

innovation

Science + Business

Autumn 2017



ENERGY EFFICIENT ROBOTS FOR FUTURE CAR MANUFACTURING

27.11 Riga hosts the second Global technology, startups, politics and life-style festival, *Digital Freedom Festival*. This year's theme of the festival is smart cities and cyber security, artificial intelligence, green technologies, fintech and digital detox. Within the framework of the festival a number of startups competitions will take place, that will be created in collaboration with one of the world's leading accelerators: *500 Startups*, the association of international entrepreneurs, investors and mentors; *Rockstart and the Latvian Business Angels Network (LatBAN)*.

30.11 Helsinki, the capital of Finland, hosts one of the most significant events in the startup sector *SLUSH*, where startups, international investors, experts and the media meet. In order to attract the attention to the Latvian market and promote the flow of investments into new local companies, within the framework of *SLUSH*, there will be Latvian national stand with participation of IT and startups, as well as two seminars.

30.11 Riga hosts the international exhibition *Tech Industry* of engineering, metalworking, automation, electronics, electrical engineering, manufacturing materials, instruments and new technologies.



7.12 *Export & Innovation Award 2017* ceremony is taking place. The competition is organized for the thirteenth year by the Latvian Investment and Development Agency and the Ministry of Economics in order to congratulate and honour Latvian companies that create and manufacture innovative and export products and provide excellent services, the produce of which seriously compete with imported products and which value the importance of qualified workforce.



12.12 With the support of Climate Knowledge and Innovation Community *Climate KIC* Riga Technical University launched the conference *How to engage in innovation*. The aim of the conference is to exchange experience in realisation of facilitation strategy of innovations, including development and implementation of cooperation model of scientists, startups, students, representatives of industry and state institutions.

13.12 Fall season of the innovation platform *Demola Latvia* is ending. 17 teams will present their developed concept solutions for the challenges submitted by the leading enterprises. *Demola Latvia* unites interdisciplinary and motivated students who during four months receive help from coordinators, training process and assistance tools to solve defined challenges of enterprises with a possibility to continue this cooperation also after conclusion of the project.

15.12 The capital of Finland, Helsinki, hosts virtual reality conference. The aim of the conference is to connect different virtual reality developers, investors, incubators, accelerators and enthusiasts from Estonia and other Nordic countries. The focus of the conference is on different virtual reality talks, workshops and networking.



9.02 Riga hosts *Tech-Chill*, an annual international innovation and technology conference, which brings together technology sector specialists, media representatives, business people, students, and other interested parties. There will be an exhibition of the ideas and products of the most promising startups in the Baltic States — *Startup Expo*. Forty startups selected by *Startup Expo* will be able to present their products to the audience, which, according to the organizers, will enable them to reach potential clients from the Baltic States, Nordic States and CIS countries, to create new partnerships and to find out expert opinions.



Cover photo — RTU archive

ABOUT MEETING

Science and business present different paradigms. Businessmen and scientists speak in different languages. Business does not realise the significance of scientific discovery. Scientists cannot solve business problems. These and similar statements are heard when scientists and businessmen explain why they do not seek for their partners in business or science environment. Is collaboration really so inert? What slows it down and what can facilitate it? What can the parties obtain through collaboration? What profit will it bring to national economy? When will the society enjoy the fruit of the collaboration? Can every scientist be a successful entrepreneur and is it really needed?

The aim of the journal is to disperse myths about inability and unwillingness to communicate, to showcase success stories, to inspire those who have been doubtful about collaboration. Latvia is the birthplace of global-level innovative ideas, our scientists can solve industry problems not only on the local, but also on the global scale. The youths, whose budding entrepreneurial capacity has not been dried out by studies but has been generously encouraged and unfolded as beautiful flower, are not afraid of taking risks and establishing their enterprises. We should be proud of it! Certainly, we must protect our intellectual property, but we should also overcome our fear about it being derided or stolen. When we were working on the first issue of the journal, Minister of Education and Science Kārlis Šadurskis told us that only those who have nothing to say to the world hide their ideas fearful about them being stolen. Therefore, we want to take pride in and share not only the ideas generated within the walls of Riga Technical University, but also the success stories of other Latvian higher educational institutions, of business achievements and bright ideas at new enterprises. According to Līga Meņģelšone, Director General of the Employers' Confederation of Latvia, a modern enterprise is inconceivable without research in its area and into its product. Without research and development there is only one way — backwards.

Why did we, Riga Technical University, initiate discussion on collaboration? Because, for the university valorisation, which envisages commercialisation of products created at the university and promotion of the results of applied research, their patenting, introduction and usage in establishing new enterprises, is at the heart of the development strategy. As Rector of the Riga Technical University Academician Leonīds Ribicks has emphasised many times, a modern engineering technology and high-tech university cannot develop successfully without valorisation. Moreover, who else if not our own scientists will help our enterprises to create innovative, value added products?

We believe that now, when funding is available for both business start-ups and for the transfer of scientific ideas into business, is the time not only to speak about collaboration but to do it!

**Lāsma Vaivare,
Editor**



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ARCHITECTS OF INDUSTRIAL DIRECT CURRENT NETWORK

text / Lāsma Vaivare
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LETA

The car giant *Daimler AG* is going to introduce a unique direct current power supply system created in cooperation with Riga Technical University, which is energy efficient and allows reducing electricity consumption significantly



The technology transformation era gives an opportunity to manufacture smarter, faster, more efficiently and safer through digitising the manufacturing process. At the same time, it raises a question about sustainability of this process. Increasing of the energy efficiency of robots has been on the agenda of *Daimler AG* for several years. Various components have been improved during the recent years, making the latest generation robots considerably more efficient than their predecessors; to achieve further improvements, optimisation of separate components will not be enough, admits Dāvis Meike. D. Meike, an Assistant Professor at the Department of Industrial Electronics and Electrical Technologies of Riga Technical University (RTU), was the Project Manager at *Daimler AG* within the framework of the EU FP project *Automation and Robotics for European Sustainable Manufacturing (AREUS)*. As the information of the European Commission shows, within the project a smart direct current electricity network was created, where it is possible to restore and accumulate energy, at the same time integrating in the network the energy acquired from renewable sources.

Braking effect

«A robot brakes movement, just like a car. While braking, it doesn't spend energy, instead it can generate,» explains Ansis Avotiņš, a Researcher at the Institute of Industrial Electronics and Electrical Engineering of RTU. RTU was among the participants of AREUS project. The first laboratory where direct current energy was used for power supply instead of alternating current was created here, at the

university. One of the five industrial robot prototypes, which can use and transfer self-generated energy, built by another project partner — German company *Kuka Roboter GmbH*, is now placed in the laboratory and used in studies. Also several electric drive stands were created in the laboratory, which imitate the dynamic operation of any robot. An electric energy converter, which converts direct current into alternating current, a high definition energy consumption meter, and a supercapacitor and lithium-ion accumulating system were developed as well.

The created direct current network allows robots to use their self-generated energy and accumulate it by using the developed supercapacitor and accumulator systems, says A. Avotiņš. Direct current buses also allow, for example, inflow and accumulation of solar energy into the system, continues the researcher. Accumulating systems present a method for reducing energy costs also during power peak moments when electricity consumption is the highest and most expensive.

The result is remarkable — by using the energy recovered by robots and combining it with the energy accumulation system and smart control power supply network, energy efficiency increase constitutes 10—20 %, indicates *Daimler AG* in the Sustainability Report 2016, informing about AREUS project. Measurements in the course of the project were made both at *Daimler AG* and RTU, showing 12—15 % savings, says A. Avotiņš.

First step

«*Daimler* has plants in various countries, in separate plants there are prob-

lems with power network stability, there can be voltage and suddenly it can disappear. Try to manufacture something when electricity suddenly disappears and robots stop working halfway through the process. Technologies are damaged, and huge loss is suffered. Therefore, it is conceded that, for example, when building a new plant, complete transition to direct current network could take place,» says A. Avotiņš. Though it is not expected to happen right now, the developed system can be considered as the first step towards energy efficient and sustainable future manufacturing. As indicated by RTU researcher, «we created the direct current network architecture, but ready products and technologies are required for the introduction of the system in the manufacturing process. If, for example, *Siemens* will manufacture products, *Daimler* will buy them. The university doesn't deal with such business. Moreover, everything is standardised in the industry and time is required for the approval of new technology. The introduction of technology can take five or ten years, nevertheless *Daimler* goes for it».

Although only the first step has been made, it is a very important step, confirms *Daimler AD*, reporting that researchers and engineers have created future components for an energy-efficient car manufacturing system. In addition, the project *DC-Industry*, launched the last year, which is considered as the continuation of AREUS, suggests that products will follow. The project is aimed at creating concepts for ensuring energy at industrial sites by using a smart control direct current network. *DC-Industry* project, which is coordinated by *Siemens*,



ONE OF THE SOLUTIONS FOR REDUCING COSTS

VILNIS RANTIŅŠ

Chairman of the Council of the Association of Mechanical Engineering and Metalworking Industries of Latvia

We are facing an important choice – which way to go. The population of Latvia is as it is, companies suffer from acute shortage of qualified workforce, the competition on the Western European and Scandinavian markets is huge. Majority of Latvian companies are working in large supply chains, they have to find a way for conquering the market and staying on it. How? By reducing costs as much as possible. While working in supply chains, there are three decisive requirements – quality, costs and precise delivery terms. I do not think there is future in supply chains, the future lies in creation and manufacturing of high value added products. It is the manufacturing of end products, not separate components, that creates added value. The role of engineers is of great importance in manufacturing high value added products. Robotisation is one of solutions for the reduction of costs, because, whatever the calculation, a human is the most expensive resource. Robotisation develops and will further develop also because a human is lazy – it's true. There are companies in the industry in Latvia, which are using welding robots, robots at programmed machine-tools.

«The created direct current network allows robots to use their self-generated energy and accumulate it,» says Ansis Avotīnš, Researcher at the Institute of Industrial Electronics and Electrical Engineering of RTU.

Automobile manufacturer Daimler AG widely uses robots.

FOR INFORMATION

AREUS

Partners: Italy, Latvia, Sweden, Denmark, Germany, Finland
 Total budget: 6 million euro
 EU co-financing: 3.68 million euro
 Period of implementation: September 2013 – August 2016

SOURCE: EUROPEAN COMMISSION



DAIMLER PUBLICITY PHOTO



● Researchers Armands Šenfelds and Ansis Avotiņš, the Institute of Industrial Electronics and Electrical Engineering of RTU, and Associate Professor Pēteris Apse-Apsītis, the Department of Industrial Electronics and Electrical Engineering, are satisfied with the electric drive stands created in the laboratory, which imitate dynamic operation of any robot.

involves a number of large companies including *Daimler AG*, *Bosch Rexroth*, *Phoenix Contact*, *Bauer Gear Motor* etc.

Studies continue

Although the direct current system has been developed and approved in cooperation with *Daimler AG* for being used by the *Mercedes-Benz* plant, it can be used also by other companies, including companies in Latvia. A. Avotiņš admits that robots are not yet widely used in manufacturing in Latvia; moreover, local companies are cautious towards investment with a long period of recovery of investment. «Whereas the energy efficiency issue is currently very topical for the German industry,» he adds.

Studies continue also in Latvia. One of RTU projects, with which the university researchers have successfully participated in programme *Support for Commercialisation of Research Results*, administered by the Investment and Development Agency of Latvia, is related to the development of an electricity consumption measuring and monitoring system, which is unique on the global market. This system is intended for large industrial companies, and will allow monitoring, for example, energy consumption of industrial robots, as well as diagnosing the energy network problems, thus helping to optimise the amount of consumed electricity and achieve considerable savings. This system will allow measuring direct current and alternating current of various frequency, thus being adaptable for functioning in any place of the world. A. Avotiņš explains that a robot is very dynamic; the existing measuring instruments, which make measurements

once per minute, give the average, not precise result. The researchers of RTU have built a measuring system prototype, which was tested both at *Daimler AG*, and in Riga. This measuring system can be used by any actively manufacturing company that consumes electricity. In the course of commercialisation process, it is planned to understand market requirements and to create a device with simple assembly.

Also using of the direct current network in households is worth studying.

Among the most significant

«AREUS project is an achievement. A direct current power supply network has not been built in the industry before, there have been separate attempts related to solar panels, but nobody had tried to rebuild a robot for running on direct current. *Kuka Roboter GmbH* was among the first companies to install a different power supply unit, also the converter had to be changed,» says A. Avotiņš. The project has been highly appreciated by the European Commission, which has submitted the project for the competition for the most prospective future technology.

It is a very high appreciation also for the university. «We were a very important partner — the only university of technology. Germany has many strong technology schools itself,» he explains. The cooperation with *Daimler AG* has developed step by step — through contract studies, student internships and successfully developed doctoral theses (e.g. D. Meike) in the area of solving energy efficiency problems, thus proving that RTU is a responsible and reliable partner. ●



RTU PUBLICITY PHOTO

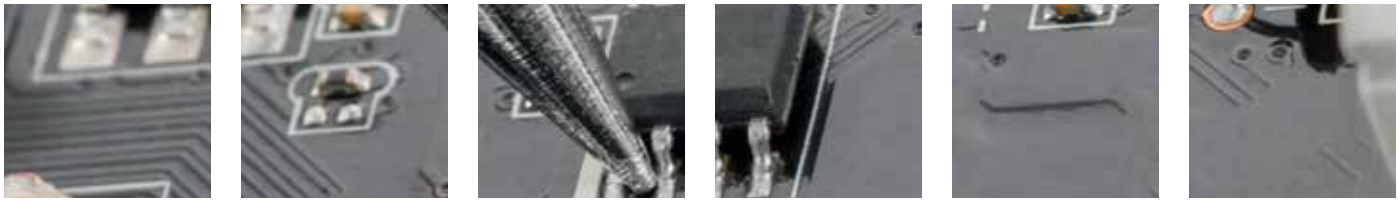
EVIDENCE OF HIGH QUALITY

LEONĪDS RIBICKIS

RTU Rector Academician,
AREUS Project Manager

Scientists of Riga Technical University are highly qualified, which is proved not only by collaboration with the largest companies in Latvia, for example, *Latvenergo*, but also with international groups. It particularly refers to the AREUS project financed by the European Union Framework Programme during which the scientists of RTU in collaboration with such global giant as *Daimler AG* developed a globally unique industrial direct current power supply system. The university was the consortium member and performed the leading role within the project, developing the main power electronics converter for the direct current stage for power supply of a large group of industrial robots.

I am proud of our university and students, who have grown up as scientists and are capable of high-quality implementation of projects at such level and are able to cooperate with local and international companies, solving their problems and making proposals. The technologies developed as a result of AREUS study ensure truly remarkable savings and impressive economy of resources.



