slovenian National Building and Civil Engineering Institute, Trimo and other consortium partners. TKK's contribution to the consortium is the development of new systems for purpose-built furniture and the development of new materials with low heat conductivity. One of the crucial factors that affects the energy efficiency of a building is that the correct material is used to seal all the cracks in the building's outer layer. The efficiency of the sealing process depends on many parameters, of which the most important are heat and sound insulation, parapermeability and air insulation on the inner and outer parts of the building layer. TKK develop systems that take the aforementioned parameters into account and offer an optimised solution. In accordance with the latest trends in the efficient use of energy, TKK and Trimo have begun developing two-component polysulfide foam that has reduced heat conductivity. Thermal and mechanical characteristics and the characteristics of the so-called water vapour and air transport in the foam enable such foam to be used in manufacture of hi-tech construction panels.

Trimo d.d.

Trimo is one of Europe's leading companies and offers holistic solutions for steel buildings, roofs, façades, steel constructions, containers, and sound-insulation systems. Trimo products can be found in over 50 countries, and its production facilities are located in Slovenia, Russia, Serbia, and the United Arab Emirates. Besides using the aforementioned products, Trimo excels in its innovative approach with a strong aesthetic input in this high-tech field, a fact confirmed by the plethora of prestigious international accolades it has been awarded for innovation and architecture; Trimo is successfully launching new trends in the construction industry.



ArtMe on



With Qbiss Trimo is a McLaren Technology Centre Partner



Trimo's ArtMe on Jodrell Bank Centre for Astrophysics, UK

University of Ljubljana, Faculty for Civil and Geodetic Engineering

Two research groups from the University of Ljubljana's Faculty of Civil and Geodetic Engineering, Chair for Buildings and Constructional Complexes, KSKE FGG UL, represented by Prof. Dr Aleš Krainer, Assist. Prof. Dr Živa Kristl, Assist. Dr Mitja Košir, Assist. Dr Mateja Dovjak and Dr Roman Kunič, a partner from Fragmat with an emphasis on construction, site selection concepts and health and performance efficiency, and the Chair of Construction Informatics, KGI FGG UL, represented by Prof. Dr Žiga Turk and Miloš Todorovič with an emphasis on building information modelling (BIM) taking into account the principles of sustainable construction design are engaged in Competence Centre, KC TIGR in three RRP: the RRP1 development of building concept, RRP3 energy sources and RRP4 building management. The objectives of the KSKE are the interventions which have besides the development of the concept of healthy and stimulative system of living and working environment, represented by open, dynamic building structures on the basis of the time-space continuum principle, the efficient energy use as one but not the first influential factor.

The objective of the KGI is to undertake a comprehensive comparative analysis to demonstrate how BIM can overcome the problems of today's 2D CAD (Computer Aided Design) practice. Hopefully this study will contribute to the mind and paradigm shift needed in the Slovene construction industry, as by now there were hardly any improvements towards using more BIM technologies in practice.



National Institute of Chemistry

The 'National Institute of Chemistry's employees at the Laboratory for Environmental Sciences and Engineering led by Prof. Albin Pintar, PhD play an active role in basic and advanced research on both national and international levels in the following fields:

modern waste water cleaning processes, environmental protection, ecotoxicology, biological and chemical measurements, renewable energy sources (biogas), sustainable waste management, and process engineering in ecology. The Institute is also active in translaboratory research, testing for various Slovenian and foreign

clients, monitoring and giving advice on waste water management, and analysing the effects on the environment.

The latest activities that have been undertaken by the Institute (the development of new processes for the rationalisation of water in residential and commercial buildings) within the CC TIGR framework have resulted in an interesting innovation that may result in considerable reductions in use of drinking water in the future. The team has developed a multi-functional compact washing sink that collects waste water in a building unit, performs all the necessary water treatment processes (bio-cleaning, disinfection process) and enables the water to be re-used for further purposes, such as toilet washing, for example. The sink can function as a classical toilet kettle and is also useful since it can be used separately or as an additional unit and can be easily incorporated into existing buildings.



Dr Albin Pintar

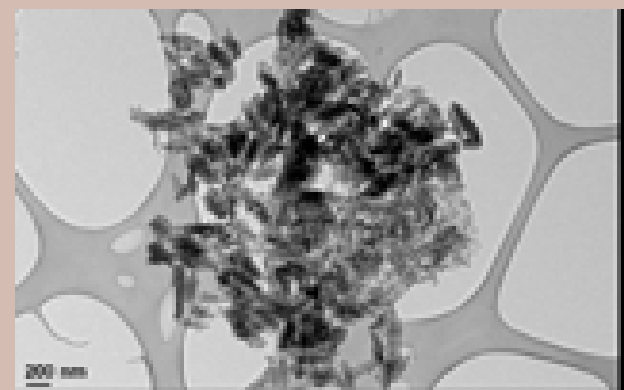
University of Ljubljana, Faculty of Mechanical Engineering

The Chair of Heat and Mass Transfer and Environmental Studies of the Faculty of Mechanical Engineering in Ljubljana is engaged in two research projects at the Competence Centre. The group working at the Laboratory for Heating, Sanitary and Solar Technology, led by Prof. Medved, Asst Prof. C. Arkar, PhD, B. Vidrih, PhD and S. Domjan, BSc is engaged in developing new building concepts in the RRP1. The research carried out comprises the following: the development and modelling of active building components for the autonomous heating and electricity supply of buildings, based on renewable energy sources and low energy free cooling and heating technologies; research on the integral controlling of low energy building service systems including the user-friendly monitoring of energy demands; the development of the concept of module structured mini-home buildings with low carbon footprints. This activity will be used to test interdisciplinary education concepts at the University of Ljubljana and will work closely with the IEE IDES_EDU project. The group working at the Laboratory of Refrigeration, presented by Prof. A. Poredoš, PhD, Asst Prof. A. Kitanovski, PhD, U. Flisar, PhD, M. Ožbolt and U. Tomc, leads the RRP2 (Energy sources) and is engaged in the research and development of solar cogeneration technology and its integration with solar cooling. The laboratory performs R&D in the field of refrigeration and cooling, and is also involved in various heat and mass transfer research activities. The laboratory also plays an active role in the interdisciplinary research of combined solid state physics, thermodynamics, and process engineering. The team will develop basic conceptual designs, analyses, experiments, the optimization of particular components, and the development of solar cogeneration technology with its industrial partners.

Slovenian National Building and Civil Engineering Institute

The Slovenian National Building and Civil Engineering Institute is the leading Slovenian institution on building material assessments and testing, adopting a distinctive research attitude. The institute has a wide range of activities, from research on civil engineering construction projects and buildings, larger constructions and smaller products and even nanomaterials. The Institute also plays an active role in the preservation of cultural heritage. The Institute's research is mostly oriented towards long-term sustainable solutions and its innovativeness is self-evident.

