innovation

Science + Business

#3 Summer 2018

THE HIDDEN TREASURE

MAGNETIC LATVIA

11.06

The *CeBIT* computer expo will be held in Hanover, Germany. This year it positions itself as Europe's Business Festival for Innovation and Digitization. It is one of the industry's biggest events, simultaneously being an expo, a conference, and a networking event, and it will conclude on June 15. Its concept is based on four pillars — *d!conomy, d!tec, d!talk,* and *d!campus*, reports *kursors.lv,* a technology blog. *d!conomy* — CEBIT is still an expo for companies that have things to sell and those who want to buy products and services; seven exhibition halls are allocated for showcasing products and promoting mutual cooperation. *d!tec* — dedicated focus on new technologies that are only beginning their victory parade. It is also possible to meet startups distinguished by modern business models and their approaches to work. *d!talk* — the expo also has conferences and workshops. *d!campus* — environment that fosters networking and informal discussions.

19.06

As part of IV World Congress of Latvian Scientists, *ResearchSlam* — a special event, will take place at the National Library of Latvia, where seven young scientists from various Latvian higher education institutions and scientific fields will talk about topics that are innovative and important for society, as well as discuss Latvia's scientific achievements. *ResearchSlam* is a competition for Master and Doctoral students organized by the Doctoral School of Riga Technical University with the aim of familiarizing society with research and scientific work carried out by young Latvian scientists in a way that is easy to understand, interesting, and fascinating.

13.06

Startup Safari Riga will begin with a two-day event held in the city of the same name that will make it possible to learn more about the Latvian startup ecosystem. It is similar to an open house day when startups, corporations, venture capital investors, and acceleration funds open their doors to interested parties that travel the city, meet potential business partners, investors, and developers, so that they can network and interact.

20.06

Discover New Business Opportunities. Discover Latvia, a two-day international business forum, organized by the Investment and Development Agency of Latvia, starts that day. The Forum is organized as a high-level foreign and Latvian business meeting to make business contacts and develop collaboration, paying close attention to Latvia as a country with significant potential for international collaboration in different sectors of the economy. The central theme of the forum is world trends and opportunities, what they mean today, when Latvia is celebrating its centenary. The event, looking back at Latvia's hundred years, identifies present opportunities, and looking forward to the future, identifies changes taking place in the world that influence the everyone's life and development. The event features presentations from both foreign and local experts, thematic business panels, workshops, success stories presentations, bilateral business meetings, company visits, as well as activities related to the project *Atgriezies un strādā Latvijā!* (*Return and Work in Latvia!*). During the event foreign delegations from Europe and Asia are familiarized with Latvian business environment, investment projects, and opportunities for cooperation. The forum takes place at *Radisson Blue Hotel Latvija*.

18.06

IV World Congress of Latvian Scientists will be held until June 20, at the National Library of Latvia, gathering Latvian scientists and scientists of Latvian origin and their strategic partners from all over the world to offer solutions for the development of Latvia and promote long-term scientific collaboration. The Congress was planned as a discussion platform and innovation forum, where participants meet, network, and collaborate to achieve common goals and start projects in various scientific fields. It will inform Latvian society about the outstanding achievements and success stories of Latvian scientists and scientists of Latvian origin, revealing the strength and potential of Latvian human capital, strengthen the quality of being rooted in Latvia, get to know Latvian culture and traditions, and enhance the reputation of Latvian science and its institutions. The Congress is dedicated to issues important to Latvia on its centenary. The central theme of the first day is society's safety and security — during multiple sessions, participants will discuss security and the information space, technological and cyber security, safety and the national economy, as well as safety and the human as an individual — a member of society. The theme of the second day is defining global development trends in science and Latvia's potential for participation. Scientists will work in six sections of the following science fields: natural sciences, engineering and technology, medicine and health sciences, agriculture and forestry, social sciences and humanities. During the third day, participants will look into the future and at the concluding forum *Formula of Latvia 2050* they will discuss Latvia's development scenarios and suggest solutions. In the conclusion, they will adopt the Congress Resolution.