The value of collaboration

Business and higher education establishments are willing and capable to collaborate, it is only the question of intensity and motivation of collaboration

teksts / Lāsma Vaivare



«Understanding of collaboration and types of collaboration is very diverse. One of widely recognised ways is apprenticeship, but the best example is the collaboration of scientists and enterprises in solving problems,» says Modris Ozoliņš, Director of Norway-Latvian MBA programme *Innovations and Entrepreneurship* of the Faculty of Engineering Economics and Management of Riga Technical University (RTU). M. Ozoliņš is one of the authors of the development of implementation conditions of research *Examination of alternative models for facilitation measures for cooperation of study process and industry* for measure *Innovation grants for students*, co-financed by the European Union and to be implemented on behalf of the Ministry of Education and Science.

It does matter

Collaboration between higher education establishments and industry is transforming, nowadays it is directed towards the implementation of student innovation projects, practical solution of

challenges for a sector and society, at the same time ensuring the development of entrepreneurial skills and creativity. Latvian higher education establishments have accumulated experience in collaboration, they have study courses and events facilitating the development of entrepreneurial skills and creativity of learners, nevertheless the results are not sufficient. According to the authors of the research «initiative that could ensure facilitation of student innovation, development of entrepreneurial skills (entrepreneurship) and creativity in higher education in Latvia, including collaboration mechanisms for attraction of co-financing from enterprises and transfer of knowledge, motivation mechanisms for students, mutual collaboration of different stakeholders, decreasing of administrative burden, is a set of measures significant for the development of entrepreneurship market in Latvia.»

Starting from 2018 the EU structural funds co-financed measure *Innovation Grants for Students* will be launched in order to facilitate implementation of stu-

dent research and innovation projects, strengthen collaboration with enterprises and attract private financing for the development of innovation skills and entrepreneurship. The Ministry of Education and Science informs that student research and innovation projects should be directed towards practical and real solutions of challenges of the sector and society, applying knowledge in practice and learning by doing. Total eligible financing of the measure is about EUR 38.5 million of which EUR 28.9 million is the financing of the European Regional Development Fund and about EUR 9.6 million is the private co-financing. Professor Kārlis Šadurskis, Minister of Education and Science, explains, that this measure is directly targeted at strengthening of collaboration between higher education establishments and business, because in order to attract financing in the amount of 25 % of the total amount the education establishments will have to look for contacts. Agrita Kiopa, Deputy State Secretary of the Ministry, Director of the Department of Higher Education, Science and Innovations, says



Even if the obstacle is removed, nothing happens if there is no motivation. Collaboration mainly depends on motivation and incentives. The question is open — what they are?

ELĪNA GAILE-SARKANE

DEAN OF RTU FACULTY OF ENGINEERING ECONOMICS AND MANAGEMENT, PROFESSOR

that higher education establishments will have to create a bank of innovation ideas and problems; enterprises will be able to express their interests, but students — to offer the solutions. This is one of business collaboration possibilities, another one is to donate resources being confident that in return there will be a good educational programme, which will develop innovative and entrepreneurial skills of students.

Lack of information

Within the research, when questioning students, it has been concluded that one of the most significant catalysts for developing entrepreneurial skills is a possibility to work in a team, to create and analyse something by themselves. When analysing the questions about incentives that could facilitate the involvement of learners in innovation, two most important factors were mentioned: stipends or other type of financial support and conceptual offer of involvement possibilities. Not least important are the factors of available technical, scientific and mentor assistance, career possibilities in an enterprise and project integration in the study process. Important are also credit points, and a precise and clearly defined process. As the main obstacle for involvement of learners in innovation projects lack of information is mentioned.

Different experience

The overview of information on higher education establishments made during the research allowed to conclude that collaboration with industry exists, however the intensity and type of collaboration and processes and results in each higher education establishment are different. There are higher education establishments where collaboration has been formalised — there are technology transfer centres or contact points, incubators, laboratories, apprenticeships, contracts are concluded

with enterprises. In others, there are programmes, where collaboration is carried out, within the framework of elaboration of student qualification papers, through collaborative lecturers with industry, lectures by invited lecturers, situation analysis of enterprises or case studies performed during the study process.

Higher education establishments are aware of series of obstacles as well as incentives influencing collaboration, for example, there is insufficient capacity — people, who are able to engage in projects, are already overloaded. A hindering factor is also «non-existence of a road map» — both involved parties would benefit from a system to be followed, where separate details would be described. In order to develop collaboration and to motivate personnel it is necessary to have financial support. Academic staff is not always motivated, because collaboration with industry is not giving additional credit, when qualifying for the elected positions of academic staff. Partners still have a lot of unclear questions concerning application of intellectual property rights to joint developments, in addition the existing legal regulation does not stipulate equal conditions for public and private higher education establishment. It would be desirable to decrease the bureaucratic burden that usually exists during the implementation of projects and delivery of results.

Collaboration would be facilitated by success stories, support mechanisms and cross-disciplinary programmes. As an incentive should be considered also the development of new knowledge and skills for learners and university lecturers, development of contact network. Summarising all incentives among the main should be mentioned — development of practical skills and competencies (social, professional) of students, possibility to receive additional financing, develop-

ment of skills of scientific and academic staff, higher prestige of education establishments, possibilities to ensure potential jobs for students, to improve study process, to widen collaboration with industry, to perfect qualification, to commercialise scientific research, etc.

Human is the key

Bureaucracy is seen as an obstacle for collaboration also in separate cases when collaboration is going on with particular, known and verified contacts, it does not seem to be a significant hindrance. Personal contacts and successful previous experience is very important. There are enterprises that are disappointed in competence and motivation of students and consider that projects, which are related to specifics of the enterprise would be too complicated for them. It has also been admitted that enterprises have not highlighted their problematic issues, employees of enterprises are engaging unwillingly or the enterprise in general has no time, human and financial resources. Also as a hindering aspect was mentioned the fact that higher education establishments do not know how to sell their ideas/products.

«Collaboration is carried out between people, not between institutions. If the approach is formal — you have to collaborate and solve problems, if there is no mutual interest, nothing happens. Human factor is important, it is established based on trust built in a long period of time. Trust is earned with deeds, not words,» emphasises M. Ozoliņš. He also believes that «to facilitate mutual understanding one party should try to understand the other. It should be understood that for a student, if he/she is involved in solution of challenges of industry, it is not the only activity, that the student might have different motivation, interest and amount of energy put into this activity. Some of

the interviewed enterprises admitted that during a joint project it can be felt that the enterprise is giving to the student more than receiving back. One should be aware that it may be so: once or twice the enterprise will have greater input, however next time there will be return from the student. There might be situations when the contribution of both collaborative parties has to be given for a longer period of time. Moreover, one should be ready for mistakes. It is typically in our region to consider, that a mistake is a failure. In America a mistake is part of a learning process.»

It turns out that younger managers of enterprises, as well as enterprises with foreign capital are more open to collaboration.

Motivation is a must

Intensity of collaboration depends not only on financial resources, but also on the needs of enterprises — not all of them need to develop technologies. One of the authors of the research, Dean of RTU Faculty of Engineering Economics and Management Professor Elina Gaile-Sarkane, says that «not all enterprises are willing to have innovations, many are looking for the solutions for task optimisation. Optimisation is to be done by their management, not by us.»

The interviewed enterprises as incentives for successful collaboration between higher education establishments and industry mention the possibility to develop solutions at a lower cost, to attract new employees, to influence education process, to contribute to multiplying of common benefit, to provide professional growth of employees of the enterprise, to develop new and innovative solutions by engaging external recourses, competences, experience, skill, support of higher education establishment in defining the challenges, etc. Collaboration would be facilitated by clear communication, concrete offers from universities, information about similar projects, financing activities, changes in the regulatory framework of cooperation, awareness and clarity about issues of intellectual property rights.

Referring to a thesis expressed at the conference of University Industry Innovation Network (an organization, which facilitates interaction and collaboration of universities and industry) E. Gaile-Sarkane admits: «Even if the obstacle is removed, nothing happens if there is no motivation. Collaboration mainly depends on motivation and incentives. The question is open — what they are?» ●

+ Collaboration between institutions of higher education and the industry

PROMOTED BY

- Opportunity to get solution at low cost.
- Opportunity to influence the creation and development of competences for the potential labour market, including student projects, serve as a tool for attracting and selecting new employees, an opportunity to influence the educational process.
- Additional funding is available.
- Existence of a network of contacts and positive experience.
- Flexible involvement of employees in projects.
- Clear communication, concrete offer from the labour market.
- Prestige for both sides.
- Decrease of bureaucratic burdens.
- Lifelong learning — participation in the development of the project ensures the professional development of personnel for both sides.
- Additional benefits to higher education establishments, such as budget places, funding, new study programs, etc.

HINDERED BY

- Lack of resources — people, time, money — on both sides, explicitly in companies.
- Communication problems — companies lack information on opportunities for collaboration, universities — on market demand.
- Lack of competences and/or infrastructure in institutions of higher education from the viewpoint of companies.
- Lack of interest in collaboration, lack of motivation from both sides.
- Lack of understanding, who will be the owner of the intellectual property.
- High bureaucracy, complex organizational process of collaboration.
- Lack of unified structure that coordinates collaboration, lack of methodology for project development.

From the viewpoint of the society — improvement of the economic situation, development or restoration of economic sectors.

From the viewpoint of the institution of higher education — the creation of new knowledge, the development of intellectual capital, the attraction of financial resources.

From the viewpoint of the companies — talent recruitment, fast and cheap solution for company's problems, access to the infrastructure of the institution of higher education.

THE RESULT

Closer connection between the study process and industry – improvement of the business environment, **development of entrepreneurship for young people,** **decrease of unemployment.**

Source: Research Examination of alternative models for facilitation measures for cooperation of study process and industry

Mission possible

Intensifying of collaboration between higher education establishments and business would be beneficial not only to both parties, but also to the economy in general

text / Lāsma Vaivare

«We would like the collaboration between universities and companies to be much more extensive. So that teachers and researchers could assist Latvian companies in introducing contemporary production technologies. Higher education establishments offer good knowledge of the latest discoveries and trends, and we wish them to approach Latvian companies saying: «It is very likely, that five years from now these technologies will be used. We are already preparing students for this, we also can train your employees, help with advice or solution.» This was said by Minister for Economics Arvils Ašeradens, who is confident, that «Latvian enterprises will be able to become rich only by being one step ahead of their competitors — with unique, innovative products.»

Not yet an everyday situation

Statistics and studies show that in terms of many criteria concerning innovation and investment in research and development (R&D) Latvia is far from the average level of the European Union. A. Ašeradens agrees that investment of the private sector in R&D does not achieve the planned results, which mainly can be explained by the fact, that Latvian companies willingly manufacture cheap and simple things. At the same time, the Minister blames universities for not being very active in offering their assistance to companies. Although good examples can be observed, according to the

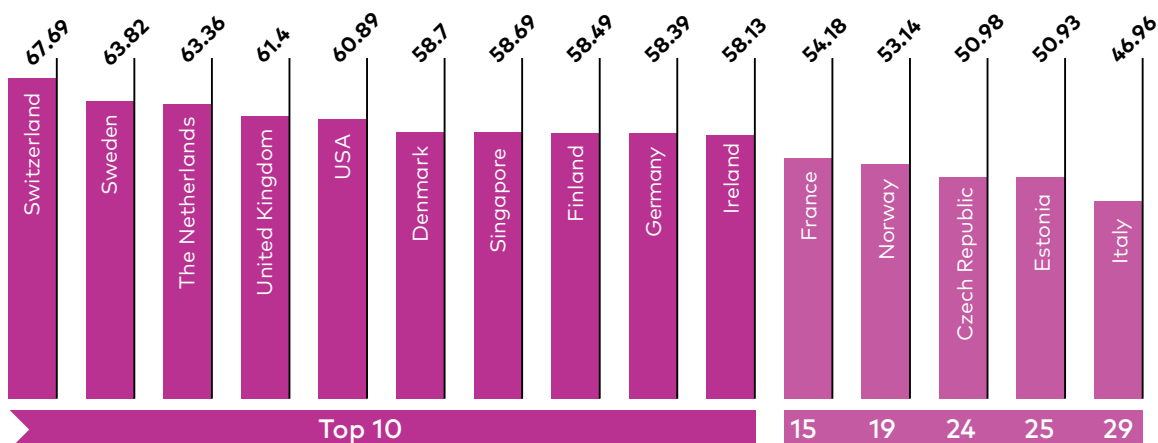
Minister collaboration is still not an everyday situation. «Riga Technical University (RTU) is the leader in Latvia in terms of collaboration with merchants. For example, the drones with carrying capacity of 100 kg have been created in collaboration with *Aerones*. These are the first drones in the world, which can pull a snowboarder with speed 70km/h. These drones will be suitable for using both in sports and also, for example, instead of people during extinguishing of highly dangerous fires. Or, for example, the start-up *Conelum*, which brings together RTU researchers, who have developed a method for fast and ef-

ficient determination, whether there are fungi or mold in food products. A good example is the creation of a unique device during collaboration between the University of Latvia (UL) and *Peruza*, which can automatically arrange fish on a conveyor qualitatively and precisely by using a sensor and image processing, also the practically invisible glass and durability strengthening coatings developed together with *GroGlass*. Other Latvian scientific institutions collaborating with merchants are Latvia University of Agriculture, Institute of Electronics and Computer Science, Pauls Stradiņš Clinical University Hospital, Rēzekne Academy of Technologies, Biotechnical Centre and others,» says the Minister of Economics.

Financial incentives

The Ministry of Economics has several programmes, which are directly addressing collaboration between universities and companies. Until 2020, 430 million euro are available to entrepreneurs, out of which 194 million euro are intended for strengthening of innovation in particular, but the remaining financing is oriented towards the development of technologies and products. «The task of the Ministry of Economics is more complicated than the revision of R&D indicators. The task is to radically change the structure of economy of Latvia, decreasing the number of manufacturers of cheap products and to have more companies, which develop complicated, particularly contemporary products,» explains A. Ašeradens. Through raising awareness about technology transfer and granting financing of EU structural funds for particular projects, The Investment and Development Agency of Latvia (LIAA) encourages

Global Innovation Index 2017



The comparison shows countries with the highest and lowest ratings, as well as countries which, according to CSB data, are the major destinations for the export of Latvian goods and services.

Assessment (0-100)

scientists to collaborate more closely with the private sector.

To step down from the ivory throne

Minister of Education and Science, Professor Kārlis Šadurskis, and Deputy State Secretary of the Ministry, Director of the Department of Higher Education, Science and Innovation Agrita Kiopa agrees, that finances have a significant role in changing the direction in favour of cooperation. Financial incentives are integrated in the university financing model and in support programmes of studies, practical studies and postdoctoral research. «Universities are motivated to step down from the ivory throne and understand, what is required for business, in which direction they have to work. Universities have chosen a good way, but also entrepreneurs have to understand, that it is impossible to raise their competitiveness and productivity without investing in research. The new tax reform, which allows applying zero tax rate to re-invested profit, will be a good incentive for entrepreneurs to invest in development and research. Compared to the average level in Europe, our level of productivity is low; therefore, we have enormous potential for development,» says the Minister. «Universities have developed their own research programmes, assessed their research offer, validated it with companies and have focused their offer more on the directions that are required by companies,» adds A. Kiopa. Asked, whether such focusing is sufficient, she admits: «It is sufficient, considering the state financing for research.»