TEM display of modified nano-organic pigment for self-cleaning façade coating



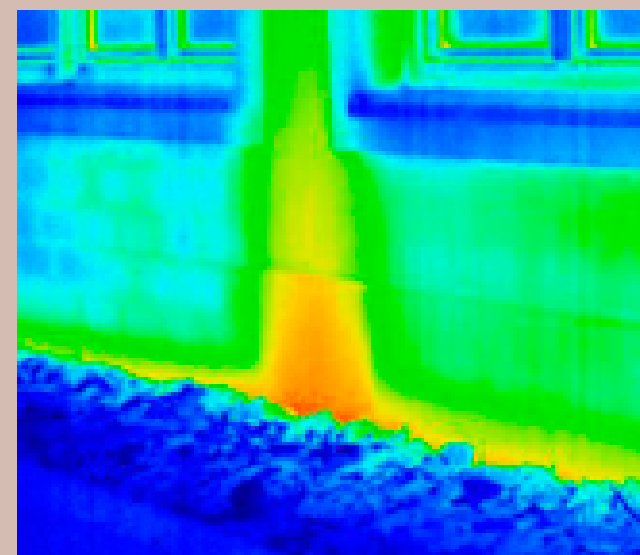
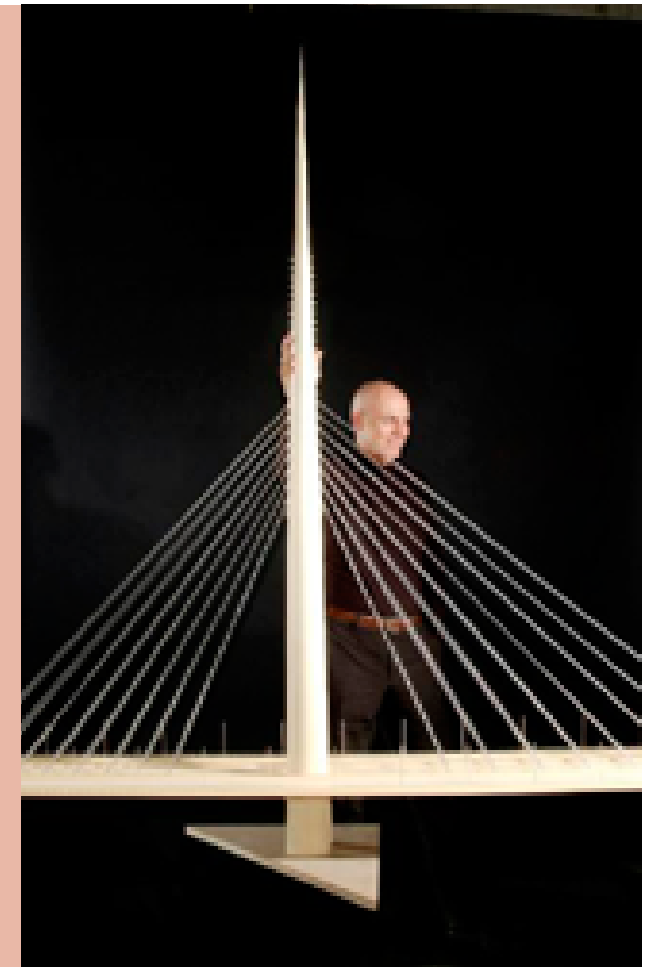
University of Ljubljana, Faculty of Architecture

The Ljubljana School of Architecture has a long-standing tradition and was established just one year after the University of Ljubljana was founded (1920). Its founder was the architect, Ivan Vurnik, but the first architects to leave their indelible marks on the school were Jože Plečnik and then later Edvard Ravnikar. It was with these two names that the Ljubljana School of Architecture become known all over Europe and the world.

Faculty profile

Ljubljana's Faculty of Architecture is generally considered one of the best architecture schools in Central Europe. Many of its successful students and graduates testify to its quality, often achieving enviable results both domestically and abroad. Our graduates are known for their general and professionally profiled knowledge and systematic approach to projects facilitating successful employment in various fields of artistic and architectural endeavour.

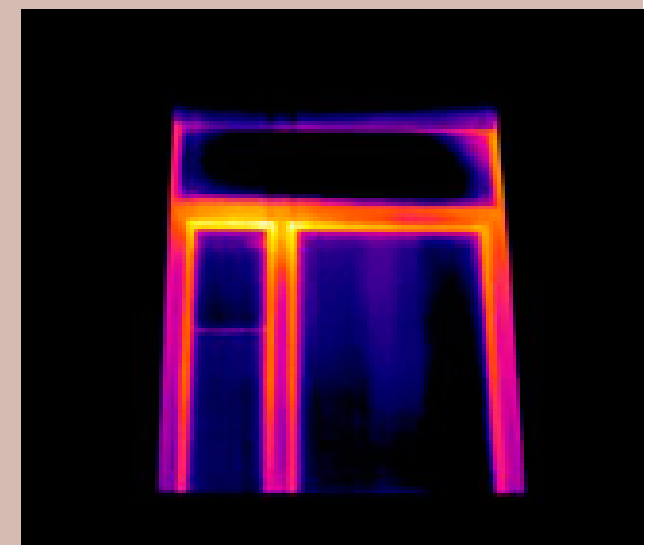
The faculty is today part of the international university and research network. At the faculty we pursue increased cooperation between other faculties with ties with the best foreign universities in order to increase or maintain the high level of domestic excellence in research and teaching assignments. We are present in European integration processes through various programmes (Erasmus, Tempus, Ceepus, etc.). We are also introducing intensive international student exchanges on both graduate and post-graduate levels.



Thermography

The Institute has a long history of fruitful cooperation with the TIGR CC's members. This CC represents for us only the fruit of all our previous endeavours. Our field of work in the TIGR CC is the development of new sustainable building construction concepts, outer building layer development and advanced HVAC elements development. We are researching new technological concepts: from highly isolative building layers, interactive panel solutions and the use of natural materials to details in building physics and the preservation of

cultural heritage. We develop new construction technologies – not just as concepts – but we also aim to put them into practice. Much emphasis is also put on our LCA (Life Cycle Analysis) processes where we aim to incorporate this viewpoint into each and every design of our products and processes.



Thermograph of an aluminium-frame window

<http://www.eurocloud.si>

KC Class – a Hub of Potential

<http://www.kc.class.eu>

The consortium brings together partners who work in high-priority IT fields, most of which specialise in different areas of cloud computing (CC), such as file systems, petabyte data warehouses, virtual networking systems, security and some others. It employs 400 researchers and developers from **six small and four medium-sized enterprises, and seven research organisations**. As a result, it offers cutting edge know-how on security, networking, mobile applications and terminals, identity management, data processing, quality assurance, high availability computation, service-oriented architectures, infrastructures, etc. The consortium's partners are IT enterprises that cover business, logistics, medical, educational and environmental informational systems. We also devote a lot of attention to knowledge transfer systems.

Five small and four medium-sized enterprises, together with seven research organisations, are involved in more than **30 FP6 and FP7 EU-funded projects**, as well as 30 other international projects. Besides that, they are involved in 160 national projects, collaborate in 12 networks of excellence, 11 technology platforms and 8 European technology platforms.