WRITTEN BY LĀSMA VAIVARE

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EDITION

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COMPARING COSTS TO BENEFITS

In the last three years 39 % of companies needed funding for developing and implementing new products and services, says research carried out by *Altum,* a finance institution, and SKDS, marketing and public opinion research centre, which asked the opinion of Latvian companies working in the field of smart specialization. Even though companies cannot always succeed in attracting the necessary funds, and their business ideas do not always turn out to be viable, this is considered good news, confirming that Latvian companies have a need to develop and are not resting on their laurels. On the road to development, the turning point might be meeting a true scientist at the right time. Yes, science-based ideas entering the market might be slow and they might require a large amount of investments, but their added value is expected to be higher.

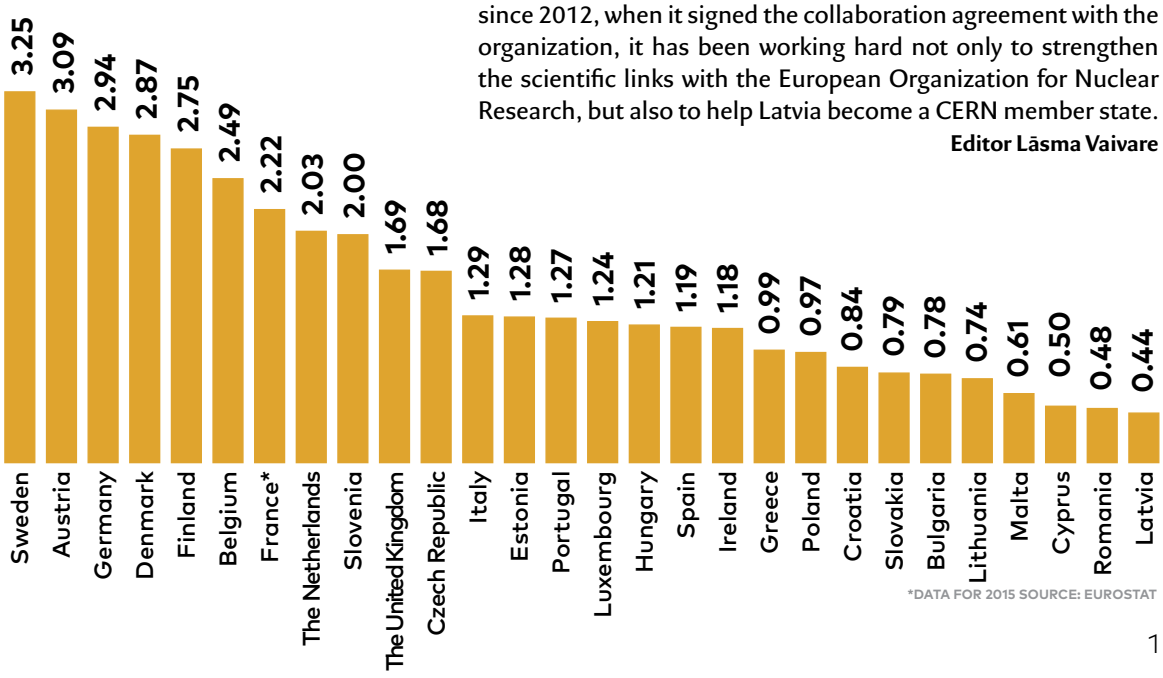
We are not arguing about the fact that to ensure economic growth, we need research & development investments, however, the current situation is not anywhere near positive. Research and development investments in Latvia are low, it is a long way to go before we reach the goal we have defined, that is, 1.5 % of GDP until 2020 and 3 % of GDP in 2030. It will also take us time to reach the EU average. In addition, when looking at statistics, we see that Latvian companies that decide in favour of technological innovation, often prefer to invest in new equipment, machines, and software, instead of research. When comparing costs to benefits, it is very likely that the return on investment from new technologies will become visible faster.

As for Latvia becoming a member of the European Organization for Nuclear Research (CERN), there is the timely question about comparing costs and benefits. Looking at the considerable membership fee, we should keep in mind that CERN is the most important centre for researching particle physics and innovation, where the most advanced scientific discoveries take place, and they influence global development.

RTU is confident that CERN membership will accelerate the development of Latvia's science and business fields, that is why since 2012, when it signed the collaboration agreement with the organization, it has been working hard not only to strengthen the scientific links with the European Organization for Nuclear Research, but also to help Latvia become a CERN member state.