K. Šadurskis admits, that collaboration between universities and commercial companies could be better; however, it



The state cannot order to collaborate, but we can support those who are doing it. We have defined clearly — the state support will be granted to those enterprises that invest in new technologies, develop innovative products, train employees, and export. And such enterprises frequently develop joint projects with Latvian researchers.

ARVILS AŠERADENS,
DEPUTY PRIME MINISTER, THE MINISTER OF ECONOMY

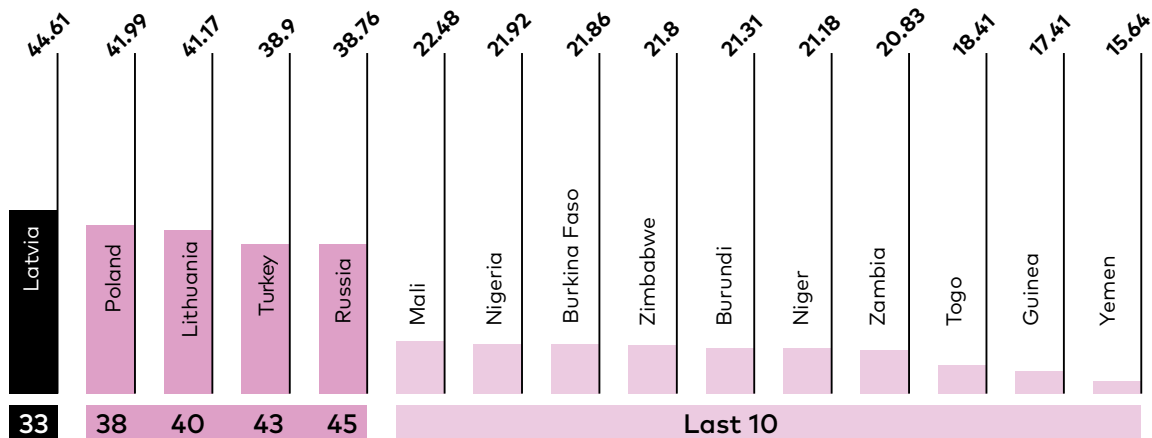
has increased significantly: «Previously there was a great lack of dialogue. Now, many steps have been made in the right

direction, for example, RTU has an excellent project *Dizaina fabrika*. Though it is more intended for students to improve their skills, but what do we need from a young, talented, motivated specialist? It is new ideas and ability to see opportunities for commercialisation of these ideas. Close collaboration with companies in the form of internship is significant with that internship becoming the starting point for further career. Thereby, companies ensure change of generations for themselves,» explains the Minister.

Internship is mentioned as the most traditional, but not the only form of cooperation also by Līga Meņģelšone, Director General of the Employers' Confederation of Latvia (LDDK). She is confident, that collaboration itself is not an innovation anymore, it is standard. «What is the benefit of collaboration? Growth. In turn, growth cannot be achieved by a company, where staff — the most significant company asset — is incapable to perform and is not innovative,» she says.

To be closer

Listing the interrelation points, L. Meņģelšone mentions collaboration in research, mobility of teaching staff and students. «We can learn about early integration of youth in the labour environment from German speaking countries, where dual training is widely used in professional education. We are only now starting to introduce the training based in labour environment. I think, that this approach could be used also in higher education, especially STEM areas (science, technology, engineering and mathematics). Collaboration is necessary in commercialisation of research results, as well as in the de-



Source: Global Innovation Index 2017

velopment and implementation of study programmes. In my opinion, ideally, universities would come to the entrepreneurs' organization, which knows the needs and demand of the sector, to establish, whether the planned study direction is necessary. The second way is the industry itself defining the demand and development of study programme that is to be implemented collectively,» the Director General of LDDK outlines her vision. Closer cooperation could be developed also in lifelong learning, in development programmes, which would help to develop entrepreneurship skills of students and in the area of university management.

In the opinion of L. Meņģelšone, collaboration can be facilitated in several ways, one of the most significant is physical presence, for example, by establishing a technology park in the territory of a university. The collaboration would also be facilitated by promoting success stories, more active communication via sectoral associations, and strengthening of prestige of collaboration. «Successful collaboration with companies would be the quality indicator of a university,» continues L. Meņģelšone.

Insufficient information

Ieva Krūmiņa, Head of the Association of Latvian Young Scientists, holds a view, that lack of information is the main collaboration hindering factor. There is a lack of information on the offer and capabilities of Latvian scientists on the local market, not to mention beyond the borders of Latvia, but science is international. «How a foreign entrepreneur would know, what we can offer, if this information is hidden even from local entrepreneurs? We are working on establishing a unified information system. A for-

0.44

Such % from GDP in 2016 was used to finance research in Latvia.

SOURCE: CSP

FOR INFORMATION

Only every fourth innovatively active company has had collaboration with other companies or institutions in implementation of innovative activities. Suppliers of equipment, materials, components or software are mentioned as collaboration partners more frequently, whereas higher education and scientific research institutions — very rarely.

SOURCE: INFORMATIVE REVIEW INNOVATION IN LATVIA, (CSB)

eign entrepreneur absolutely doesn't care, where the scientist comes from. Whereas for us it is important to ensure, that our scientists are involved in the international network, because we have equipment, machinery, smart people. This information has to be put on the market, so that money starts to flow in,» explains I. Krūmiņa. «When we are speaking about collaboration and synergy between entrepreneurs and scientists, I remember my family gathering, when grandmothers poked the family bachelors: «Isn't it time to get married?» What is the

result of such reminding twice a year? Zero. What has to be done — a situation has to be created, the potential candidate has to be invited from the other party. Speaking by itself doesn't mean anything. A system has to be established and action has to be taken,» she continues.

There is experience

«Collaboration is established both with the largest Latvian companies and with international companies, for example, *Daimler AG, Airbus,*» says Laila Eliņa, Head of RTU Innovation and Technology Transfer Centre. «Last year, RTU has implemented 129 contract works, which is considerably more than in previous years, when this number was approximately 95–96. The technology transfer can't be accounted for so easy, as it includes various activities, such as licence agreements, contract works, projects etc. This competence is successfully developed at RTU and in total seven licensing contracts have been concluded, informs L. Eliņa.

Linda Gabrusenoka, Head of the Technology Transfer Office of Riga Stradiņš University (RSU), indicates: «The increase of the volume of contract studies or ordered studies from the industry from less than two thousand euro in 2008 to on average 200 thousand euro a year at the moment. Studies that particularly stand out in this portfolio are related to the safety of work environment, risks of work environment, antioxidative capacity of products, testing of cosmetic products and household chemicals, and services in molecular biology.»

«Scientific work of RSU is basically carried out in such areas as medicine, pharmacy and rehabilitation, where potentially commercialisable products or services are

Whether and to what extent companies and universities in the country collaborated in the area of research and development (R&D) in 2016?



Data on countries with the highest and lowest assessment, as well as on countries, which according to the data of the CSB are the largest destinations of Latvian products and services export, are used for comparison. comparison. Assessment, 7 - cooperates intensively, 1 - does not cooperate.

*Data of 2015

created; however, it has to be taken into consideration, that elaboration of such developments or technologies take ten, in separate cases even more than 15 years, and requires huge financial investments of up to several hundred million euro, for this product to enter the market. We are proud of each development, which has turned into a real product,» states L. Gabrusenoka, mentioning pharmaceutical products *Fitesten* and *Glycomune*, as well as fermented skimmed milk product *Labdaris* as examples. Among RSU achievements in the last year L. Gabrusenoka mentions assuring the global pharmaceutical company *Pfizer* of capabilities of the university.

In order to even more strengthen the collaboration, broader awareness of the industry is necessary about what our scientists are capable of: «Sometimes, representatives of business environment have bias that we are dealing only with «high» science and our researchers are not interested in looking for simple, practically applicable solutions. The older generation of entrepreneurs has similar perception — science is for free.» Uldis Berķis, Director of RSU Science Department, Associate Professor, adds: «For a company such collaboration potentially increases the added value of product or service, which also means higher profitability. In turn, the benefit to the university is the opportunity to implement the so called third mission, namely, in parallel to the academic and research activity the university can ensure transfer of knowledge and technologies. This concept has experienced significant development in the last ten years in Latvia and has become self-evident not only in various strategic documents, but also in the daily activities of universities.»



Money follows an idea. In the moment when there is an idea and a team able to implement it, the money will be found. There is a lot of money in the world awaiting for ideas. The task of universities and companies is to promote generation of ideas.

LĪGA MEŅĢELŠONE,
DIRECTOR GENERAL OF THE EMPLOYERS'
CONFEDERATION OF LATVIA

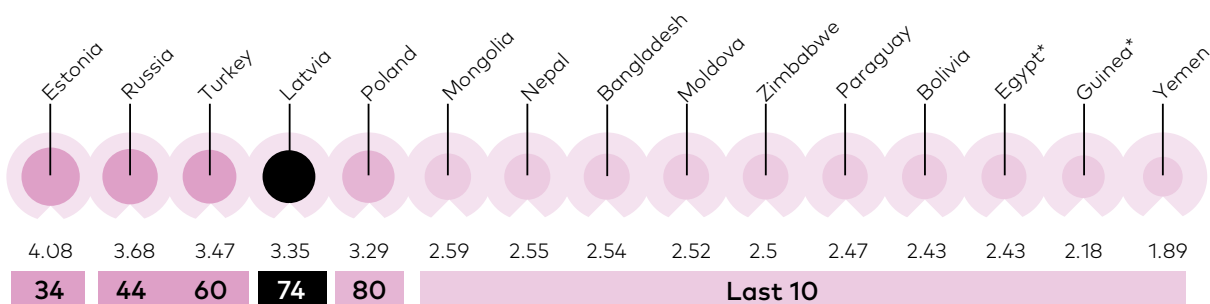
Faster results

Sandra Muižniece-Brasava, Head of the Technology Knowledge Transfer Department of the Latvia University of Agriculture (LLU), Associate Professor, indicated at the innovation and technological innovation festival *Inovuss*, organised by LIAA,

that collaboration with researchers allows companies to achieve results faster: «*Cereal Milzu!* is a success story. Entrepreneur Enno Ence previously was not related to the food production business. He came to us, scientists, knowing very specifically, what he wanted to achieve. If he had proceeded this way all by himself, the product definitely would have not reached considerable turnover on the Latvian market and export to several foreign countries so fast. Our scientists attend not only scientific events outside Latvia, but also various events for collaboration with companies. They have accumulated valuable knowledge, very often a scientist needs only a short moment for reflection to find new solutions for problems of a company».

Universities are not sitting on their hands awaiting, when business will find them. S. Muižniece-Brasava tells, that also various events and seminars are attended, introducing people to what university can offer. This is indicated also by Marketing Specialist and researcher at the Department of Communication and Innovation of the University of Latvia (UL) Mārtiņš Boroduškis. The UL has itself intensified its search for collaboration, the university participates in seminars of sectoral associations and LIAA and has created a special website. «Each week we are speaking with several companies about specific studies. We know all external instruments, we also have an internal instrument — UL Efficient Collaboration,» he continues. For successful collaboration «it is important, that during negotiations with an entrepreneur there is a knowledgeable person on the part of the university. Translators are needed between a company and scientist,» admits M. Boroduškis. ●

LDDK PUBLICITY PHOTO



IN BALANCE

BETWEEN SCIENCE

AND BUSINESS

text / Lāsma Vaivare
photo / Edijs Pālens, LETA, personal archive

Having changed the scientific assistant's white overall for an official costume, Katrina Krivenko is sending a technology made in Latvia to a mission to the Moon

Katrina Krivenko is the European Space Agency project manager of start-up *Eventech*. The company is known as the success story of platform *Commercialisation Reactor*: in 2016, in cooperation with the Institute of Electronics and Computer Science and the Czech Space Research Centre it managed to attract a contract of 400 thousand euros with the European Space Agency on development of application of the multi-purpose event timer for needs of space but this year an agreement with the British space technology company *Neptec*, which cooperates with NASA, the European Space Agency, *AirBus*, the British Space Agency, etc., was reached. The company was entrusted with the task to develop a component of spacecraft *Luna-27* landing system — laser scanning or LiDAR (light detection and ranging) sensors. The sensors have to provide high-resolution 3D Moon surface images in order to help finding a safe spacecraft landing site. The Moon mission is scheduled for 2021. *Eventech* is a spin-off company, it developed in collaboration with the Institute of Electronics and Computer Science and licensed the Institute's technology, which was invented by investigator Jurijs Artjuhs 40 years ago. Jurijs Artjuhs, who has passed away, invented an event timer, which ensures high-accuracy measurements. After his death, scientists Vadims Vedins, Vladimirs Bepajko and Jevgeņijs Buls continued developing the idea.

Being among space researchers and entrepreneurs, it is important for K. Krivenko to maintain femininity and generate discussion about women's place in the science and technology industry. She has



At the moment, the circumstances, the environment supports creation of ideas. You have to believe that the idea may succeed and you have to be proactive. And you have to do it by yourself.

KATRINA KRIVENKO
THE EUROPEAN SPACE AGENCY PROJECT MANAGER OF
START-UP EVENTECH

not always been in the business — Katrina has studied chemistry, she has been a scientific assistant in the Latvian Institute of Organic Synthesis and has even thought about a doctoral degree.

You have been described as an experienced business process manager with academic background. How would you describe yourself: are you more involved in business or in science?

Today, I associate myself with business but, if I would not have a scientific experience, it would be very difficult for me to

do what I do. In the business, I am related to management of scientific projects.

I am not longer focused on the academic since although there was a time when I thought about doctor's degree... The breaking point, when I decided to leave the Latvian Institute of Organic Synthesis, came when I faced the situation — today you have the work but you may lose it in a couple of month because the project is coming to the end — for the second time. When you are a young student, you can have such a life, but not later, no matter how big is your love to the science. People should not be afraid of changes in their lives.

You have studied chemistry. Why did you choose it?

I loved the exact science a lot but I never got the highest rating in physics at school although all guys in the class were writing off the answers from me. I could not because I am a girl. I chose to study chemistry; moreover, when I was looking at companies as *Olainfarm*, *Grindeks*, I saw a possibility to apply it in practice.

During the studies I came to the Latvian Institute of Organic Synthesis, participated both in scientific and commercial projects. Then I went to work for *Grindeks* and then for *Sandoz*. I was the medicine registration specialist in both companies but I did not see a great potential for growth; moreover, I noticed the lack of pharmaceutical education. I felt the need to change my life again, and I chose to return to the university and to study business economy. Shortly after I received an offer from the *Commercialisation Reactor*.