Coordinator of KC Class – Zavod e-Oblak

Zavod e-Oblak is the coordinator of KC Class program activities. Within the program activities Zavod e-Oblak is also active in:

The certification program

This program is crucial since it represents the centralisation of knowledge and competence in the field of cloud computing. E-oblak coordinates the requirements of this field with its European partners as a member of the management board of EuroCloud Europe, to ensure a uniform certification scheme within the EU. E-oblak is closely related to the economy representatives and is acting under the association ZIT-Zitex of the Slovenian Chamber of Commerce.



Dalibor Baskovc, CEO, Zavod e-oblak, Chairman EuroCloud Slovenia

The E-oblak impact

The E-Oblak Institute is connected to the consortium partners through four major content areas. Other external members (eg, IBM, Microsoft, Astec, Xlab, Zeleno) are ICT companies that have expressed a willingness to cooperate in the field of cloud computing. These companies will be invited to **actively create the CLASS eco-system** by developing their own services and products that complement the services and products of the consortium. With these external members of the KC-CLASS, the consortium is getting wider support for the Slovenian ICT industry and thus has larger international weight and recognition. The companies that do not fall within the ICT industry are to be the early adopters of the CLASS solutions. With this last area, **the sphere of impact of the KC-CLASS affects all the sectors and branches of Slovenian industry.**

Technology strategy

The primary technological goal of the competence centre is to establish a unified, integrated and open platform for cloud computing, which will provide an opportunity for an economical breakthrough in terms of developing innovative services and a research-development breakthrough in terms of the development of new technologies and skills in one of the most important ICT areas, cloud computing. The unified open platform for cloud computing will **provide the infrastructure, expertise and support services** for the Slovenian companies, research-development institutions, government, universities and other interested parties, which will offer top-level platform, adjusted specifically to the Slovenian environment for **developing innovative services and products at all levels** of cloud computing: infrastructure, platform and service. In doing this, the open platform will address the key challenges, associated with shifting

to the cloud, including the data and services location, legislation accordance, safety, elasticity, flexibility and interoperability.

Demonstration Laboratory

In cooperation with partners, E-Oblak is establishing a demonstration facility that will be operating on the premises of the Ljubljana Brdo Technology Park. Within this facility, the visitors will be able to get information about the products and the services generated within the project, as well as come into contact with individual researchers and developers in order to widen the consortium's impact.

Building a brand

For the integration of the cloud computing field within the competence centre we have chosen the brand name 'EuroCloud Slovenia' that connects us to other similar organisations throughout Europe and world, which to this day are established in 28 countries. In Slovenia, the appropriate positioning of this brand is in the beginning stages,

but in the coming years we intend to develop the brand so that it becomes recognised within Slovenia and Europe. The majority of Slovenian business and research organisations, which either have cloud computing services or these services are planned in their medium-term development plans, have been included in the E-Oblak competence centre for this purpose.

Market technology recognition

Epilog is one of the leading European enterprises for warehouse management systems and material flow systems. The **certificate awarded by the Fraunhofer IMS Institute**, the highest authority in Europe for WMS systems, is testament to the quality of their work. The institute has certified just under 100 enterprises in Europe.

Infotehna is the **most important content management provider** in Europe for generic pharmaceutical companies.

<http://www.infotehna.com>

<http://www.feri.uni-mb.si/>

The Geometric Modelling and Multimedia Algorithms Laboratory (University of Maribor, Faculty Of Electrical Engineering and Computer Science) is an internationally recognised laboratory that produced algorithms built into the commercial software of companies such as Autodesk.

<http://www.inova.si>

INOVA IT markets its products exclusively abroad with clients such as Nokia and the BT Group. The competencies that are to be developed further within KC class are development of mobile applications on Symbian, Windows Mobile, Google Android, Samsung Bada and Apple iPhone platforms, VoIP networks as well as development of platform services for mobile applications support.

SmartCom has been awarded numerous international accolades (Telindus – Excellent Performance, 2004; Extreme Networks – Regional Partner, 2007; Oracle – Oracle PartnerNetwork Partner, 2008; and Ciena – Partnership with Smart Com, 2006). The BeeSmart



service platform has been deployed in four countries.

Turboinštitut is home to one of the only two independent laboratories in the world for the modelling and testing of all types of water turbines in accordance with the IEC 60193 international standard. It also owns one of the **most powerful supercomputers** in industry worldwide.

Alpineon (<http://www.alpineon.si>) is a research organisation which, along with its partner organisation AlfaNum, is the leading **provider of speech technology solutions** for southern Slavic languages (<http://www.alpineon.si>/proteus, <http://www.voiceTRAN.org>).

<http://www.fri.uni-lj.si/en>

The Faculty of Computer and Information Science at the University of Ljubljana is one of the Slovenia's most important research, development and pedagogical institutions in the field of IT. They have gained recognition in basic and applied research, as well as in collaboration with industry.

The **NIL** enterprise is an internationally recognised high-tech business for development of proprietary remote labs solutions, remote education and the FlipIT cloud computing service.

<http://www.nil.si/english>

Jozef Stefan Institut (JSI) mostly markets its own platform for educational video content abroad, with subscribers such as the MIT, Berkeley, CERN, OCW, Yale and Stanford. We offer also parallel programs for high performance computer simulations and dedicated research equipment for the advanced bio-signal processing in medicine.

Studio Moderna is leading multi-channel e-commerce and direct to consumer platform in Central & Eastern Europe, with a vertically-integrated network reaching more than 400million consumers across 21 countries.

The customers of the consortium's members include the following worldwide recognized companies: **Autodesk, Red Hat, Nokia, BT Group, Adobe, RSA/EMC** and **eBay**. The technological excellence and international recognition of the partners manifests itself in the huge international support garnered for the project. We

have received letters of support from **Google, Oracle, IBM, SAP, INRIA and Red Hat/IBoss**.

KC Class involvement in international programs

The consortium's partners are involved in 25 international projects within the framework of the FP7, 28 projects in the FP6, and 32 other international projects. Seven partners are involved in the FP7 research projects, four in the FP6 research projects, and nine partners are involved in other research projects and programs. All of the research projects accounted for are from the fields that are somehow related to cloud computing, either from technical or from users point of view.

Amongst the most important projects are the following: **(FP7)** BAL, EIFFEL, P2P-Next in GLO, COLLECTIVE; **(FP6)** eMAPPS, PROLEARN, iCamp, ALIPRO, BReATH, SERENITY, DIADEM in DAID-ALOS; **(Eureka)**, COST Action 2101: Biometrics for Identity Documents and Smart cards, COST Action 2102.

Networks of excellence: IJS collaborates in two networks of excellence: CO-BIK and CO-VESOLJE. The third, CO-ICT has already wrapped up. The institute is further involved in the PROLEARN (Network of Excellence Professional Learning, FP6), SatNEx (Satellite Communications Network of Excellence, FP6), PASCAL, PASCAL-2 (Pattern Analysis, Statistical Modelling and Computational Learning), MetaNet (building the technological foundations of a multilingual European information society), and PlanetData (NOE and AI Planning).