Editor Lāsma Vaivare

Research & Development expenditure (% of GDP) in 2016



*DATA FOR 2015 SOURCE: EUROSTAT

text / Lāsma Vaivare
photo / Sintija Zandersone, LETA, Elīna Karaseva, Gundega Preiss

MIRACLE TREE

This white powder does not taste or smell like anything, says Uldis Peipiņš, Lead Researcher of the Faculty of Materials Science and Applied Chemistry of Riga Technical University (RTU), who is encouraging us to taste betulin — a valuable substance hidden in birch bark. It can help fight severe illnesses, improve your well-being and appearance, and keep food fresh longer

LEARN MORE

How to get pure betulin?

Watch the video!

rtu.lv/innovation

/magazineinnovation

After a long winter, many people drink birch sap to make their bodies stronger and to purify themselves. The penchant for birch sap inherited since ancient times has been turned into a business by active Latvian companies, e.g. *Sula* Ltd., and *Kainaiži* Ltd., which sell not only sap, but also beverages, syrups, even wine made from it. Whereas AS *Madara Cosmetics*, a cosmetics manufacturer, replaces water with birch sap in its anti-aging cosmetics line, and its positive effect on human skin was proven thanks to *in vitro* studies carried out at the Faculty of Biology of University of Latvia. The company claims that it is the first anti-aging cosmetics line based on birch sap. Betulin obtained from birch bark — a substance that makes bark white — is not yet widely used, even though it is being actively researched at the scientific institutions in Latvia as well as elsewhere in the world; it

is also being produced, for instance, in China. However, compared to its Chinese counterpart, betulin produced in Latvia is cleaner and of higher quality, claims U. Peipiņš, who invented, designed, and built the equipment for producing betulin on his own. Now the equipment is used in the Institute of Organic Chemistry and Technology Laboratory of RTU to produce betulin for research purposes. In the future, RTU researchers want to commercialize the technology using *Support for Commercialization of Research Results*, a program administered by the Investment and Development Agency of Latvia (LIAA). «Betulin, a substance we could offer to food, cosmetics, and food supplements companies will be commercialized. Who will do that, how it will happen, depends on the commercialization strategy,» says the researcher.

Byproduct

Birch bark is an industrial byproduct from manufacturing plywood and furniture, researchers do not go into woods to rip *skin* off trees. From the point of view of producing betulin, its resources are inexhaustible, says U. Peipiņš. «More than the amount of water in the Baltic Sea,» he draws a comparison. To obtain betulin, bark in the RTU laboratory is grinded, a solvent is used to extract its valuable substance, the liquid is separated from birch bark grist, from which betulin is secreted. «Betulin is a natural product, and we must deliver it to people in the most environmentally friendly way. Our policy from the moment we began our research has been — no harmful substances and the cheapest possible technology that consumes as little energy as possible. Only human and environmentally friendly substances and techniques are used to obtain the cleanest betulin with high added value. You can taste it at any technological stage. Our biggest asset is a relatively easy method for refining betulin until it turns into a white powder with high basic substance content. Admixture of other substances is so negligible that it is not considered a mixture — it is a pure chemical of a certain quality,» boasts the RTU researcher.

It has been tested for heavy metals because researchers do not know where the birch tree was growing. The presence of heavy metals was not detected. «In the future we will be developing betulin production and testing all batches. It is essential when using betulin as food and food supplements,» U. Peipiņš points out.

INFORMATION

__Development of a new anticancer drug for rare tumor therapy related to lupane triterpenoids
__Goal – to create inter-university research groups and develop interdisciplinary and commercially viable research, RTU and RSU are working on a scientific collaboration project with the goal to develop new lupane pentacyclic triterpenoid derivatives with anti-tumor properties for rare tumors
__Funding: EUR 150 000, split into two parts and provided by RTU and RSU
Period: from February 2016 to February 2019