CV

Katrina Krivenko

— Education

Master's degree in organic chemistry, bachelor's degree in business economy

— Work experience

Currently, the space project manager of SIA *Eventech*, head of SIA *Snap Latvia*

Has worked with the *Commercialization Reactor* before, where she was the project manager of companies *Conelum*, *Spatial Initiatives*, *Aminostream*. Has worked as a medical product registration specialist in *Grindeks* and *Sandoz*, scientific assistant in the Latvian Institute of Organic Synthesis

SOURCE: KATRINA KRIVENKO

In the Commercialization Reactor, you were appointed to Eventech team as a business process manager?

At that time, I did not have a specific project management experience, so I became the assistant manager for a number of start-ups, I helped with everything that was needed. Over time, I reoriented to *Eventech* only. Now I have slightly changed the business orientation again, and in *Eventech* I am working only with the space project, which is being implemented on bases of the contract concluded with the European Space Agency. In parallel, I am managing *Snapchat* subsidiary company in Latvia — I work for *Snap Latvia*.

Would you like to return to the science?

I think a lot about it. I feel that it is a difficult time in the chemistry science, there are a lot of substances in the medical market, which are being intensively used. A giant work is not enough to discover something new, you need luck. I see the big pharmaceutical manufacturers choosing to buy research as an outsource service; they are looking for medicine start-ups, which have discovered an active substance and work on the base of this discovery. What is the guarantee that it will be the pharmaceutical company's laboratory where researchers — no matter how brilliant they are — will come to the correct molecule? While you are a student, conclusion of a study with «no result» is the result as well, but in a company, a negative result is not enough. Of course, you can deal with the fundamental science but, to some extent, it is the work «for paper». Important publications

in a magazine as prestige as possible, but it is the same there as well — no one rushes to publish a study that has concluded without a result.

Can we say that today you feel more comfortable in the business environment, acting to some extent as a connecting element between science and business?

I wouldn't say that there are some comfort zones in business. You have to do the maximum every day here as well because as soon as you sit deeper into the chair, you miss the right moment. Therefore, you have to keep yourself in a continuous stress, think ahead and be proactive. You have to

understand technologies and their application, you have to know how to talk both with partners and other scientific institutions, the scientific community, because scientists will not do it. I love to achieve results. In business I see that I manage to achieve a result, and it encourages me to move on. The scientific basis is very useful. All young people have to learn physics, chemistry, engineering, etc., because technology is everywhere and it will be even more, and technical education will always be of high value in the labour market.

You said that as business process manager you have to understand technology, with which the company works.





Eventech team — Jevgeņijs Buls, Vladimirs Bepaļko, Katrina Krivenko and Vadims Vedins — at the timer, which provides high precision measurements.



Nikolajs Adamovičs, head of the platform *Commercialisation Reactor*, is to a great extent responsible for the successful marketing of *Eventech* technology

Are you aware of the space technology?

It is not so simple. *Eventech* product is one of the components for the landing system in the space mission. *Eventech* provides a part of the hardware, which will be used for very precise measurements of the distance to the Moon surface, in order to facilitate the landing. If we are talking about the complete device or the entire space mission project, even scientists do not know all the details perfectly — each has specialized in his or her own field — and you cannot ask it from people with a different operating profile.

Is the contract with the European Space Agency your merit?

I helped. It is the merit of Ģirts Ozoliņš, who was the executive director of *Eventech* at that time. With signing of the contract Mr. Ozoliņš decided to leave the company, and I took over the obligations.

Thus, the implementation of the project is your merit.

We all are working actively as a team, also Nikolajs Adamovičs, the investor and head of the *Commercialization Reactor*. My merit is the promotion of recognition; in the industry, our technology and the company is already know in the world market. The contract with the European Space Agency, which was concluded in the beginning of 2016, is valid for two

FOR INFORMATION

The *Commercialization Reactor* is a Latvia-based international deep-tech technology commercialisation platform aimed at developing of new businesses based on scientific and technological success.

SOURCE: COMMERCIALIZATION REACTOR

years. We have to complete the technology until the beginning of next year. The contractual sum is the biggest in Latvia by now — 400 thousand euro. We have succeeded in finding partners abroad, we cooperate with the Institute of Electronics and Computer Science in implementation of the project.

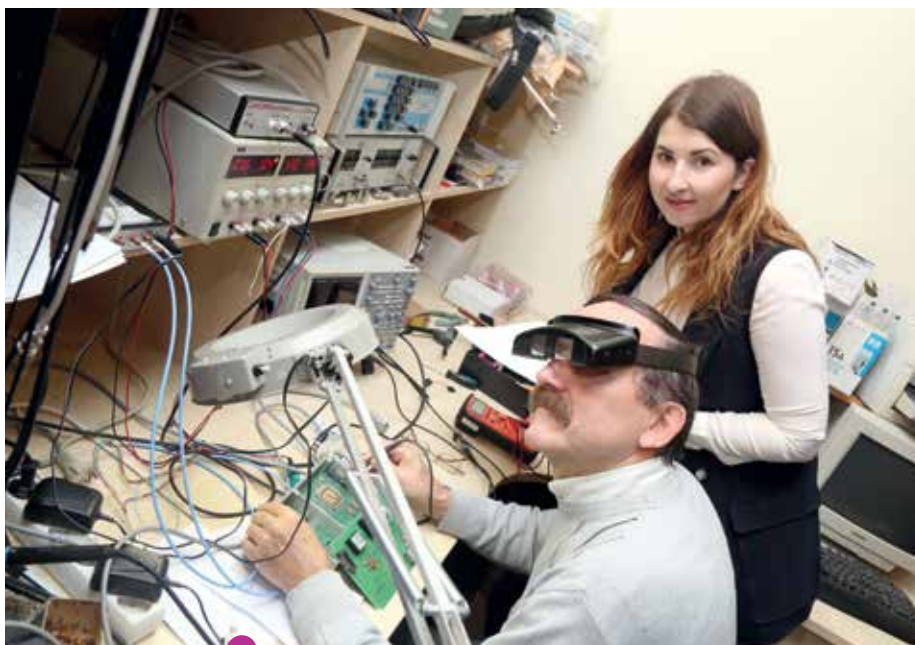
Are you looking for other markets and applications of the technology?

It is the daily work. The space project is the result of the daily work. Many areas do not require such precise technology as the one offered by *Eventech*, which is a timer with a picosecond accuracy; it is enough with accuracy of up to nanosecond or even microsecond. The primary application of the timer is navigation of satellite lasers; since 2011, when the company was founded, we have conquered more than 50 % of the world market of such application already. It can be used not

only in landing technologies, but also in transferring information from one satellite to another, in synchronization tasks between the satellites and the Earth, and other applications.

The technology is not new, its roots lie in the invention made by researcher Jurijs Artjuhs in the Institute of Electronics and Computer Science 40 years ago, but it was commercialized only now.

Jurijs Artjuhs came to the *Commercialization Reactor* by himself, which is not a very common practice. Usually, scientists are addressed, and they may refuse to cooperate. The idea of the *Commercialization Reactor* seems great to me — do not hide your invention, your success, share it to produce a product, that will be used by the industry instead of remaining on the paper only for the accounting in a table drawer. Mr. Artjuhs wanted to make the technology well-known and to find other applications; at that time, the Institute of Electronics and Computer Science had several partners already. The institute scientists had a close cooperation with the specialists of the Institute of Astronomy of the University of Latvia; when examining the technology, the findings were surprising — very precise measurements can be obtained from the first time already, you do not have to repeat the measurements for several times and then



Jevgenijs Buls and Katrina Krivenko have something to be proud of — a timer whose primary application is satellite laser navigation, which since 2011 has conquered more than 50 % of the world market of this application.

to calculate the average. Consequently, the technology can be applied to moving objects — satellites — successfully. The technology was assessed by NASA and the International Laser Ranging Service as well. In mutual communication, the industry experts learned about the technology, and an interest rose about it. This is considered the beginning of the commercialisation. *Eventech*, by taking over the technology, continues to promote it, to search for new markets. I am very happy that this is the Latvian success story.

How often success stories of commercialisation of scientific inventions can occur in such a small country as Latvia?

IT is a science as well; there can be a lot of success stories in this industry rather often, for example, the visual presentation platform *Prezi* purchased Latvian company *Infogr.am* this year — it is a success story. During the recession years, people left the country, depopulation refers to the success, while the absence of investment does not allow purchasing of modern equipment. This also limits occurrence of success stories. The objective must be to raise the scientific achievements' level in the country — it is the basis for giving birth to success stories.

A scientist and a business must meet, and then we can speak of a

possible success story. Are they ready to meet?

It is difficult to meet. The *Commercialization Reactor* is a platform where to meet, universities have technology transfer centres, there are incubators, there are various options offered by the Investment and Development Agency of Latvia. We have to speak about educating scientists more.

Are you saying that we have to teach scientists to speak about their research?

Scientists are often passive and want to remain passive. There is a cooperation platform, but why all scientists do not rush to use it? There are researchers, who are afraid that people will criticize the idea they have cherished. Yes, it is possible, in development of any start-up there are moments, when you can make some modifications, when the business tells scientists what they have to do.

How big is the role of the team?

A big one. The investor assesses it; and, it is important to the investor to be sure that the team is competent both in science and business. The research is as a child to the scientist, he or she has to stand for it with all of his or her heart. The business process manager in the team has to feel the same, he or she in the team has to be the driving force. ●

«I have titanium wires implanted in my body so that I can feel the magnetic field of the planet. Now cyborgs may scare the people. The digital environment in the middle of 1990s seemed to be a threat to the music industry. But what initially seems to be sinister afterwards turns out to be a benefit to a mankind.»

*Cyborg, co-founder of Cyborg Nest,
SCOTT COHEN*

«Technology allows not only to solve the problems, but also to be ahead of them.»

*Entrepreneur, lecturer, innovation activist,
CECILIA THAM*

«For me the inventor is the synonym for the term scientist. His work is to invent. Researchers may not always be successful in doing business. You need to be able to find people who are doing business by continuing to make inventions by the scientist - that is his strong aspect.»

*Entrepreneur, founder of the Institute of Environmental Solutions,
GUNDARS SKUDRIŅŠ*

«Small countries have big advantages, they can become very strong in the field of innovation.

You have smart people, you have a desire to do. In small countries, it is much easier than in big ones to develop an ecosystem where people from different fields - industry, higher education, government, army, etc. — can meet. Being in Latvia for the third time, I have come to the conviction that there is not much that is needed to make this country a significant player in the field of innovation on a global scale. The move has to start with young people who are ready to risk and make mistakes again and again until a success story will be reached. Success promotes the success, start with small success stories and build them bigger and bigger.»

*Entrepreneur, cyber security expert and advisor,
MANNY BARZILAY*

START-UP ECOSYSTEM

BUSINESS INCUBATORS

Incubators provide support to private persons and micro, small and medium enterprises for starting and developing business activity by providing consultations, training and events on general business issues, mentor support, premises and co-funding for business activity expenses

Creative Industries Incubator in Riga
Provides support to the existing, new and upcoming enterprises working in the sphere of creative industries. Territory of activity – entire Latvia.

PUBLIC AUTHORITIES

Ministry of Economics
Policy maker

Investment and Development Agency of Latvia (LIAA)
Policy executor; aims at becoming the one-stop agency for start-ups.

FINANCIAL INSTITUTION

Altum
State development financial institution. Administrates acceleration programme managing 15 million euro for innovative start-up business ideas, business and product creation and development, aiming at facilitating their growth and competitiveness, especially for technological and industrial projects. Funding is available through three acceleration funds. It is envisaged that 60 million euro will be available for an additional acceleration programme.

FINANCING FOR GROWTH

€ 15 mill.

+

€ 60 mill.*

*planned 2018

BI in Ventspils

BI in Kuldiga

BI in Liepaja

15
Business Incubators in Latvia

TOTAL PLANNED FUNDING

€ 30.8 mill.

INCUBATOR PROJECT

is on until 2023

For information: the most active representatives of start-up ecosystem are mentioned
Source: LIAA, publicly available information

PUBLIC ORGANISATIONS

Latvian Start-up Association (StartIn)

Public organisation established in 2016 to develop the ecosystem of Latvian start-ups, to popularize the start-up movement in Latvia and in the world and to protect their interests.

Latvian Business Angel Network (LatBan)

Public organisation. Aims at widening and developing investor network in Latvia and supporting new and promising projects. It is not limited to start-ups. *Business Angel* is an experienced investor in business and invests its private funds in business projects. It supports start-ups with potential of rapid growth and at the early stage of development.

Latvian Private Equity and Venture Capital Association (LVCA)

Public organisation, brings together the largest companies working in the sphere of venture capital in Latvia. By investing finances in an enterprise, venture capital fund becomes a co-owner, thus undertaking part of business risks, but also expecting payback corresponding to higher risks.

EDUCATIONAL ESTABLISHMENTS

Riga Technical University

Educational establishment, *Idea Lab, Design Factory* – a place where ideas of scientists and students are turned into prototypes due to technological capacities.

University of Latvia

Educational establishment, student business incubator.

Stockholm School of Economics

Educational establishment, business support centre.

RISEBA

Educational establishment, creative business incubator.

Banku augstskola

Educational establishment, student business incubator.

Biznesa skola Turība

Educational establishment, Business HUB.

PLATFORMS

TechHub Riga

A community of start-ups, co-working space for technological start-ups.

The Mill Riga

A community of start-ups, established as a co-working space for designers and programmers.

Oracle Tang Space

A community of start-ups, co-working space.

Teikums

A community of start-ups, co-working space.

Riga Venture Summit

Forum, international start-up eco-system policy development round table.

TechChill

International conference on innovation and technology.

Digital Freedom Festival

International festival of technologies, start-ups and lifestyle.

Startup Slalom hackathon

48-hour event aiming at stimulating the generation of new and innovative ideas by IT, marketing and design specialists and start-up enthusiasts.

Startup Wise Guys

One of the largest B2B accelerators in Europe.

Commercialization Reactor

International technology commercialization platform aiming at generating new enterprises based on scientific and technological achievements.

RIGA

BI in Talsi

BI in Jūrmala

BI in Jelgava

BI in Bauska

BI in Sigulda

BI in Ogre

BI in Jekabpils

BI in Valmiera

BI in Madona

BI in Rēzekne

BI in Daugavpils

To look under human skin

text / Lāsma Vaiivare



«I want to build something big and permanent — it can be a huge granite monument and can be a successful company,» says Sandis Kondrāts, the manager and co-founder of the start-up Anatomy Next. As a sculptor he has engaged in the business of medical education technology.

Anatomy Next offers an interactive application, which helps to learn human anatomy in three-dimensional (3D) format with augmented reality possibilities, for future medical and healthcare specialists. Currently, the application allows to study human head and neck in detail, revealing bones, nerves, muscles and organs layer by layer. As stated by S. Kondrāts head and neck in their complexity comprise a half of human body. It is planned to finish also the rest of the body by the end of the year. The next step is creation of a simulator which will allow to practise the acquired theoretical knowledge and to learn carrying out surgeries in virtual environment. «We are living in the 21st century, but the way of training of future medics doesn't significantly differ from that in the 17th century. Our aim is to change it. Residents are still learning and making mistakes while doing surgery on people. Mistakes have to be made during training, but they can't leave a negative impression on real people,» emphasizes S. Kondrāts.