Technology platforms: Many of the consortium's partners are involved in ISI (Integral Satcom Initiative) international technology platforms, eMobility (Mobile and Wireless Communications), NEM (the Networked and Electronic Media), and the NESSI (Networked European Software and Services Initiative). FERi is a founding member of NESSI Slovenia and, as its president, an active member of the NESSI National Initiatives Task Force Group (NIs TFG). FERi had an active role in the establishment and operation of the ARTEMIS, NESSI Slovenia and NEM technology platforms, also helping their connections and col-

laborations with European technology platforms. FE is a member of the programme board of Slovenian ICT Technology Network (<http://www.ict-slovenia.net/>). The partner, Alpineon, is a member of the eMobilnost, Artemis and Mediji v e-omrežjih (NEM) national technology platforms.

These partners are involved in six international technology platforms. The consortium plans to merge the activities performed to achieve a higher level of participation for the whole consortium in all the listed platforms. The European networks of excellence link partners from the selected field. The consortium's partners already collaborate in multiple networks, granting access to the latest findings in the networks for the whole consortium.

Working packages

P1 Cloud Infrastructure – IaaS

We will collect and develop a set of software and best practice recommendations that will enable easier and cheaper migration of businesses to the cloud. Moreover, the resulting software and recommendations will support businesses in all phases of their product development.

Objectives: to provide built-in infrastructure components which upgrade existing infrastructure with a flexible allocation of resources, distributed data storage and security mechanisms. The implementation plan: creation of technical specifications which will provide the basis to assess, enable and choose the most appropriate existing solutions and upgrade them with missing functionalities.

P2 Cloud Platform – PaaS

The development of an open platform as a cloud service for the simple and effective migration of existing applications or the development of new service applications.

Objectives: an open platform enabling cheaper and faster transition of services to the cloud. The implementation plan: specification design, software design and implementation, and testing.

P3 SaaS Support Services

Innovative solutions in terms of applications as a service that will enable partners to develop new business

models and processes.

Objectives: to implement statistical services, ERP supporting interfaces, an access point to security mechanisms (AAA) and integration with social networks.

The implementation plan: specification design, software design and implementation, and testing.

P4 Sustainable Growth and Quality of Life Support

Innovative process solutions for customer relationship and product life cycle management. Objectives: advanced cloud-based applications, CRM and PLM.

The implementation plan: to capture end-user requirements, to determine the specifications and implementation of prototype applications.

P5 E-Learning Services in the Cloud

Simple, pervasive access to knowledge allows companies to respond faster to market changes. Pervasive access to content regardless of the access location helps to reduce regional inequalities and improves availability of content and knowledge for human resource development.

Objectives: the design and implementation of a vertically integrated e-learning system, with emphasis on the commercial aspects.

The implementation plan: to establish requirements and specifications, on the basis of which the infrastructure and platform services are used to build the application.

P6 Cost-efficient Vertical Integration of Logistics

The cost-effective provision of solutions to problems concerning logistics and logistics planning in the cloud. To enable the provision of flexible approaches through the use of the infrastructure and platform to solve optimisation logistical problems in the cloud.

Objectives: The ultimate goal is to ensure a complete vertical integration from micro to macro levels of management and to monitor products, markets, indicators, demand and overstock.

The implementation plan: to establish requirements and specifications, on the basis of which the infrastructure and platform services are used to build the application.

P7 e-Health and Environmental Services in the Cloud

The first part of the project focuses on services dealing with the health aspects of a patient. The second part researches health predictions based on environmental data.

The objectives are to develop a pilot collaborative system and a social network, enabling patients to manage their health and services, and enabling the contact between service providers and patients using modern communication media and mobile devices.

The implementation plan: to establish requirements and specifications, on

<http://www.epilog.net>

Epilog d.o.o. and the CLASS Competence Centre

Epilog is a successful Slovene gazelle, a provider of integrated software solutions of high quality for internal logistics, automated and manual warehouses. For 20 years we have been building up our knowledge and experience in warehouse management software (WMS) in demanding projects all over Europe. All of this experience has now been accumulated in our very own software package known as AtlasWMS.

In the European market we supply WMS and MFS (material flow system) to the leading producers of automated warehouses and we are one of the first suppliers of IT solutions for the warehousing of metals and other materials from pharmaceutical and other branches. The international structure of our clients is reflected in the export share which is around 98%.

As a member of KC Class Competence Centre, we are researching approaches to offering WMS and related logistic services (SAAS) and to develop a prototype of a logistic cloud.

<http://www.fe.uni-lj.si>

The Faculty of Electrical Engineering, University of Ljubljana and the Class Competence Centre

The Faculty of Electrical Engineering covers a wide range of interdisciplinary skills in the fields of telecommunications, electronics, automation and power engineering. All fields are integrated with computer and IT sciences, including the most up-to-date communications tools, Internet developments and multimedia solutions. The department of the Laboratory for Telecommunications (LTFE), which is involved in the KC Class, is focusing on research, development, and the implementation and testing of modern communications and multimedia systems and services in various mainstream and interdisciplinary fields of application. Our research and development work involves intelligent access networks (Future Internet, Smart access, self-organised networks, signalling), Internet of things (Smart living, Smart cities, Smart traffic), quality of user experience, SmartGrid communications and design of mobile and multimedia applications in different development environments (iPhone/iPad, Android, IPTV and interactive TV platforms). An important focus is given to the research, development and implementation of ICT-supported education. Our own developed e-learning management system E-CHO (www.e-cho.org) is used in academic, corporate environments and public school sector. The research and development work is supported by a powerful test and measurement environment (Test Centre) available within the laboratory, featuring latest operator-grade equipment and communications infrastructure.

UL FE is participating in the P5: "E-Learning Services in the Cloud" project. Building on our knowledge and rich experiences in e-learning technologies and processes, we are contributing to the design and conceptualisation of a cloud enabled e-learning service together with other project partners. Our goal is to deploy our learning management system into a KC CLASS cloud and integrate it with other partners' tools, offering users a seamless environment supporting e-learning processes. The overall mission is to provide a portfolio of services and tools needed by enterprise, public sector and private customers to organise, deploy, conduct and manage e-learning, leveraging flexibility, universal presence and cost efficiency offered by the cloud. Besides research contributions, an important part of our activities is scoped to the development of prototype applications, demonstrating the usability and benefits of the e-learning services in a CLASS cloud.

the basis of which the infrastructure and platform services are used to build the application.

CONCLUSIONS

If Slovenia wants to partner and follow cloud strategy that the EU is developing, and be prepared for the next 2020 perspective as well as to become a legible partner in existing EU consortium partners which are already involved in the cloud computing area, Slovenia has an ideal opportunity to make a breakthrough with developing competencies in this highly innovative field also through projects like KC Class.

Europe on the other hand is developing different programs, like for example the European Cloud Partnership (ECP), which has a tendency to also involve the public sector and we strongly believe that that will give European industry, as well as research institutions, a new push towards new investments and innovations.