SOURCE: RSU

Healthy and fresh

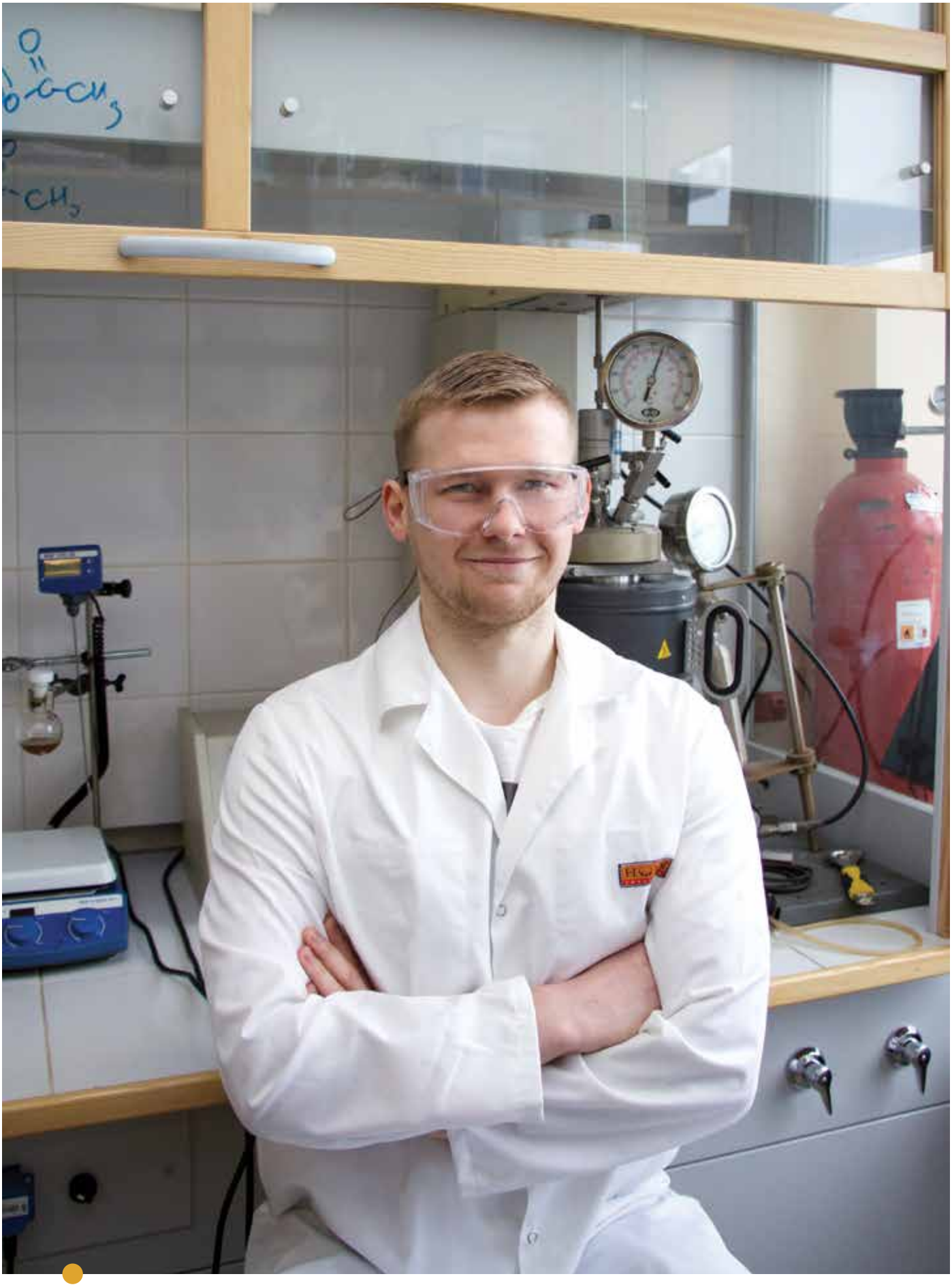
The valuable properties of betulin allow for its wide use. «Betulin obtained from birch bark, and its natural compounds help maintain the body's immunity, preventing the formation of malignant cells, serving as a preventative measure. Betulin is also used in producing medical cosmetics. It has been proven to improve the healing of microscarring and skin regeneration ability. Its capacity to regenerate liver has also been proven,» says Māris Turks, Academician and Professor of RTU Faculty of Materials Science and Applied Chemistry. As for food production, for example, adding betulin to dough results in bread that stays soft for longer, continues U. Peipiņš, adding that smell and taste do not change. This substance could prolong storage life of other groceries, for example milk, meat and meat products. Research has been started in collaboration with Latvia University of Life Sciences and Technologies (LLU) on the use of betulin in food production.