The application is tested and used by medical students in Latvia and USA, and pilot projects also have been carried out in several European countries. The company successfully participates in various competitions, and it will represent in the competition of start-ups *Creative Business Cup* in Copenhagen in November.

First, there was a book

Anatomy Next has grown from an idea of the company co-founder, sculptor Uldis Zariņš, about creation of visual learning aids for artists. S. Kondrāts says that it is easier to il-

lustrate a human body with visual materials. The book *Anatomy for Sculptors* was created. The book reached a medicine professor of the University of Washington who looked through it and approved it as being useful for students of medicine, whose level of studies drops, who are bored and have gotten used to interactive, visual information. This was the first indication. «Step by step, our attention switched from artists to medics. The breaking point was when we realized that we can help the artists of the animation studio *Pixar*, but it is not big deal if they make a mistake, for example, illustrating a human nose, but, if such a mistake is made by a doctor, the quality of life of a person is impacted a lot,» admits the co-founder of *Anatomy Next*.

When asked about how much time did it take to develop the product, S. Kondrāts lists: creation of the first book took one year; two years for the next book, which already had 3D images; plus an application for artists was created, which served as a basis for building the application for medics. Financial resources were attracted both in *Kickstarters* campaigns (for books) and in the form of risk capital, for example, in this year 500 thousand euros are attracted. It is planned to attract another 2.5 million euros. S. Kondrāts admits that investment is mainly required for marketing and sales activities in USA. USA is the target market of *Anatomy Next*. S. Kondrāts has lived and worked there for a long time and still travels between Latvia and USA. He says, «USA represents one half of the global money for medicine; it has one language. There is practically no market in Latvia. Of course, Latvia will benefit from the fact that we develop the product here, so Latvian universities will be the first to have the opportunity to try it out. We are submitting an application to the EU research and innovation programme *Horizon 2020*, and, if we receive support, we will use these resources to prepare the product for European market. The problem of Europe is many languages, huge bureaucracy and fear of everything new.» S. Kondrāts refers to calculations showing that the value of global market of medical and healthcare simulators is estimated at approximately 1.2 billion US dollars, and half of it is in USA. Considering the extensive market opportunities, the

BUSINESS CV

Anatomy Next

Owner: Exonicus, Inc, a company registered in USA

The company registered in 2015

Turnover in 2016 — 69.2 thousand euros

SOURCE: LURSOFT, PUBLICLY AVAILABLE INFORMATION



company believes that its turnover in 2020 will already be 20 million euros. «It is absolutely realistic; it is even a minimum,» states S. Kondrāts.

In Latin

The development of products was started in USA but was moved to Latvia; one of the reasons was that there are much more opportunities for cooperation with medics. «In USA it is impossible to attract medics for building a product — huge salaries, heavy workload. Here in Latvia medical professionals and students see an opportunity in the product to improve their knowledge and are much more responsive. There are great, smart people,» the co-founder of *Anatomy Next* is pleased to admit. He mentions several medical professionals — radiologist at Pauls Stradiņš Clinical University Hospital and lecturer at the Faculty of Medicine of the University of Latvia Jānis Šavlovskis, the Head of the Heart Surgery Centre of Pauls Stradiņš Clinical University Hospital Pēteris Stradiņš, who even invited *Anatomy Next* to attend a surgery, and lecturer at Riga Stradiņš University, dentist, mouth, face and jaw surgeon Kaspars Stāmers.

In the presence of medics artists have drawn the ideal, completely healthy person layer by layer based on depersonalised radiology data, while also removing various pathologies. The greatest value of *Anatomy Next* is exactly its multidisciplinary team of professionals. «Usually, there is a 3D artist who doesn't understand anything from medicine and a medic who conversely doesn't understand anything from 3D art; there is a medic who doesn't understand anything from programming and a programmer who doesn't understand anything from art and medicine. We have created a team, where a medic understands the principles of 3D art and programming, whereas a programmer has good knowledge of art and medicine, and an artist communicates with medics by using Latin terms,» says the co-founder of *Anatomy Next*. He himself has not acquired Latin but instead learned business terminology in order to be able to develop business. The author of technical solution and one of co-founders of the company is Jānis Kondrāts, the brother of S. Kondrāts and a graduate of Riga Technical University. ●

I LOVE ANATOMY

JĀNIS ŠAVLOVSKIS

a radiologist at Pauls Stradiņš Clinical University Hospital and a lecturer at the Faculty of Medicine of the University of Latvia:

I love anatomy — it is my main motivation to join the team. I am an invasive and diagnostic radiologist, so during my daily work at the hospital I have an opportunity to see anatomy of living people in a way that was not possible earlier — before the invention of computed tomography, magnetic resonance and digital subtraction angiography. However, both preliminary knowledge and specialised software is required to be able to see beauty in radiological images. All I want is that more people would have an opportunity to see what I see. The greatest value of *Anatomy Next* is the level at which the project is implemented. It is very high. 3D models are geometrically far more precise than anything created before. The content is planned to be implemented at a very high level also in terms of didactics. If everything goes well, the end product will be a full-fledged training tool.

TEAM FORCE

RŪDOLFS KRESE

Investment Director of ZGI Capital, member of the national jury of the competition Creative Business Cup:

The company has a very strong team, which combines medical, design, marketing and sales specialists. The strong side — the product is demanded by the market; it serves to solve specific problems, and clients are paying for it. The product has high aesthetic value, and it is pleasant to use. Majority of investors worldwide invest in their own region; there it is easier to supervise companies and give advice to them. It is great if an investor can be found or experts can be attracted in the country with greater market potential. The value of medical sector market of USA is estimated at trillions, and I wish *Anatomy Next* would conquer this market. The investment success is not determined by the sector in which a company operates. The positive aspect in the education industry is that it is a growing sector, which is taken over by technologies. Overcoming the long sales cycle will be a challenge for new companies that start their business in this sector. They have to learn how to show that their product is better, faster, more convenient, why someone should start using it and pay money for it.



One of the mechanisms that allows a person to act on the basis of «common sense» is emotions and related processes; thus, this could improve the computer system's ability to make decisions, says RTU Associate Professor Egons Lavendelis, Scientific Assistant Sintija Petroviča, Associate Professor Alla Anohina-Naumeca and Scientific Assistant Māra Pudāne.

Why computer systems need emotional intelligence?

Modelling and simulation of human reasoning is an important task of artificial intelligence

*text /Alla Anohina-Naumeca and Egons Lavendelis, RTU Associate Professors, Sintija Petroviča and Māra Pudāne, Scientific Assistants
photo/ Edijs Pālens, LETA*

This evening Jānis has decided to complete the report, but computers are all Greek to him. He attempts to fill out the form several times, but it turns out that something is missing each time at the confirmation step, and the previous input of information disappears. «Preposterous system!» he mutters to himself and starts to press his computer keys even stronger. In anger he accidentally clicks the mouse twice in one place thus closing the system. «I will not do it again» Jānis screams at the computer, and annoyed he dials the number of the bank on the phone. «Hello, nothing works for me again!»

Such situations are not rare. If the computer system would have been able to

realize that Jānis was annoyed and was able to help him, the work would be done quicker, better and without unnecessary nervousness.

What is affective computing?

There do exist such artificial intelligence systems that think and act rationally and such systems that behave like a human being. These groups differ from others also by the ability to model emotions, which, moreover, is a significant difference between a human and a computer. At the dawn of the computer era, when computers were found only in universities and companies, the presence of emotions in machinery was not important. With the

arrival of computers in our homes and pockets, the requirements have changed.

First of all, the emotional intelligence is the ability to understand and use our emotions effectively; secondly, it is the ability to understand and to help regulate emotions of others. In the past the emotions were seen as a negative side effect of rational thinking, and therefore the concept of emotional intelligence arose relatively recently – with the discovery that emotions are an important driving force in the decision making process and allow to make decisions within a certain time and with limited computing resources. In 1997 Rosalind Picard defined the concept of affective computing. It is an interdisciplinary

field that combines and uses the methods and technologies of psychology, artificial intelligence, sociology, robotics and other fields. It studies the retrieval of emotions from a human, their origin, imitation and generation, as well as the use of emotions in order to adapt the behaviour of the computer system to the user.

Affective computing allows not only to improve existing solutions but also opens the door for creating new ones. Department of Artificial Intelligence and Systems Engineering of the Faculty of Computer Science and Information Technology of RTU (FCSIT DAISE) is the only one in Latvia doing targeted and long term research in the area of Affective computing. The research was initiated in 2008.

Emotions in intelligent tutoring systems

One of the first directions that has occurred in the artificial intelligence industry is the development of intelligent tutoring systems aimed at imitating a teacher. The development of such tutoring systems is an interdisciplinary field, and it is not possible without close cooperation among teachers, psychologists and computer specialists. Initially, intelligent tutoring systems were rigorously rational like any other computer systems, but emotions in life are one of the cornerstones of the learning process. If the person lacks the capacity to feel emotions, intellectual functions are also blocked. Both in science and in practice, it has been proven that positive emotions contribute to creativity, to motivation to learn and to work. However, in the learning process we are often faced with negative emotions.

We are saying that a good teacher must be able to recognize and understand the emotions of his or her students, and to respond accordingly. When a student studies with the help of an intelligent tutoring system, emotions emerge similarly to studying with a real teacher, but there is a lack of essential component – the teacher's emotional intelligence that helps to reduce the impact of negative emotions and increase positive ones.

One of the main areas of research at which the developers of intelligent tutoring systems are focused is the recognition of emotions, but what to do with the acquired emotions? DAISE works in this direction, in particular focusing the attention on adapting system's behaviour to the student's emotions. This is another equally important step towards full functionality of the system. Now, the main

FOR MORE INFORMATION

For further reading

__Picard, R., *Affective Computing*, MIT Press, 1997.

__Petroviča, S., Anohina-Naumeca, A., Ekenel, H.K. *Emotion Recognition in Affective Tutoring Systems: Collection of Ground-Truth Data*. *Procedia Computer Science*, 2017, Vol.104, p.p. 437-444

__Pudāne, M., Radin, M., Brooks, B. *Emotion Contagion among Affective Agents: Issues and Discussion*. In: *Proceedings of 9th International Conference on Intelligent Systems and Agents (ICAART 2017)*, Portugal, Porto, Feb 24-26

research work is devoted to the development of a multi-level tutoring adaptation approach in which the user's emotions, their recognition and proper response to them form an essential aspect. One of the goals of the approach is the ability of the system to adapt to humans with different personalities because personality directly affects the emergence and manifestation of emotions.

In order to evaluate the effectiveness of the developed approach, parallel the work is carried out on the implementation of the educational game integrating the identification of the user's emotions from the data of the video recorder. Regarding the recognition of facial expressions and emotions in 2015 and 2016, successful cooperation with the Istanbul Technical University (Turkey) was also carried out. The system to be developed will be an important step towards truly emotionally intelligent tutoring systems that can adapt to the personality and emotions of any student creating the impression that communication with a real person is taking place.

DAISE also examines systems that really «feel» emotions not just express them. Such systems are used to simulate humans in order to display the behaviour and to make decisions that are characteristic of humans even if they are not the «correct» ones or rationally superior.

Modelling of a group

Modelling and simulation of human reasoning is an important task of artificial intelligence for several reasons. Computer systems nowadays are still very limited. Questions and tasks that seem simple or

even trivial to humans (for example, to select milk at the store) are often not practically performable by computer systems. This is partly due to hardware constraints; for example, the robot does not have «hands». But the ability of a computer system to simulate human decision making is just as important. It is believed that one of the mechanisms that allows a person to act on the basis of «common sense» is emotions and related processes; thus, this could improve the computer system's ability to make decisions. Emotions are also an important part of human reasoning. Simulation of rational processes is not enough to create reliable simulation models.

DAISE studies are devoted to the feasible modelling of human emotional processes in a group. Complete simulation models will provide more opportunities to predict the crowd behaviour and group learning scenarios as well as to study patterns of behaviour of different social groups. The modelling of a group of humans involves two interrelated parts: the simulation of human reasoning and behaviour and the simulation of interaction within the group.

Simulation of the person's reasoning is closely related to the personality and its effect on the intensity and origin of emotions as well as to the factors that cause emotions and emotion interaction with rational processes. There are many different theories on the origin of emotions, emotional classifications and emotional interaction models in psychology literature.

Just as the modelling of one person is based on psychological models, the human interaction modelling is based on social interaction mechanisms. DAISE in co-operation with the Rochester Institute of Technology (USA) carries out research whose main challenges are the formalization of emotions and related processes as well as simulation of social models empirically observed in groups. The results will be used to simulate group behaviour and to explore social interactions.

Emotion-related studies and developments are created for commerce and advertising purposes as well as for human-computer interaction. With the commercialisation of smart environments and social robots, one of uprising areas are long-term user modelling that would enable these artificial helpers to become companions or even friends.

Alla Anohina-Naumeca and Egons Lavendelis, RTU associate professors, Sintija Petroviča and Māra Pudāne, scientific assistants ●

Not science fiction anymore

Artificial intelligence as an academic discipline arose already in the middle of the last century, but the jump in the development occurred around 2012, when the first successful research results for neural networks appeared. Neuron-based image recognition outweighed all other previously used methods. Similarly, artificial intelligence also affects other areas — speech recognition and translation are now best done by the neural network, and nobody is interested in the old methods anymore

The simple and the general one

Artificial intelligence can be divided into two parts — simple artificial intelligence and general artificial intelligence. The leading researcher of the Artificial Intelligence Laboratory of the Institute of Mathematics and Informatics of the University of Latvia Guntis Bārzdiņš explains: «The general artificial intelligence means that it is as capable as a human being. We simply call as artificial intelligence the fact that a computer or program is capable to automate some field of human activities, for example, to listen to a spoken word and to transform it into text or translation. Each of these narrow areas we call as artificial intelligence, but all the areas together that a person can do is a general artificial intelligence. The general artificial intelligence is still the future, but the development in this direction is very rapid.»

At the very beginning the Laboratory of Artificial Intelligence of the Institute of Mathematics and Informatics of the University of Latvia worked on computer linguistics, but recently it has commenced serious work with robots, as computer linguistics have come to a dead end — it is possible to achieve something, to translate, recognize a speech, but it is impossible to understand the meaning of the text deeply. G. Bārzdiņš says: «The new approach is that the language must be based on the physical world, the language cannot be disconnected from the

physical world, and only the robot is the one who has eyes, hearing, hands, feet

and who can touch the world just like people. And only then one can fully understand the language. Currently, the fashionable thing in the artificial intelligence is to do these things [computer linguistics and robots] together.»