“The purpose of the European Cloud Partnership (ECP) is namely to overcome the fragmented public sector demand for cloud services in the EU. The public sector collectively is the largest buyer of IT services in the Union but its impact is very limited today. More harmonisation and integration of this buying power, notably through common requirements across different application areas (e.g. eHealth or eGovernment services) will bring direct benefits to the public sector via new efficiency gains. The growing market will help existing and new cloud providers. Additional private sector benefits will come through an improved business environment, e.g. higher quality of supply, more competition and better interoperability” (source: European Commission).

We feel Slovenia can be an important player in the years to come with respect to new fields that are emerging within the cloud computing sector, whether this would be through new research, innovation, or education, as well as with new business opportunities, based on cloud computing.

<http://www.turboinstitut.si/>

Turboinstitut d.d. and the CLASS Competence Centre



Dr. Vladimir Kercan, general manager of Turboinstitut d.d.

Turboinstitut d.d. is a company with over 60 years of tradition in the research and development of hydraulic machines and more than 25 years of experience in Computational Fluid Dynamics (CFD). The company specialises in the research and development of water turbines and pumps, the design, manufacture and engineering of equipment for small hydropower plants, and it works closely with universities throughout Slovenia and South-East Europe on a postgraduate level. In industry, substantial numerical analysis and computer modelling is used in the development process. Virtual prototyping can reduce the need for expensive, time-consuming and energy inefficient experimental methods. In some areas the complete characteristics can be predicted before any part of the product is produced. Related industries which are possible users of the abovementioned software are: Turbo machinery, Aerospace, Automotive, Chemical Processing, Civil Engineering, Electronics, Environmental, Defence, HVAC/Refrigeration, Industrial Equipment, Marine/Offshore, Medical, Power Generation, Semiconductor and Telecommunications. Considering research oriented future plans, Turboinstitut has established a supercomputing centre with the most powerful computer in this part of Europe. As a partner in KC Class Turboinstitut wants to develop the complete CFD and HPC service in the cloud computing environment.

http://www.studio-moderna.com/default_noflash.asp/

Studio Moderna and the CLASS Competence Centre

Studio Moderna is the leading multi-channel e-commerce and direct to consumer platform in Central & Eastern Europe (CEE).

Reaching a market of 400 million consumers across 21 countries, Studio Moderna is unrivalled in our ability to drive demand and sell popular branded products to consumers through our highly sophisticated, vertically integrated multi-channel sales, media, marketing and distribution platform. Studio Moderna's sophisticated operations offer unified scalable sourcing and production and country-specific sales, delivery and service.

We handle every single stage of the selling process: product selection, country localisation, direct and indirect sales, third party selling, telesales, delivery and fulfilment and customer service. The growth of the company and the diversification into many other different areas demand new CRM and PLM solutions.

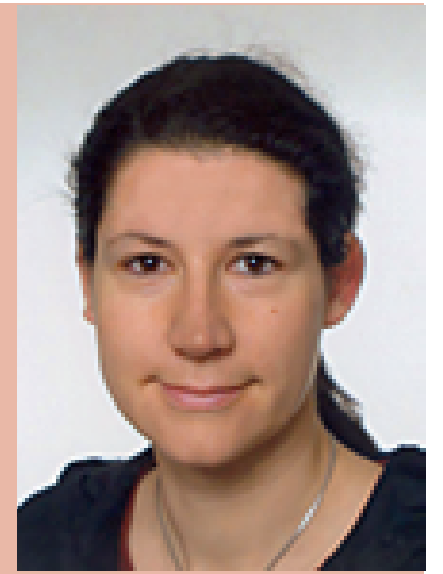
As a member of the CLASS Competence Centre, Studio Moderna is going to research and develop a prototype of the new generation of CRM and PLM solutions. Through that we are expected to be more efficient in detecting consumer needs, get better feedback, which will then be directly forwarded to PLM solutions. The Cloud Infrastructure will help the company to organise PLM processes, optimise analysis and KPI monitoring which will lead to faster product development and better time-to-market indicators. With advanced collaboration methods and integration we will achieve a better overall synergy. All this is expected to enable savings and strengthen Studio Moderna's marketing position.

<http://www.alpineon.com/>

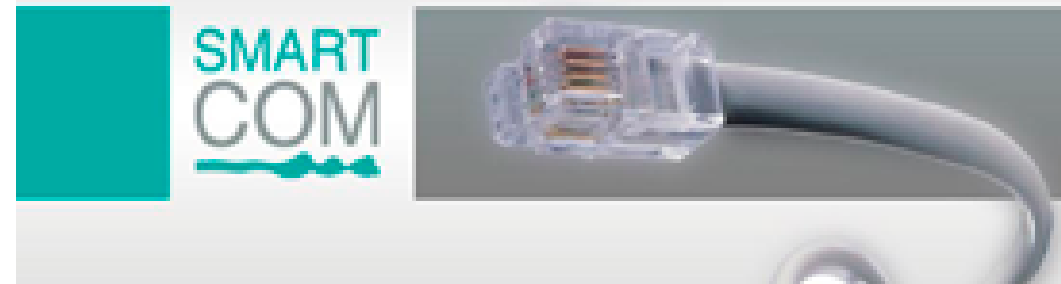
Alpineon and the CLASS Competence Centre

“We are a high-tech RTD performing SME with core competences in the field of biometric technologies (voice and face biometrics) and speech technologies (speech recognition, synthesis and translation, voice portal applications and SMS/electronic mail readers). Within the framework of the KC Class Competence Centre, we work as a research organisation with the concession for providing public service in the field of research activities. Within the P3 project, we play the key role in the planning and development of a novel SaaS that will enable user authentication and access authorisation using face biometrics.”

Dr. Jerneja Žganec Gros

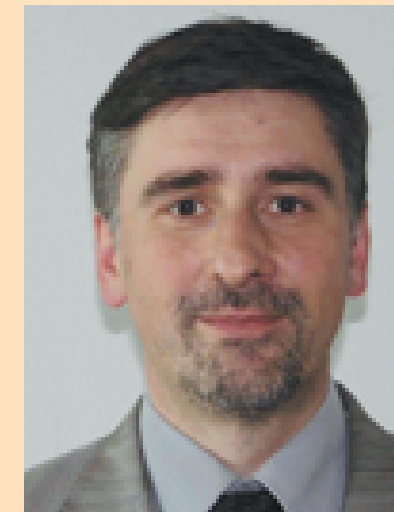


<http://www.smartcom.si>



Smart Com and the CLASS Competence Centre

Smart Com is a high-tech SME and a part of a larger group of enterprises. Its core business is development and integration in the field of Information and Communications Technologies (ICTs). Smart Com provides a complete set of services in the lifecycle of an integrated end-2-end ICT system: consultancy, design, development, integration, implementation, operation, support and maintenance. Smart Com develops software solutions for the market and for internal use. It includes an R&D group, which is registered with the national research agency; the group's members have a long track record of successful in large scale national and European R&D projects. The R&D focus is currently on Smart Energy Grids, health and inclusion, and new ICT infrastructures and services. Smart Com is an active partner in two major national R&D



Igor Mlakar, Customer Services Manager, Smart Com

efforts during the period 2011–2013, the SURE Competence Centre on Smart Grids and the CLASS Competence Centre on Cloud Computing.