Beat cancer

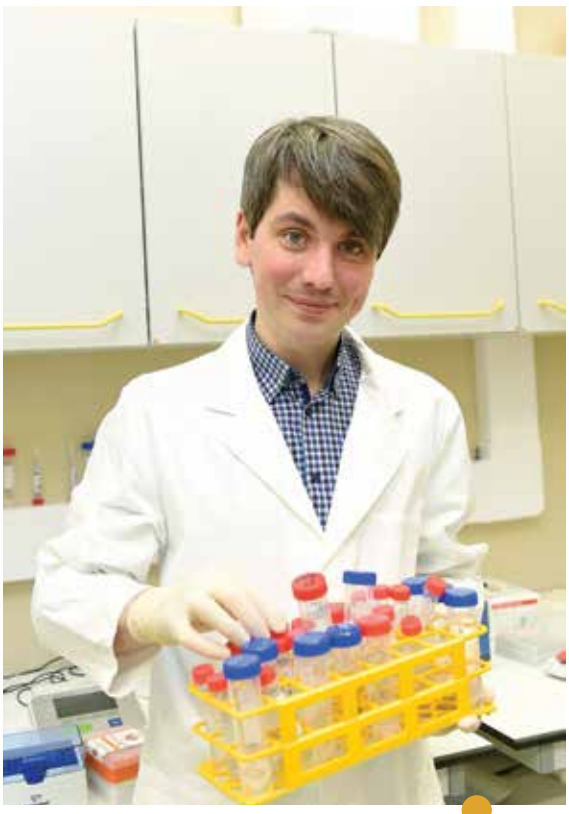
They are also researching its potential to beat rare oncological diseases — an ongoing interdisciplinary study in collaboration with Rīga Stradiņš University (RSU) will conclude in 2019. In this study, betulin obtained in the RTU laboratory serves as a raw material to create betulinic acid and new derivatives. M. Turks notes that betulin's oxidized forms — betulinic acid and betulonic acid — have the highest value-added. «Birch bark has betulinic acid, but there is not much of it. The economically profitable way would be to obtain betulin from birch bark, then synthesize it into betulinic acid and betulonic acid — make the same thing nature does, but only using a flask. We have patented the purification process, because, if we want to position the product as interchangeable with its natural counterpart, we must guarantee that it has no other chemical residues, there is only «the power of nature»,» explains the professor.

RTU gives the new derivatives to RSU, where its researchers check the biological activity of the newly synthesized substances. They have checked several dozen of newly synthesized substances on various tumor cells for anticancer and other toxic activity properties, says Reinis Vilšķērsts, Assistant Professor of RSU and leading researcher of Latvian Institute of Organic Synthesis (OSI). «The goal is to find compounds that would kill tumor cells without damaging healthy cells. So far, we have found one substance that is practically harmless to healthy cells, but it can kill tumor cells. It is interesting that new betulinic acid derivatives selectively show cytotoxic activity against several types of tumor cells,» informs R. Vilšķērsts. There are also derivatives that kill both tumor cells and healthy cells. It is important to take note of that if you are a researcher — it gives information on how to continue synthesizing substances. Next, the collaboration project envisages to research how compounds affect angiogenesis — how substances can affect the creation of new blood vessels. «When a tumor is growing, new blood vessels are created so that tumor cells can feed on them and receive oxygen. If substances suppressed this process, it could affect the further advancement of clinical or preclinical studies. It is also important to find out the metabolic stability of the substances so that they would not degrade immediately after having been injected in the body and would be able to do their job — kill tumor cells,» the researcher continues.

Developing new betulinic acid forms and its derivatives is one of the fields pharmacologists in other countries are also working on. The problem is that betulinic acid is poorly soluble and it has a low bioavailability, hence the need to find a state that would help achieve the necessary therapeutic window and be effective, says R. Vilšķērsts.



«Our biggest asset is a relatively easy method for refining betulin until it turns into a white powder with high basic substance content,» says Uldis Peipiņš, Lead Researcher of the Faculty of Materials Science and Applied Chemistry of Riga Technical University.



text / Lāsma Vaivare
photo / Evija Trifanova, LETA

For all it's worth

<u>When birch bark is used to obtain raw materials for producing binders for composites for cosmetics and wood, only potassium nitrate is left over, and it too can be used — as a mineral fertilizer</u>

«The goal is to find compounds that would kill tumor cells without damaging healthy cells,» says Reinis Vilšķērsts, Assistant Professor of Rīga Stradiņš University and leading researcher of Latvian Institute of Organic Synthesis.