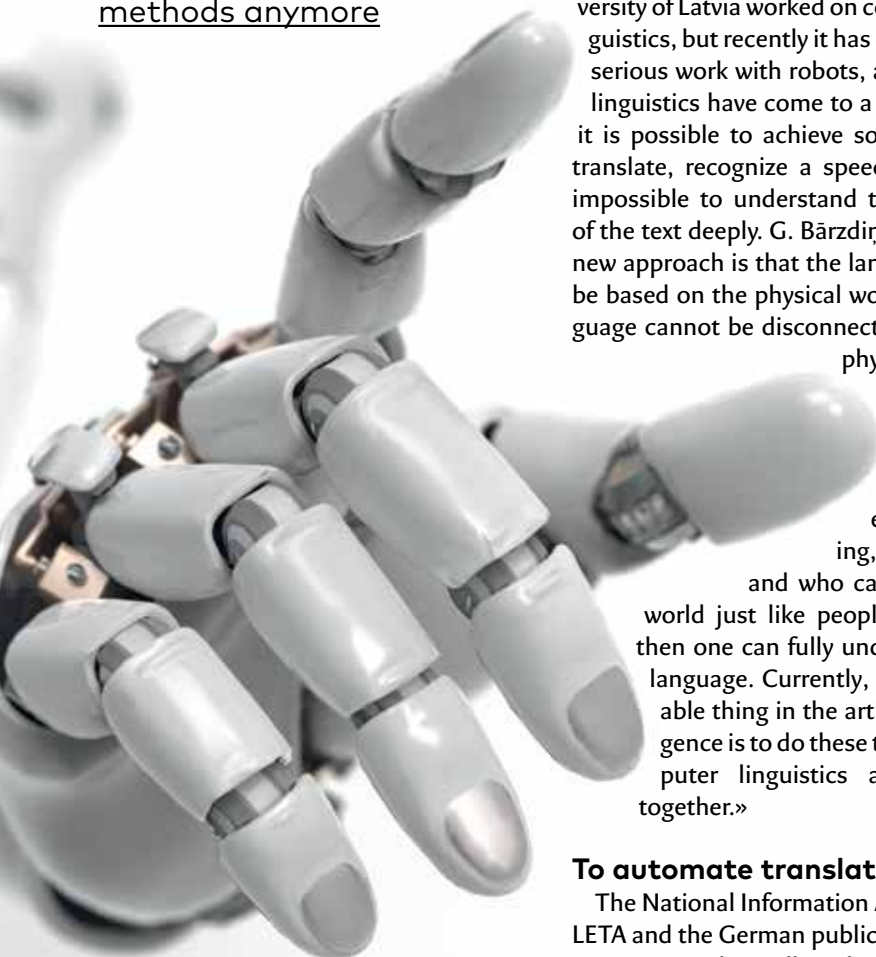
To automate translation

The National Information Agency LETA and the German public broadcaster *Deutsche Welle* within frame-

work of Google DNI (*Digital News Initiative*) project are working on a tool to automate the translation of video messages. The idea came from cooperation among the BBC, the University of Edinburgh and other partners at the big data project SUMMA (*Scalable Understanding of Multilingual Media*) in the framework of the European Union research and innovation program, *Horizon 2020*. G. Bārzdiņš explains that in the framework of several related projects the unified system combines tools developed by the University of Edinburgh (translation, speech recognition), LU Artificial Intelligence Laboratory (semantic language analysis), as well as *Google, IBM, Amazon* translation, speech recognition, and speech synthesis systems.

In these projects, it is planned to develop technologies for the recognition of multilingual speech, translation of messages, automatic grouping of similar messages, as well as identification of persons, organizations and events mentioned in the reports. Along with the major languages of the project — English, German, Spanish, Arabic, Russian, Ukrainian, Portuguese, and Persian — all these technologies will be available also for Latvian.

The project description shows that the Google DNI project has five key activities planned. The first three activities relate to the creation and evaluation of machine-readable, syntactically and semantically annotated text corpora for language comprehension purposes, while the fourth is intended for formalizing and integrating a large interpretative and synonym dictionary in the open-source data cloud semantically related with the web. Multilingual computing lexicon that is needed in the text generation — natural language text generation and synthesis — will be derived from the formalized vocabulary. These results will be used in the fifth step by developing a laboratory prototype for text automatic summarization technology. News organizations are also involved in the projects, since it is more practical to find the solution needed in the production environment, and it is also easier to test the tool.



Will the robots take over humans' work?

Although in Latvia more and more companies are interested in artificial intelligence and are working with possible solutions (for example, *Exigen Services Latvia*, *Accenture Latvia*, *Tilde*), G. Bārzdīņš predicts that the arrival of artificial intelligence to the society on a daily basis will be a gradual process similar to introduction of the Internet (in 1992, under the guidance of G. Bārzdīņš the first Internet connection in Latvia was created). First of all, the specialists of artificial intelligence have to be prepared; therefore, from the spring of 2016, the Deep Machine Learning Course in the University of Latvia is being taught. One of the nearest events that could greatly change the public's habits is self-driving cars.

G. Bārzdīņš points out that there is no base to be afraid of changes, but may be it will not be possible to work in one profession for the whole life; the artificial intelligence gradually takes over many professions, but it will not completely take over all the work and new professions will emerge.

«The question on how artificial intelligence will affect the labour market is topical in the society because artificial intelligence is able to replace the human labour in many areas. Experience has shown that the best results can be achieved by combining artificial intelligence and machine-learning technologies with humans' work. Namely, the biggest benefit will go to the companies that will not replace employees with technologies, but will find ways in which employees can maximize the use of artificial intelligence in their favour,» says the head of *Accenture* in Latvia Maksims Jegorovs.

One of the areas where he believes artificial intelligence can be widely used is call centres. The technology company *IPsoft* has created the artificial intelligence agent *Amelia*, which imitates human intelligence, allowing you to communicate with employees and customers in a natural, empathy-based way. *Amelia* is able to recognize the mood of the conversation member and to create a friendly but at the same time also professional contact within 24 hours a day in several languages. The agent persistently collects information and learns in order to accomplish tasks or solve issues based on the analysis of the accumulated data. Last year, *Accenture* also developed a customer support solution based on the *IPsoft Amelia* platform. *Amelia* can do many different work tasks,



The general artificial intelligence is still the future, but the development in this direction is very rapid.

GUNTIS BĀRZDĪŅŠ
LEADING RESEARCHER OF THE ARTIFICIAL INTELLIGENCE
LABORATORY OF THE INSTITUTE OF MATHEMATICS AND
INFORMATICS OF THE UNIVERSITY OF LATVIA

such as helping bank customers to create bank accounts, processing applications of insurance claims.

To focus on the specific

M. Jegorovs also points out that changes will occur in all sectors, including medicine. The recent *Accenture* study concluded that artificial intelligence applications are already good enough to save 150 billion USD in the industry over the next ten years. For example, in the surgeries performed by robots potential savings could reach 40 billion USD, while virtual nursing assistants can save 20 billion USD. In the area of health care, the ability to use both human beings and artificial intelligence will be the best solution. Already now, by analyzing indicators of human medical history and tests, it is possible to determine not only the possible expertise but also to adjust the best treatment method in a very detailed way.

«In order to create artificial intelligence, it is necessary to have an appropriate environment, laboratories — therefore, it is important for Latvia as a small country to focus on something specific in this area. It is important that the benefits of artificial intelligence can be used as widely as possible,» concludes M. Jegorovs. ●

«The first wave - to automate production processes, mechanical processes. It is already happening and will happen also further. In China the government subsidizes production automation, as it will increase productivity. People will lose their jobs; one mobile phone manufacturer replaced people with robots, and 60 thousand people lost their jobs. The next wave — to automate the service sector. In Japan there is a restaurant where robots make sushi, and also servicing staff in McDonald becomes less and less. The thoughts about whether this will lead to unemployment or the emergence of new occupations differ. The answer is somewhere in the middle - the content of the work will change, and new professions will emerge. Also the entertainment field is already being taken over by computers, even the London Symphony Orchestra has played a piece composed by a computer. Computers become curious and creative. We should talk about the universal base income that is already in the agenda of many countries, in order the people in situation when they face massive unemployment will occur and people will not able to find a place in the new environment, they would not choose a life-style that is dangerous for others.»

TATJANA VOLKOVA,
Professor at BA School of
Business and Finance

«We are all partially cyborgs, at least us with pocket-sized phones with, for example, facebook application. Part of my personality, my brain autonomy, has been given back to the social network, we are somehow enslaved. We read what facebook selects, it knows better what our friends are that we are interested in. And if you are not in the first three search results in google, you do not exist at all.»

VJAČESLAVS KAŠČEJEVS,
associate professor at the
University of Latvia, quantum
physics researcher

Ash instead of cement

Ash left in boiler houses after burning woodchips could return to the forests — as a considerably cheaper material for road construction

After long rains, forestry workers complain: the ground is too wet; machines go down; it's hard to get wood out of the forest which leads to forced downtime. The owners and residents in forested areas, in turn, are far from happy about the roads ruined by heavy machinery. Good forest roads are crucial for competitiveness in woodworking. The development and maintenance of forest road network requires a considerable investment from the joint stock company *Latvijas Valsts meži* (Latvia's State Forests). After investing 19 million euro in 2016, company commissioned 285 km of forest roads of which 117 km have been rebuilt and 168 km — newly built, according to the company's annual report.

Gravel and dolomite chips, stabilised by cement or lime, are usually used for building forest roads. Using biofuel fly ash as the binding element in road building will be less expensive as currently ash does not cost anything. Moreover, heat energy producers must pay for depositing ash at waste yards. And there is a lot of ash.

Suitable for roads

«Ash ensures remarkable improvement of mechanical characteristics of roads. Using this material, we can slow down deterioration of forest roads and lengthen their lifecycle,» says Viktors Haritonovs, the leading research of the Department of Roads and Bridges, Riga Technical University, referring to a study on the use of ash for forest roads. The study was done as collaboration between *Latvijas Valsts meži*, RTU and *Fortum Latvia*. The ash for the study was obtained from *Fortum Latvia* cogeneration station in Jelgava, where about 4000 tonnes of ash are produced annually. This summer saw the conclusion of the second stage of the study with laboratory tests involving ash as well as mixtures of gravel and dolomite chips used for building forest roads. Negotiations on options for the third stage of the research — building an experimental forest road — are ongoing. «The third stage would involve not only building a road, but also five-year monitoring to compare it with a reference

text / Lāsma Vaivare
photo / Gundega Preiss

Condition of this considerably damaged forest road could be improved if fly ash was to be used in the construction — so believes Viktors Haritonovs, the leading researcher of the Department of Roads and Bridges, Riga Technical University (RTU).





The possibility to use ash in order to strengthen gravel roads of local municipalities should also be considered.

INDULIS BRAUNERS,
HEAD OF RESEARCH OF THE DEVELOPMENT DEPARTMENT OF LATVIJAS VALSTS MEŽI (LATVIA'S STATE FORESTS)

road with no stabilisation at all or with stabilisation using traditional materials — Portland cement, which is far more expensive,» V. Haritonovs explains the possible future route.

In turn, the first stage included analysis of literature and chemical analysis of ash. «We must prove that the material is safe for the environment and people, including checking for heavy metals, chemical elements that would stimulate exceedingly fast growth of grass,» explains the RTU researcher. To the questions about chemical analysis results, he answers that some heavy metals were found in ash, but their concentration is below critical. «Chemical elements in ash are similar by 70–80 % to the ones in cement,» continues V. Haritonovs.

Likewise, legitimization of ash material required for using it as road building material was studied. According to V. Haritonovs the Finnish parent company of *Fortum Latvia* is already on the way to recognise the use of ash.

Another essential is forecasting of the amount of ash in order to plan the scale of road building. Currently available amount of ash does not allow full substitution of traditionally used stabilisers.

Use in Scandinavia

Scandinavia has some experience in using ash for road construction. This is stated in the study: «The most common ground stabilisation material is cement or quicklime, but the use of biofuel ash is an alternative employed in building less important roads in Sweden and Finland. Biofuel fly ash has been used successfully in construction of various roads and squares in Europe. Test results after construction confirmed that road constructions with layers stabilised by biofuel fly ash have higher bearing capacity and application qualities compared to reference road constructions under the same conditions. The risks of freezing and thawing, the development of bumps and ruts are decreased.»

Also for other roads

While forest road construction uses granite or dolomite chips mixed with ash

to create the top layer of the road, ash can be used for asphalt road construction for the lower unbound construction layers. «For the layer that uses dolomite stabilised by cement, ash can be used to stabilize, strengthen and ensure better distribution of load,» explains the researcher.

In turn, Indulis Brauners, the head of research of the Development Department of *Latvijas Valsts meži*, says that one could also consider the option to use ash for improving gravel roads. At the same time he acknowledges that it is impossible to promise that company will be using ash in construction of forest roads in the next decade. The company does not build roads for the sake of building; there is a reasonable density of road network to be achieved. The network is to be completed in the next five years, and ash will not be used to maintain the existing roads.

Bringing together

To the question why *Latvijas Valsts meži* engaged in the study I. Brauners answered that the company works with selling energy woodchips, including their export. As they sell a product that leads to the production of ash, they considered the option of taking the ash back from customers. Customers either deposit the ash or use it as liming material. «Ash contains phosphorus and potassium and can be used as fertilizer,» continues I. Brauners and notes that this aspect of using ash is studied by the Latvian State Forestry Science Research Institute *Silava* on order from *Latvijas Valsts meži*.

V. Haritonovs says that the meeting of the researchers with representatives of companies was initiated by the RTU Innovation and Technology Transfer Centre. Before the development of the study, its pre-research was done in the form of a master thesis by Raitis Plonis. R. Plonis, V. Haritonovs, Pēteris Šķēle and Andris Paeģlītis are scientific authors of the study.

Using ash in forest road construction completes the cycle. Nothing would be lost of the trees transported by these very roads from the forest to be processed into, e.g., boards, with the shavings used as woodchip fuel. ●

RESOURCES MUST BE USED TO THE MAXIMUM

ANDRIS VANAGS

Chairman of the Board of Fortum Latvia:

Fortum inquired into the option of using ash from Jelgava biomass cogeneration station, which is the largest biomass cogeneration station, already during its construction. However, in view of the requirements of the Latvian legislation, this was impossible. We have been collaborating with RTU for a long time already: we have been organizing tours for students to the biomass cogeneration station, offered students internships and research themes for master theses.

According to *Fortum's* strategy and conviction, the available natural resources must be used efficiently to the maximum of their capacity. Why take materials that can be profitably used to the waste yard? The best examples from the Nordic countries show that ash can be used as fertilizer (especially for forests) as well as for road construction. In these countries cogeneration stations do not deposit ash as waste.

The annual amount of ash from the *Fortum* biomass cogeneration station in Jelgava depends on the station's load and the ratio of ash in biomass, averaging to 5000 t per year. The aim of *Fortum* is to find useful application for ash in Latvian agriculture, while decreasing its impact on the environment. Practical use of ash would certainly facilitate this. We are sure that our collaborative study will show options for useful application of ash in construction of forest roads and decrease the amount of ash stored on Latvian dumping grounds.