As a member of the CLASS Competence Centre, Smart Com contributes to five of the seven main projects: WP1: Infrastructure as a Service; WP2: Platform as a Service; WP3: Software as a Service Support; WP4: Sustainable Growth and Quality of Life Support; and WP7: e-Health and e-Environment Service in the Cloud. Our main R&D tracks for the CLASS Competence Centre are related to the Sensor Cloud, Cloud Operations Manager and tools for monitoring and analysing cloud information and communication

infrastructure. We develop sensor cloud infrastructure under WP2 (sensor server) and WP4 (sensor portal); however a prototype of a practical appliance will be available to partners on WP7 as a part of e-Environment Services. The cloud operations manager comprises many different tools and procedures for gathering information from cloud infrastructure devices and focuses on enforcing security mechanisms and standards throughout the process of maintaining cloud resources. This prototype product will be developed mainly under WP1 and data gathered on this level will be available for further statistical and system analysis with higher level tools. Under WP2 and WP3, Smart Com focuses mainly on an experimental evaluation of the WP1 prototype and development of an analytical and reporting system for cloud infrastructure.

Smart Com believes the field of Cloud Services and Cloud Infrastructure is of strategic importance. We take an active part in the CLASS Competence Centre and have considerable expertise gained from former R&D projects. Our goal is to transfer knowledge from contemporaneous ICT systems to the cloud environment. In this way, we strengthen our market position as well as establish and enhance our partnerships with key stakeholders in the cloud.

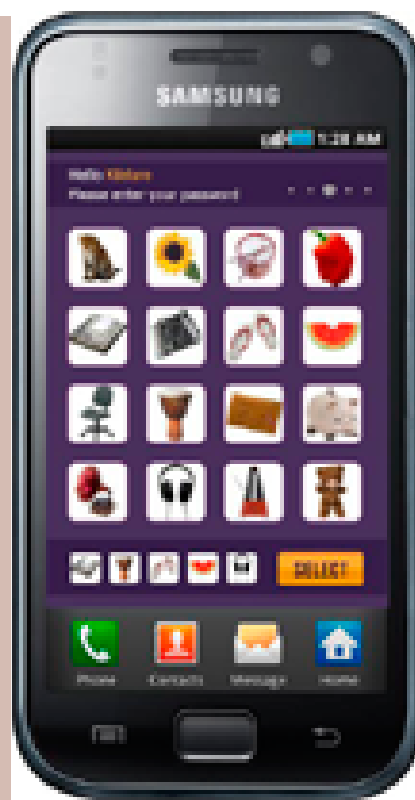
The Jožef Stefan Institute and the CLASS Competence Centre

The Jožef Stefan Institute (JSI) is Slovenia's leading research organisation. It is responsible for a broad spectrum of basic and applied research in technology and natural sciences. The main subjects concern production and control technologies, communication and computer technologies, knowledge technologies, biotechnologies, environmental technologies, new materials, nanotechnologies and nuclear engineering. The JSI accumulates and disseminates knowledge and technologies to the benefit of society through the pursuit of science, development and education at the highest international level of excellence. The JSI's basic goals are to provide expert scientific and applied output in the form of processes, products and consultancy, and to produce well-trained young scientists. As partner of KC CLASS, the JSI will focus on identity management, the provision of security services in communications, high performance computing and computer simulations in clouds, petabyte storage systems, the data mining of multimodal data (text data, data streams) and semantic technologies.

Three JSI departments are involved in KC Class:

<http://www.e5.ijs.si>

The main activities of **Laboratory for Open Systems and Networks** are the R&D of next generation networks, telecommunication technologies, components and integrated systems, and information society services and applications. The laboratory is implementing



Picture 3: Mobile application for graphical authentication ImagePass

the research programme "Future internet technologies: concepts, architectures, services and socio-economic issues", where research on information security and privacy plays a prominent role. Advances made in scientific research provide answers to the major questions and dilemmas in the design of the Future Internet, and ensure Slovenia's leading position in research of generic technologies and applications, which form the core of knowledge economy.

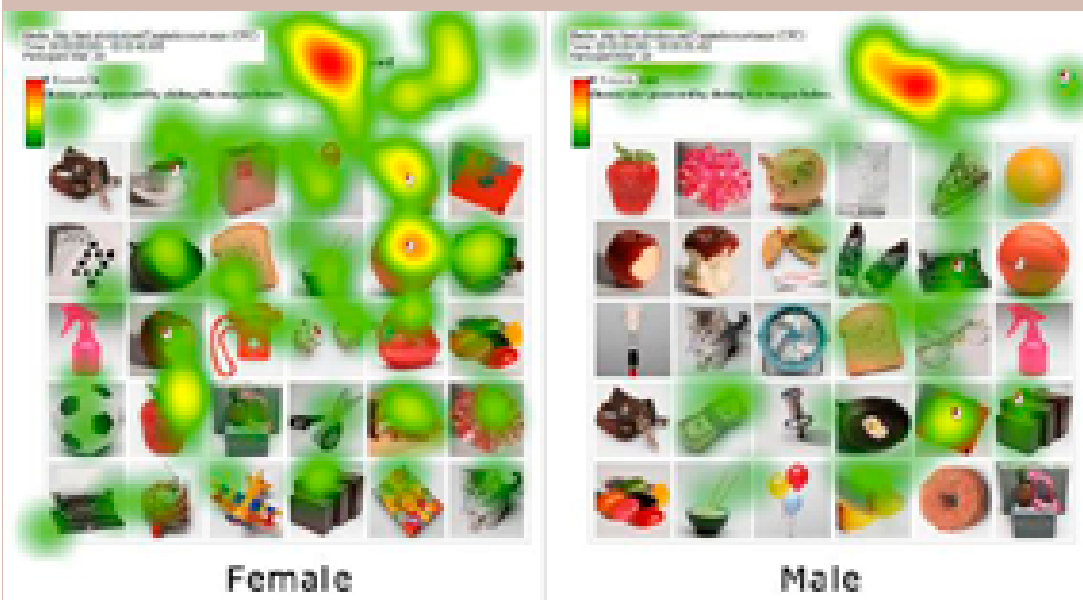
<http://www-e6.ijs.si/>

The Department of Communication Systems is concerned mainly with the research, design and simulation of communication systems, and the development of new parallel and distributed computing algorithms for HPC and advanced bio-signal processing.

Other research activities are in the development of software tools for testing, modelling and simulation of natural phenomena, and in the development of distributed and cloud environments for computer supported co-operative work. We are educating young researchers, and transfer the knowledge and new technologies to our industrial partners.

<http://ailab.ijs.si/>

The Artificial Intelligence Laboratory is concerned mainly with research and development in information technologies with an emphasis on artificial intelligence. The main research areas are the following: (a) data analysis with an emphasis on text, web and cross-modal data, (b) scalable real-time data analysis, (c) the visualisation of complex data, (d) semantic technologies; and (e) language technologies. The Artificial Intelligence Laboratory puts special emphasis on the promotion of science. In collaboration with the Centre for Knowledge Transfer in Information Technologies (CT3) we are developing the VideoLectures.NET educational portal and organising the national ACM competition in Computer Science (in Slovene).