VITAMIN INTAKE FOR COMMERCIALISATION

«We do not want to turn all scientists into businessmen because everybody must do their work, but we want to increase the understanding about commercialisation»

text / Lāsma Vaivare

These are the words of Edgars Babris, director of the Technology Department of the Investment and Development Agency of Latvia (LIAA). The programme administered by the *LIAA Funding for Commercialisation of Research Results* targets the commercialisation of research results that are the property of research organisation in Latvia or abroad and are being prepared for the second stage of project application. During the first stage ten out of forty submitted projects received approval.

How many out of 100?

It is planned that in 2022, when the programme will be over, the actors of at least 100 research projects will have «tested» the savour of commercialisation. However, this does not mean 100 new «smart» products. «We cannot make it mandatory to create 100 products because, in view of the projects' early stage (Technology Readiness Level or TRL), it is impossible to foresee if the formulae on paper can be transferred into production. Nine out of ten start-ups go bankrupt, and these transfer projects too may turn out to have a considerable rate of attrition.

«The reason we began the programme is that we know that scientists have many ideas and studies, and one of them shall be commercially interesting,» explains E. Babris. Likewise, funding available for the programme is insufficient to commercialise 100 projects according to the terms of funding: a single project may receive up to 300 thousand euro with funding intensity of 90 %. Currently, the total funding available, which consists of the ERAF and the state budget funds, is approximately eight million euro. By March 2018 the available funding can be increased after meeting set criteria,

Most common mistakes in commercialisation of technologies

__Technology developed for a non-existent market, with unsuitable price, business model, market size, etc.

__Technology lacks data tests, and it is hard to increase market interest

__Technology is released in the market too early generating hopes that cannot be harmonised with the needs of consumers Technology is not prepared to enter the market, and there is no funding for further development

__Technology is partially developed but is not proven commercially leading to difficulties in engaging additional funding in P&A and capital investments.

__Funding was engaged too early, and it is impossible to fulfil initial promises to investors leading to difficulties in obtaining additional funding

SOURCE: LIAA

reaching 20 million euro. E. Babris says that projects will be assessed a number of times. The first selection takes place at the stage of application. Successful applicants may receive up to 25 thousand euro for technical economic preliminary study and development of commercial strategy necessary for the scientists themselves and the LIAA to be sure whether the idea is promising. E. Babris adds that it is pos-

sible that scientists themselves realise at this stage that they have no reason to apply for further funding. If they realise that the product already exists globally, that it will not be competitive or that it will not find a market, a decision to forego further funding may be submitted to the LIAA. The LIAA will engage experts in this assessment. However, the scientists will have gained experience in commercialisation even in case of attrition; therefore, projects can be added to the one hundred of successful applications.

The projects that will pass the second assessment can be submitted for consideration for the other part of the funding. «The second stage involves industrial research, experimental development, prototyping and other commercial activities. When a prototype is completed, it will be possible to look for collaboration partners, the market, to attend exhibitions, to go to possible collaboration partners and register intellectual property rights,» the director of LIAA Technology Department lists the next steps.

«If 20 products are prepared, it will be a lot,» says technology scout Lita Lazdiņa. The ideas and development of Riga Technical University (RTU) are at the centre of her attention. Likewise, technology scout Māris Jansons who is aware of the events at the University of Latvia (UL) estimates that, if every research institution that engages in the project and it will have one or two success stories at the end, this will be a good result. Scientists have no lack of ideas. M. Jansons says that at least the first stage of project application had set high standards for the leaders of scientist groups and that it may have slowed down scientists' activity.



We know that scientists have many ideas and studies, and one of them shall be commercially interesting.

EDGARS BABRIS,
DIRECTOR OF THE TECHNOLOGY DEPARTMENT OF THE INVESTMENT AND DEVELOPMENT AGENCY OF LATVIA

Being a trustee

A scout is a bridge between scientists and business to whom research ideas are presented and who has to assess their commercialisation potential at a very early stage, to motivate researchers to engage in commercialisation process, provide all kinds of assistance that researchers may need in this process and help researchers to consider the project from commercial perspective.

Positive collaboration experience and personal contacts — these competences are required of scouts. «For university people it is very important to see a scout as one of their own; it is hard for an outsider to come and try to engage scientists by promising them good things. A credit of trust developed during previous work is the decisive factor for successful collaboration,» states L. Lazdiņa. She has accumulated considerable experience having worked at the RTU Innovation and Technology Transfer Centre and knows how to talk to every scientist, what is going on in which laboratory and who is the best specialist for solving an issue or a problem. Technology transfer process is very familiar to M. Jansons too. He began to work at the UL Innovation Centre over ten years ago and is active in technology transfer point of contact project that was carried out during the previous European Union structural funding period.

A springboard

«Whether an idea is successful or not determines its excellence. Good ideas never stay without an owner,» believes M. Jansons. Of course, it is possible that the amount of funding available for each project as part of the programme will be insufficient for reaching appropriate com-

mercialisation result. Likewise, it may be that the period of three years within which an idea is to be commercialised will turn out to be too short. L. Lazdiņa gives an example, «in ICT it takes much less time to develop a product than, for instance, in pharmacy.»

«The programme will not be a cure-all, but it will offer an intake of vitamins in terms of funding which will enable assessing the commercial potential for a greater number of projects. This is an additional tool that will enable scientists to gain new experience, to further their knowledge of working with a market in mind and communicating with companies,» Laila Eliņa, head of RTU Innovation and Technology Transfer Centre, provides an assessment of the programme. According to her one benefit of collaboration with businesses is the possibility of seeing new horizons and constructively assessing one's technology. «Sometimes it is enough to look in a somewhat different direction or add a small component to find that the project works not in the area for which it was envisaged but in another one,» she says.

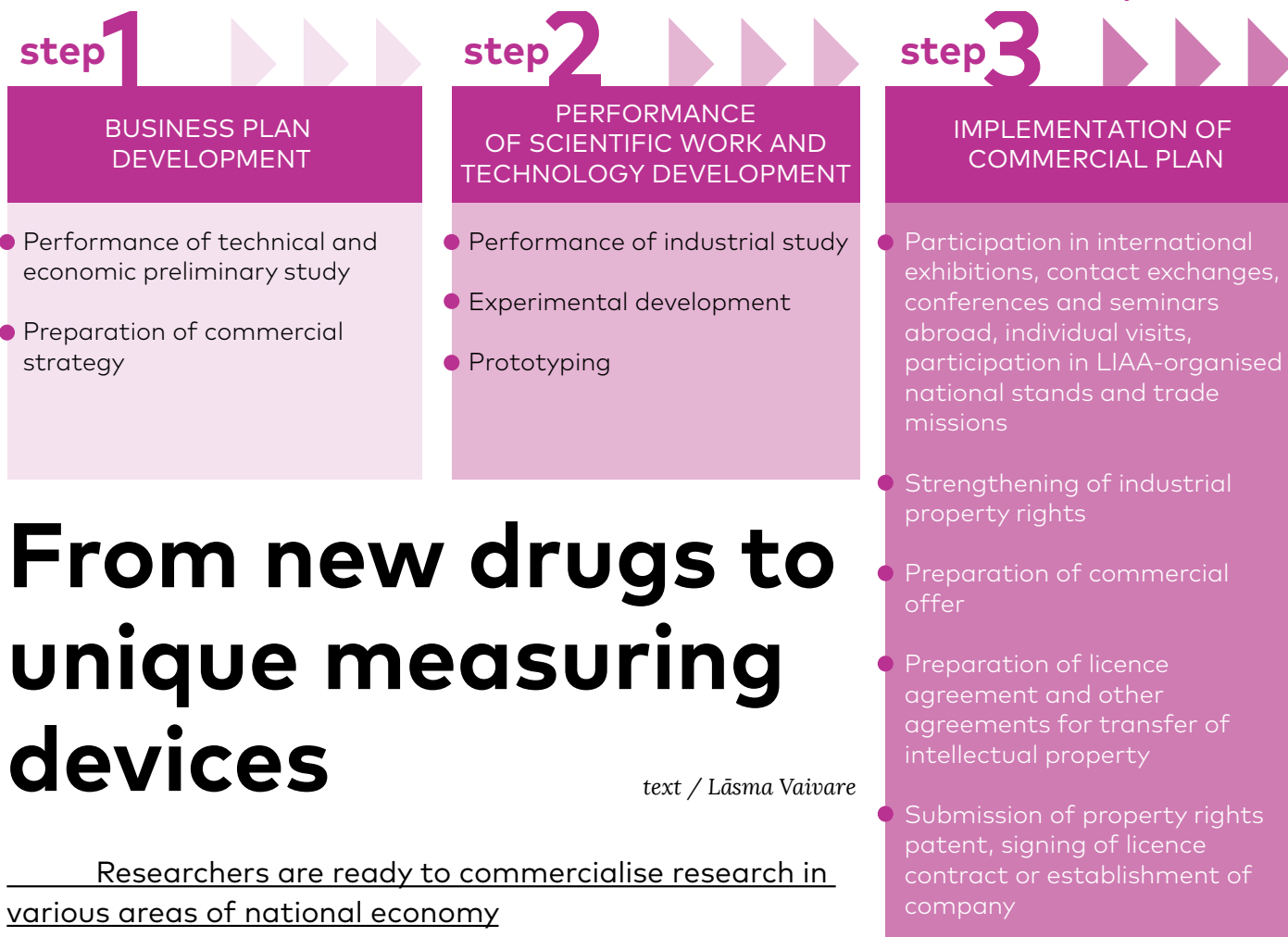
«This is a good instrument for changing thinking,» adds L. Lazdiņa. Naturally, it may happen that having become familiar with the stage of commercialisation researchers realise that they are not fit to collaborate with the industry. And this is not necessary for all according to technology scouts. «I like the example given by the dean of the UL Faculty of Business, Management and Economics Gundars Bērziņš. Usain Bolt is good at running 100 m, but, if he was to run hurdles, the result would be mediocre. If a researcher is Usain Bolt in science, he cannot change his field. Everyone must do their own best; there are researchers who are excellent lecturers and educators; there

are researchers excelling in their studies and promoting science, while others are very good at commercialising and even have their own business,» says M. Jansons.

Hand in hand with a businessman

LIAA concludes after the first stage of project application that scientists lack skills for assessing and describing commercialisation potential and market for projects. Therefore, the greatest challenge now is to change their thinking. «Not all scientists want to share their studies as these, certainly, have secrets. However, we have to explain them that, if scientists conduct research and develop projects thinking that someone might steal them, then when the project is over the ideas will not be possible to commercialise, because they will be afraid of investors, and no investor will invest in a product he knows nothing about,» emphasises a LIAA representative. LIAA asserts that, to make commercialisation more successful, it is essential to involve people with experience in business in the team of researchers. «We want research that targets business. If the group of scientists does not have a business leader, we will help them to find one. Scientist teams are already looking for people. To develop our economy it is important for us that a product reaches the market,» explains E. Babris.

Although LIAA does not aim to turn scientists into businessmen, the programme envisages that the final result is to be alienated and commercialised. «Alienation or the transfer of intellectual property rights can take place in two ways: either a new enterprise is established to promote the product on the market or a licence is sold to an existing company to introduce the product into production,» says E. Babris. ●



From new drugs to unique measuring devices

text / Lāsma Vaivare

Researchers are ready to commercialise research in various areas of national economy

During the first stage of application to *Funding for Research Results Commercialisation*, seven research organisations received funding; three among the ten accepted applications are from Riga Technical University (RTU) and two — projects of the Institute of Electronics and Computer Science.

Earnest preparation

One of the successful ideas by the RTU researchers involves the preparation of natural thermos package from bio resource, which is widely available in Latvia — coniferous greenery. The material is characterised by its capacity to arrest the flow of heat and cold, thus ensuring temperature required for the product and protecting it from external conditions, for instance, during transportation or storage. Besides, this is by-product of the forestry industry, which disintegrates in natural conditions, without creating pollution or making adverse impact on the environment or people's health. The second business idea is related to the development of a measuring and control system of electric energy consumption unique on the global market. The system is designed for large industrial companies

and will enable monitoring, for instance, the energy consumption by industrial robots, as well as diagnosing problems in energy network, facilitating the optimisation of the amount of consumed electric energy and saving considerable funds.

In turn, the authors of the third idea created a technology for purifying waste waters of pharmacy companies from noxious substances, which cannot be processed by current purification devices. According to Laila Eliņa, head of the Innovation and Technology Transfer Centre of the RTU, the material developed by the RTU researchers reacts under the impact of air with chemical pollution, dividing noxious elements into clean water and carbon dioxide (CO₂). It is planned to make a reactor that can be integrated into the factory sewage system and to test its performance in laboratories and industrial conditions at Latvian pharmacy companies.

For efficient treatment

Another accepted project related to the pharmacy area comes from the Latvian Institute of Organic Synthesis. The institute wants to commercialise a new drug for treating diseases of the central and pe-

ripheral nervous system. The drug action is based on sigma-1 receptor (Sig-1R) modulation. Drugs that influence Sig-1R activity are efficient for treating dementia of various origins, cognitive disorders, convulsions and depression.

The Latvian Biomedical Research and Study Centre wants to develop a personalised breast cancer molecular diagnostic test for selecting molecularly targeted drug, most suitable for each patient, and dynamic assessment of cancer during treatment. The Riga Stradiņš University, meanwhile, will be developing a genetic test based on the currently globally used standard molecular biology analytic methods, employed to determine genetic variations, including mutations. The test is meant for determining genetic variations related to infertility, using DNA.

3D sensitive textile, which can replicate three-dimensional shapes using inbuilt sensors, can be used in medicine, rehabilitation, sport and cinema industries, as well as video games, sailing sport and clothes industries, and beyond. The project is developed by the Institute of Electronics and Computer Science (IECS). Shape replication is based on the determination of separate surface segment ori-

Events

▶ **New drugs for treating dementia and epilepsy**
Latvian Institute of Organic Synthesis

▶ **Thermoelectric radiation sensor**
University of Latvia, Institute of Solid State Physics APP

▶ **Natural thermos package**
Riga Technical University

▶ **Purification of waste-water of pharmacological industry**
Riga Technical University

▶ **Ultra-broadband impulse radar sensor**
Institute of Electronics and Computer Science

▶ **Dynamic electric energy consumption control and data acquisition system**
Riga Technical University

▶ **Cascading electromagnetic induction pumps on permanent magnets with stabilised parameters**
University of Latvia

▶ **Personalised breast cancer molecular diagnostic test for drug selection and control of the course of disease**
Latvian Biomedical Research and Study Centre

▶ **3D shape sensitive textile**
Institute of Electronics and Computer Science

▶ **Genetic test for determining infertility causes**
Riga Stradiņš University

Funding for Research Results



entation using sensor junctions. Technological precision and resolution depends on the number of sensors employed and their density. The technology includes innovative wiring data communication solution, which enables connecting many hundred sensors, resulting in real-time surface shape replication, according to Ģirts Smelters, scout in ICT technology. A prototype, approbate in collaboration with a rehabilitation centre, already been developed. However, it is planned to choose which of the possible uses of 3D textile to develop further after performing technical economic preliminary research and developing commercialisation strategy. Of course, it is planned to analyse market demand for several possible applications and, depending on the result, to choose developing further an application with the highest economic potential. Although work on the project has been going on for years, it is, according to Ģ. Smelters, at the initial stage from the technology transfer perspective.