Usability evaluation of graphical authentication with an eyetracking device

<http://www.pint.upr.si/sl/>

Institute Andrej Marušič and the CLASS Competence Centre

Institute Andrej Marušič (IAM) is a public research institution and a member of the University of Primorska, which brings together researchers in the field of mathematics, computers, e-environment and e-health. In the context of the CLASS Competence Centre, all four departments are involved: the Department of Mathematics, Department of Technology, Department of Information Sciences and Technology and Department for Health Studies.



IAM is involved in practically all the KC CLASS Competence Centre's projects, where its researchers cooperate with Projects P1-P3 (information-infrastructure) and also in the more applicative Projects P5-P7, which deal with e-learning, optimisation processes in logistics and e-health. At the Department for Information Sciences and Technology we perform research on data structures, data mining and large distributed GRID architectures. These themes play a vital role in designing cloud computing architectures. Through our involvement in Projects P1-P3, we will strengthen research and development in the IaaS, PaaS and SaaS areas; through cooperation with other institutions and companies in the Competence Centre, we expect to upgrade the existing good connections, speed up knowledge transfer and establish new connections, mainly with industry. Other departments are involved in more applicative projects of Competence Centre: P5-P7. IAM plays the main role in and also leads the Project P7 - e-health and e-environment; the project lead is Dr Boris Horvat.

One of the strategic orientations of IAM is to become the leading institution in the field of informatisation in the area of healthcare that also involves information and communication technologies to support healthcare processes, to optimise resources and support knowledge exchange (collaboration networks between patients and doctors, platforms for e-learning, etc.). In IAM we have good connections with public healthcare institutions in Slovenia, and we are involved with strategic and cross-border projects from this area. All this enables us to have a good insight into the issues at hand and obtain first-hand information; at the same time, it also represents a real test area where our solutions have to work. Through the synergy established with the other development-research projects in which we cooperate at IAM, that deal with information architecture of electronic records, controlling the financing of public healthcare system through diagnosis related groups (DRG) and introduction of process leadership, corresponding informatisation and process optimisation, web and mobile technologies and e-learning, the development-research activities carried out in Project P7 will enable the much faster and coordinated development of staff, knowledge and cooperation, faster growth in corresponding areas and, as a result, a better standard of involvement with developing new technologies through knowledge transfer. The involvement in the Competence Centre is therefore completely coordinated with the e-health development goals of IAM

An important component in the activities carried out by the Department of Technology are independent measures in air pollution and sea pollution for the purpose of measuring the potential environmental influences of Luka Koper's activities in the region.

Through its measures and data processing and the provision of these data to the subscribers and wider public through public displays and the Internet, the department actively contributes to monitoring the state of the environment, especially the air in the Koper area, and to public awareness of the

meaning of environmental quality that influences not just our health but also our standard of living. In the context of this project, in cooperation with other departments, we deal with development of information communication technologies that will bring the dissemination of the results of the measures, simulations and visualisations closer to the wider interested public.

Through this we will attempt to help companies open up new markets in this area, closely connected with e-health. In the past IAM developed a special system, named TARU to inform the public about the current state of the air; in the context of our project, we also intend to upgrade this, mainly with regard to cloud data and transfer of data to mobile devices.

Among the members of the Department of Technology and the Department of Mathematics who are involved in the Competence Centre's projects, there are also few individuals that have a great deal of experience in ICTs that support e-learning and in performing logistic optimisation. Those members who are involved in Project P5 are equipped with knowledge and a platform that was developed on the basis of experience gained in working on projects with other institutions (e.g. developing www.nauk.si). In the future, in the context of this project, we plan to upgrade this platform and tailor it to the requirements of interested partners in the Competence Centre and adapt it to cloud demands. In the context of Project P6, we are involved with developing the optimisation module for the optimisation of deliveries and distributions.

Since IAM is involved in practically all the Competence Centre's activities, we represent an important partner in the Competence Centre and look to contribute significantly in our cooperation with other partners. We are also convinced that we will benefit a great deal from this cooperation and further extend the experience gained on other projects which we will perform in the form of a public-private partnership. The Competence Centre's activities cover a good part of the most important areas of IAM's work, which facilitates steady growth in these areas from a scientific and technological perspective. We will actively involve researchers, especially the University of Primorska's young researchers in applicative industrial (development-technological) activities, which will create an environment of innovation and enable knowledge transfer to the economy.



VITEL 2011

International Workshop on Telecommunications

Communications and Computing in Cloud

Brdo pri Kranju, November 7th and 8th, Slovenia

Slovenian Society for Electronic Communications EZS – SIKOM, a Sister Society of IEEE Communications Society, has a very long tradition in organising national and international events on telecommunications in Slovenia. The intention of the events has always been to concentrate on the most important and relevant topics at the time leading to more efficient and useful or simply viable telecommunications for everybody. This principle also explains the name given to these events which is VITEL (Vlable TELEcommunications).

VITEL is guided by the International Advisory Committee composed of the well-known telecommunication experts primarily from the Central and East European Region and chaired by prof. dr. Marko Jagodič. The selection of papers and creation of the final program is prepared by the Program Committee composed of the eminent telecommunication professionals from Slovenia and chaired by Alojz Hudobivnik from Iskratel. The Organising Committee, responsible for the realisation of the event is different for each event. This one was chaired by doc. dr. Dušan Caf from Faculty of Information Studies, Novo Mesto.

The committees decided to select "Communications and Computing in Cloud" as the appropriate theme for VITEL 2011 International Workshop with the objective to bring

together the experts from operators, service providers, academia and industry alike to address this very important topic for the future development of telecommunications and Internet. The event was sponsored by the Faculty of Electrical Engineering and Computer Science, University of Maribor; Laboratory for Telecommunications, Faculty of Electrical Engineering, University of Ljubljana; IEEE Communications Society Chapter of Slovenia; Telekom Slovenia; Iskratel; Si.mobil; Iskra Systems; Research Center ICT, Kranj; Post and Electronic Communications Agency of the Republic of Slovenia (APEK); Academic and Research Network of Slovenia (ARNES).

Communications and computing in cloud have great economical potential and will be in the next decade a very important driver for the future development of information and communication technologies (ICT). The new concept is bringing to customers numerous advantages because of lower cost for ICT, easier and faster entry to markets as well as the adjustment to their individual needs. Cloud computing lowers the market entry bar-

riers for new service providers and also lowers the development costs of new services. A new big market is emerging with numerous opportunities for the electronic communications operators and also the technology advanced small and medium size enterprises. Opportunities offered by communications and computing in cloud are immense. Home users started to exploit the offered capabilities for granted and began to use the new business models. A big part of the home ICT management has been left to the external operators by subscribing to the available information services.

New approach based on the use of communications and computing in cloud is more and more interesting also for economy, public administration and elsewhere but the path to their broad implementation is still far away. We are facing many technical, legal and business challenges which need to be solved to ensure for users efficient services as well as data security and privacy both at the local and the international level.

The workshop took place in the Congress Centre Brdo – Kranj on November 7th and 8th 2011. The most important foreign participants were Mr Roberto Minerva from Telecom Italia, and Mr Josip Zimet from Cisco Systems.

The first day was dedicated to more general aspects and challenges of communications and computing in cloud. In the first presentation Roberto Minerva, Head of Strategy & Innovation Department of Future Centre in Telecom Italia spoke about the challenges of telecom operators in formation of this new environment



and how control paradigms can influence service development for future networks. The Client-Server paradigm will lead to a Cloud based organization of the network and services, where the peer to peer one seems to be better aligned with the original principles of the Internet and could be exploited as a means to set the way towards a new and open Future Network in which several providers can openly compete in the market.

Other presenters addressed other important aspects like cloud architectures, development of cloud services, creating relevant standards, putting in place proper regulations and providing efficient marketing approaches. Slovenia is already rather quite engaged in the introduction of communications and computing in cloud services which was evident from the presentation of activities of the Competence Center for Cloud Assisted Services (CLASS). The first day ended with a roundtable entitled "Security and privacy in Cloud" The roundtable was very inspiring by pointing at some of the most intriguing and significant challenges related to the wide deployment of communications and computing in cloud.

On the second day examples of good practice were presented and discussed, based on different strategies, different network and service environments, different business or technology initiatives as well as on already achieved experience. The workshop was concluded with the presentation of security risks organizations are faced with when deciding to migrate to the public cloud.

More information about the workshop can be found at

<http://www.sikom.si/>

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of the
Programme
Committee



Dušan Caf,
Chairman
of the
Organizing
Committee

Organizing Committee

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A. Vreže – FERI, University of Maribor;
M. Zupančič – Telekom Slovenije;
D. Žepič – Iskratel

Development Center for Information and Communications Technologies, Ltd., Kranj, SLOVENIA

The Development Center for Information and Communications Technologies (hereinafter referred to as RC IKT: Razvojni center za informacijske in komunikacijske tehnologije) is a business, technology, and development ecosystem. The founders of the RC IKT are the Iskratel Company, Technology Park Ljubljana, the ICT Technology Network Institute, which incorporates more than 50 leading Slovenian companies in the field of information and communications technologies, Sintesis test laboratory, and the Borea Company. The initial capital amounts to 3.5 million euros. By the end of 2014, the partners will invest more than two-thirds of their own funds in the project, worth over 40 million euros. The rest of the funds will be obtained through a public tender for the development centers of the Slovenian economy (12 million euros). At least twenty new companies (employing over two hundred people) should be established within the RC IKT by the end of 2014.

The strategic objectives of the company are to build and create a stimulating development environment for developing new technologies, products and services to set up new high-technology companies and to create new high-tech jobs. Through the increased private and public capital investment in development, and through the enhanced participation of industry in the R&D sector, the company speeds up the development of the entire Slovenian ICT business line. Our vision is to become the first choice for the entrepreneurial and innovative environment of entrepreneurship development, and for starting up and expanding growth-oriented companies in the field of information and communications technologies in the region.

The RC IKT activities are organized into three pillars:

- ICT Park (Technology Park with a Business Incubator)
- Information and Communications Center
- Innovation and Technology Center

The ICT Park provides the optimum conditions for starting up companies and for accelerating the growth of new high-technology companies in the ICT sector. The Park makes available its

technology and business infrastructure (office premises, laboratory, meeting rooms) and provides business and management consulting, training, mentoring, and networking.

The ICT Park includes young companies that have obtained the status of incubated companies, and other ICT companies and organizations that have become its members. In comparison with other technology parks, the essential added value of the ICT Park lies in the participation of young companies in R&D projects that enable them to better develop new technologies, products and services much more quickly. Since the Iskratel Company is a large core company, its cooperation is ensured. The possibility of obtaining sources of funding for the stages of company development and growth is greater, and the transition to product

commercialization is considerably faster. The results expected in the ICT Park's performance are new spin-off companies, new high-tech jobs, and new products and services.

The Information and Communications Center (ICC) provides information and communications services to the RC IKT and to business users outside the ICT Park. The ICC advises its partners in providing turnkey solutions and services. It participates in technology projects and in international

tenders. In addition, it organizes specialized training courses, and provides services by using a lease model and the pay-per-use model.

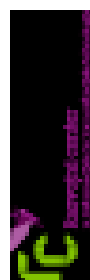
An integral part of the ICC is the data center that provides roaming services to companies (i.e., to the Park members), and a varied offer of their own cloud services. By using the pay-per-use model for offering cloud services and applications (IaaS, PaaS, SaaS,

CaaS), companies can access IT services and pay for them per use. Thus, they can substantially reduce their operating costs. If the companies have only a temporary need for ICT equipment and services, they may also lease them. They may choose the hybrid data center model or cloud computing. By implementing the Cloud Federation Service, we will additionally offer companies services that are not in our own cloud. In this way we follow a strategy that enables companies to get all the IT services they need at a single location.

One of the important strategic policies of the ICC is to establish a partnership relationship with various manufacturers and companies that are involved in the IT industry, and thereby collaborate closely with universities and with people in the academic environment. Through such an ecosystem-based approach, we want to develop the largest possible number of competencies that are urgently needed for developing and implementing state-of-the-art IT technology solutions. The Innovation and Technology Center (ITC) performs the R&D of products, applications, and overall solutions and services, primarily in the fields of customized telecommunications and information technologies. The development team, consisting of around 90 employees, has long-term experience in developing professional, highly-reliable, embedded communications systems and equipment for end users. An important part of the ITC is the Technology Transfer Office whose main tasks are to establish development cooperation with external research and technology partners, to transfer and integrate new innovative technologies and external knowledge (know-how, licensed products, patented and unpatented know-how) into new, innovative products, being developed by the ITC for its customers. The office also provides assistance to innovators, young entrepreneurs, and high-technology companies in developing business license models, and in transferring technology solutions to

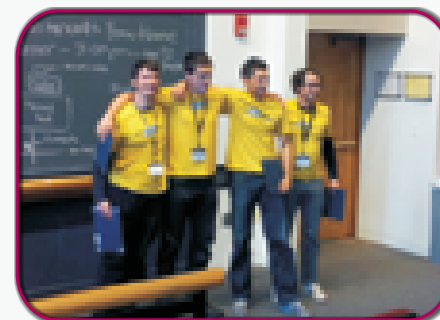


Bojan Dremelj,
RC IKT Director



Doctoral Students and Post-doctoral Fellows activities

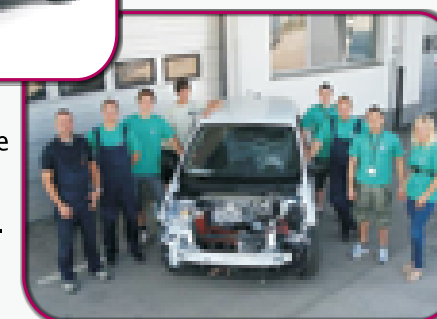
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