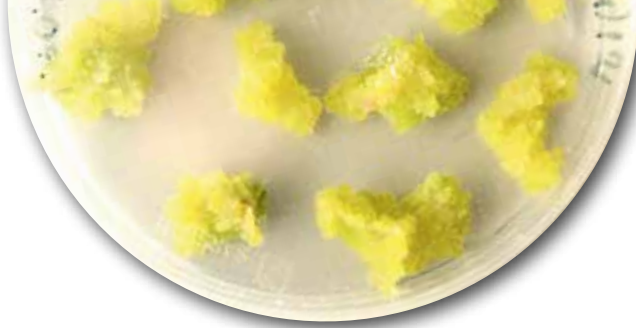
Promising good results

The second IECS project involves commercialisation of a new type of ultra-broadband impulse radar sensor,

which provides possibilities for improving or replacing the current solutions to the determination of moving objects, non-contact diagnostics and determination of dielectric parameters. This solution will be more precise, quicker and expend less energy. As the project developers point out, the current security solutions for determination of moving objects mostly use passive infrared sensors (based on heat radiance, they can determine the temperature of objects which differs from the surrounding temperature), CCTV cameras and infrared sensors. In turn, ultra-broadband impulse radar technology is based on narrow radio impulse radiation into environment and analysis of the obtained echo, which enables determining electric and magnetic reference dimensions of objects and distance to them. Besides, as Ģ. Smelters explains, electromagnetic waves are disseminated also through obstacles, enabling not only to make discrete survey, such as by hiding sensors behind walls or dropped ceilings, but also to use the technology for finding buried objects or people trapped under ruins, to diagnose breathing and cardiac activity of patients.

Technology scout Māris Jansons points to the advantages of a project by the Institute of Physics of the University of Latvia; the aim of the project is to develop electromagnetic induction (non-contact) permanent magnetic pumps (EPMP) for pumping and transferring liquid metal with control system pump working parameters stability provision. EPMP induction pumps have significant advantage compared to traditional three-stage linear induction pumps; essentially, the necessary alternating current magnetic field for pumping liquid metal is generated in a much simpler way. This, in turn, means much simpler construction and simpler manufacturing, smaller dimensions of the pump's active part and, therefore, lighter weight and higher efficiency. M. Jansons also notes that EPMP pumps are likely to have higher hydrodynamic stability.

Meantime, the Institute of Solid State Physics of the University of Latvia wants to commercialise a new, technologically innovative thermoelectric radiation sensor for spectroscopic devices. Spectroscopic methods are widely used in environmental monitoring, food quality assessment, criminalistics, pharmacy, chemical industry and elsewhere. ●



TO MAKE THE IMPOSSIBLE POSSIBLE

Small particles extracted from an endangered, rarely found in the wild or difficult to obtain plants are transformed into active substances for use in cosmetics

text / Lāsma Vaivare

photo/ Toms Grīnbergs, University of Latvia

Not in fields, dunes or forests of Latvia but in laboratory light cabinets in cooperation with the University of Latvia (UL) plants reproduce (in the case of laboratory — their mass), and the active substances extracted from these plants could be found in cosmetics tubes and jars already in near future, allowing to fight, for example, acne, ageing signs or changes of skin pigmentation.

Without causing harm to nature

«We take a very small part of the plant in the wild, and then separate and reproduce stem cells. We extract stable cell cultures, which we can later reproduce for a long time, achieving a constant result. It is much more efficient because cells are growing as a mass without producing unnecessary elements; consequently, the concentration of active substances is much higher. This would not be possible by collecting plants in the wild. Moreover, it is the only way for us to work with rare, endangered and protected medicinal plants as well as with slow growing or difficult to obtain plants. For example, if buds which are available only one week per season are necessary for extraction of a substance, you do not know when exactly this one week will come and whether the material quality will not differ from the previous season,» explains Anna Ramata-Stunda. Together with Mārtiņš Boroduškis she has founded a start-up *Alternative Plants*, which deals with development of active substances for cosmetics by using stem cell cultures of plants. Both co-founders are also researchers at UL, but the technology and related intellectual property is created and developed by themselves through support of *RebelBio* accelerator at Cork University in Ireland. The cooperation with UL is continued in the form of contract studies.

A. Ramata-Stunda and M. Boroduškis have extensive experience in cooperation with manufacturers of cosmetics, for exam-

ple, *Madara Cosmetics*. But they are not going to manufacture cosmetics themselves; they leave it to manufacturers of cosmetics to whom they will provide the active substance — an extract which is added to the end product. «We will sell the active substance in large containers,» smiles M. Boroduškis.

The company works with two species of plants protected in the Baltic Sea region; these plants are rare, and consequently — also unique on the global market. These are coastal plants, but their names are not revealed due to patenting. In the wild these plants are exposed to ultraviolet radiation and salt stress, so they generate various protective molecules. There are also products from plants that are currently in the stage of development. These plants are used in the traditional medicine and also have been used previously with a good effect in cosmetics extracts, but due to the method used by the company could give even more qualitative effect and become more easily available.

From one to several

«In addition to the fact that we offer unique active substances, our product is sustainable,» says A. Ramata-Stunda, adding that the pressure from consumers and supervising institutions on manufacturers of cosmetics to become greener increases.

M. Boroduškis also outlines other benefits. Namely, it is possible to vary the growing conditions of plants (light, nutrients) in the laboratory to obtain different raw materials. Extraction conditions can be also changed. «It is our uniqueness that we can obtain a product for different applications by using only one plant species. We can obtain several types of product for various applications from biomass of one plant,» he explains. «We can also obtain two conceptually different active substances from one plant; first we yield low-molecular substances which



Elza Kaktiņa, Anna Ramata-Stunda, Mārtiņš Boroduškis and Baiba Silamiķele – Alternative Plants team, which knows how to extract stem cells of plants from rare plants and transform them into active substances used in cosmetics.

are more effective for antioxidative protection, ageing. From the remaining material we can efficiently yield high-molecular substances which absorb moisture and are useful for moisturising products. Two different products are obtained through one technological process; they can be combined or used in two completely different products by the manufacturer of cosmetics,» adds A. Ramata-Stunda. M. Boroduškis says in this regard: «Actually non-waste production».

Proving the efficiency

It is planned that by the end of the year development of the range of *Alternative Plants* products will be finished and that proof of efficiency will be completed. Five to ten years ago marketing was more important than proof of efficiency, but now manufacturers of cosmetics require efficiency data and test themselves whether the result can be achieved by the particular component. The company carries out tests for efficient use of the active substance in products with specific application. «There is anti-acne direction, regenerating or anti-ageing active substances, substances regulating skin pigmentation, which are more interesting to manufacturers that export products to Asia. There, 90 % of cosmetics have active substances which make skin lighter. This direction also becomes more significant in Western Europe; here people more often have various pigmentation disorders related to ageing,» continues the company co-founder.

Search for investment takes place concurrently with efficiency tests. The company needs 400 thousand euros, which it hopes to attract by the second quarter of the next year in order to be able to ensure larger volume of cultivation of plant cells and, consequently, also higher production volume. The existing volume is sufficient for ensuring pilot lots of products but not ex-



BUSINESS CV

Alternative Plants
 Owners — Anna Ramata-Stunda and Mārtiņš Boroduškis
 Established in 2017

SOURCE: LLC ALTERNATIVE PLANTS

RARE COMBINATION

DĀVIDS ŠTĒBELIS

Entrepreneur, business modelling coach:

The area of biotechnology start-ups is very topical in Europe and it has huge potential in the future. Scandinavia and Great Britain have established environment for development of biotechnology start-ups; there are mentoring programmes, accelerators. Latvia does not have similar activities. Therefore, it is difficult to get innovative biotechnology products created in Latvia on the market. For a scientist it is hard to become an entrepreneur on his or her own. Consequently, *Alternative Plants* is a unique story on a Latvian scale; it can be implemented only by such a team as Anna and Mārtiņš who have ambitions of scientists and entrepreneurs to move their idea forward.

Alternative Plants co-founders Anna Ramata-Stunda and Mārtiņš Boroduškis have extensive experience in cooperation with manufacturers of cosmetics, for example, Madara Cosmetics.



tensive production. It is complicated to rouse interest of major manufacturers of cosmetics with small production volume.

The company has ambitious goals – first, to conquer markets in the Baltic states by using personal contacts and previous experience in the sector of cosmetics, then in Scandinavia and other European countries among which the company co-founders see the German speaking countries as very attractive. In 2019 it is planned to focus also on the Asian market. Whereas by 2022 the goal is to achieve 30 % market share on *premium* segment active substance markets in Europe. It is possible because only some manufacturers of active substances use stem cells of plants; therefore, the market cannot be considered over-saturated.

The global market of active substances for cosmetics is estimated at 2.63 billion US dollars; plus it is growing. «Demand for more expensive, efficient, proven active substances is increasing. The consumer has become more knowledgeable and is ready to pay more, but efficiency is required,» states A. Ramata-Stunda.

Gave a push

This is not the first joint venture established by A. Ramata-Stunda and M. Boroduškis. The company *InCell* has developed and commercialised a cell transplantation product which facilitates healing of ruptures of horse ligaments and tendons. «Again cells – but in this case animal cells. We have not gone far from cells,» says M. Boroduškis. Efforts can be felt on the market to make this cell transplantation product into a veterinary medicinal product. «As soon as something becomes a medicinal product, a huge investment is required. For such a small company as our company it is impossible to develop a product without

FOR INFORMATION

The objective of rapid business growth and company value raising programme Climate-KIC Accelerator is to support initiatives on mitigation of climate change influence and on commercialisation of «clean» technology. The programme is intended for green technology start-ups, the product or service of which can mitigate or adapt to the influence caused by climate change in such areas as cities and urban environment, sustainable production, soil and water, finances and measurements, industry, processing, energy efficiency.

SOURCE: RTU

huge investment. More and more often we consider if we should sell this company as we link our future more with *Alternative Plants*,» admits M. Boroduškis.

The previous experience in business, knowledge about the cosmetics sector and participation in *RebelBio* acceleration programme, which focuses on biotechnology start-ups, has given a push for more rapid development of *Alternative Plants*. «This accelerator was valuable because it encouraged its participants to think: they have to find a way, how to enter the market faster, how to sell now, how to gain more recognition and trust of investors. We have to learn, and it also applies to scientists, that a product has to be created, which is necessary today,» admits A. Ramata-Stunda.

Printing batteries on textiles

wider application of smart textiles can be facilitated by solutions in storing energy necessary for providing the performance of various sensors. Researchers of the University of Manchester offer their solution to the challenge; they work on elastic batteries printable on textile. According to the study the printing uses graphene-oxide ink, which ensures good stability for electrodes by interacting with textile material. High-performance sports clothes, clothes that monitor health indicators, military equipment, mobile connection devices and even portable computers are just a few possible applications for new technology.

SOURCE: [HTTP://WWW.MANCHESTER.AC.UK](http://www.manchester.ac.uk)



Special tattoos inform about health problems

Scientists of Harvard Medical School and Massachusetts Institute of Technology created an ink for tattoos which enables the control of blood composition and warns about health problems. The tattoo changes colour to warn about changes in glucose, sodium and pH level in blood. This biosensor tattoo can be useful for patients with diabetes to measure the level of sugar in blood, for cardiac patients and for hard-working people to assess their overall health condition. Likewise, they could be used for general medical diagnostics. The researchers do not plan on performing clinical studies yet.

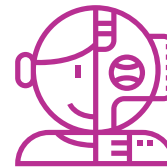
SOURCE: [HTTPS://INTERESTINGENGINEERING.COM](https://interestingengineering.com)



A step closer to humanoid robots

Researchers of the University of Columbia developed a 3D-printable synthetic soft muscle with intrinsic expansion ability that does not require an external compressor or high voltage equipment which previously limited the capacity of producing small robots that move and perform independently. The researchers believe that the artificial muscle is durable, extensible and able to lift heavy weights. Soft robots would be appropriate for places and activities requiring contact with people, such as healthcare. Unlike rigid robots, they can replicate natural movements, such as picking small or soft objects and performing delicate tasks.

SOURCE: [HTTP://ENGINEERING.COLUMBIA.EDU](http://engineering.columbia.edu)



Dentistry at the hands of a robot

The first fully automated dental surgery ever was performed in China. Two 3D-printed teeth were implanted into a patient's mouth. According to the South China Morning Post, the hour-long operation took place in the presence of two medical employees, but they did not assist. The robot used data of the patient's skull and jaw obtained with a CT scanner and special marking system. The operation marks the result of a four-year collaborative study between the Fourth Military Medical University's affiliated Stomatological Hospital and the robot institute at Beihang University. It is thought that the innovation could solve stomatological problems in China; due to shortage of specialists people often choose inadequately qualified assistance. The first dental robotic system was approved by the FDA in the United States this year, developed by Florida based company Neocis. The robot also uses a CT scan to prepare for the operation.

SOURCE: [HTTPS://INTERESTINGENGINEERING.COM](https://interestingengineering.com)



Superfast data transmission

International group of scientists used terahertz multiplexing for data transmission, simultaneously transmitting two video signals at the speed that compared to the fastest cellular networks of today is over 100 times higher. Current voice and data networks use microwaves, but the demand for data transmission is increasing. Terahertz waves have higher frequency than microwaves; therefore, they have much higher data transmission capacity. The scientists have only just begun experimenting with terahertz frequencies, and many of the basic components do not exist yet. The US Federal Communications Commission has issued a licence to test terahertz wireless data connection to Brown University, which could become the backbone of high-speed data network of the next generation.

SOURCE: [HTTPS://NEWS.BROWN.EDU](https://news.brown.edu)



Smartphone sensors could make traffic greener

By combining car sharing apps with a smartphone's ability to measure movement and vibration, the researchers of the EU-funded research programme Horizon2020 CROWD4ROADS project are hoping to make roads greener. Smoother roads create fewer vibrations and less friction on tyres meaning that vehicles need less maintenance and less fuel to power themselves into motion. This, in turn, causes less CO₂ emissions. Data obtained from smartphones about damaged, uneven and rough roads could be further submitted to the local authorities for speedy decisions on the necessary road repairs thus making their mobility sector more energy efficient. Simultaneously, it is possible to monitor the number of people in the car and by offering an incentive system to raise the number of passengers in cars. Passenger cars account for over 70 % of intra-EU passenger transport, but the average car occupancy rate is below two passengers per car.

SOURCE: [HTTPS://HORIZON-MAGAZINE.EU](https://horizon-magazine.eu)