Dream of new medication

«It may seem like nothing special — rare tumors, probably only a handful of people have them. That is false. Tumors are considered rare if fewer than five patients per 10 000 people have them. However, there are a lot of rare tumors. Of more than 16 million oncology patients worldwide 4.3 million have rare tumors. As much as 25 % of all tumors are rare. In addition, they are poorly researched and there are no suitable medications. Which makes patients' five-year survival rate even 20 % lower than of those who have more common tumors,» R. Vilšķērsts justifies the immediate importance of their research.

The derivatives synthesized by RTU researchers work well on multiple brain tumor types. Anticancer properties of all derivatives are compared to betulinic acid properties. So far scientific literature shows that betulinic acid works well on melanoma, brain, ovary tumors, whereas, for example, breast, colon, and kidney tumors are unsusceptible to this substance.

R. Vilšķērsts admits that every pharmacologist's dream is to see on pharmacies stock new medications that had been developed with his participation. There is still a long and expensive way to go before betulinic acid derivatives become such a medication. However, even though turning natural substances into a valuable health product is difficult, it is not at all impossible.

LEARN MORE

How do researchers study the use of betulinic acid and derivatives in the development of anticancer medications? Photo gallery

rtu.lv/innovation
/magazineinnovation

This is how the researchers of Latvian State Institute of Wood Chemistry (IWC) suggest converting all birch bark.

In collaboration with *Latvijas Finieris*

Contract research carried out by IWC and *Latvijas Finieris* commissioned by the Forest Sector Competence Centre will conclude at the end of this year. The aim of the project is to develop a new technology, complete the prototype and adjust it for obtaining birch bark extract (betulin) with high added value for the industrial scale cosmetics market. So far, they have created an industrial scale technical process and equipment, used in the IWC laboratory to produce birch bark ethanol powdered extract, which is to be used in creating eco-friendly cosmetics and biocosmetics; they have performed analyses and prepared documentation so that potential customers can test the product.

The betulin extracted in IWC laboratory is not pure, it is a blend of extracts. You can see the difference, too — the powder produced in RTU laboratory is white, the lined-up jars in IWC laboratory have a pale, pale brown, and a slightly darker brown powder inside. The equipment is bubbling with a brown liquid — it is extracting substances. In a big bag you see crushed birch bark, a little further — boxes filled with birch bark pulp, left over after obtaining its extract, to be used in producing suberic acid. «Our advantage is that we try to convert all birch bark into high added value products,» points out Aigars Pāže, researcher of the institute.

Our advantage is that we try to convert all birch bark into high added value products, points out Jānis Rižikovs, leading researcher of the Latvian State Institute of Wood Chemistry and Aigars Pāže, researcher of the institute.

«Our institute produces unrefined betulin, whereas the research team lead by professor Māris Turks (RTU) extracts betulin and removes impurities, so that it can be used to perform chemical synthesis and obtain new compounds,» he denotes the different aims of RTU and IWC. The researcher, referencing the institute's technological research part previously implemented as an EU Structural Funds project resulting in numerous publications, a patent, and a membership in the Green Technology Incubator with the aim to commercialize betulin, stresses that refining betulin results in separation of valuable compounds. They give betulin additional properties and biological activity, which can be useful in cosmetics and other industries: «The birch bark ethanol extract complex that we create has antioxidant, preservative, and emulsifier properties, as well as skin wound healing properties.» However, if in the future the demand for highly purified betulin increases, the experience will allow for a quick switch in the direction of its production.

Extracting and using betulin is being actively researched worldwide. According to A. Pāže, German company *Amryt* AG, have had one of the most serious successes in its usage: it has created both a cosmetics line and a medication for healing skin wounds. The European Medicines Agency has registered the medication. When asked why the contract research focuses on the usage of betulin in cosmetics, A. Pāže reveals that it is the «happy medium». The creation of a new pharmaceutical product requires gigantic financial and time resources, while food prices are relatively low, which limits the possibility to recover funds invested in research and development, which would be significant for potential customers. «Entrepreneurs want results. They are not as interested in scientific evidence as they are in potential market, volumes, and etc.,» he adds, smiling. In addition, even though the idea of using betulin in cosmetics is not new, it is not possible to buy raw betulin materials for cosmetics, which are customized and tested especially for the cosmetics market. The research attempts to fill this niche. The contract research also concludes that the product could be used in producing food supplements, which is being verified.

The researchers are not going to work on product commercialization, it is the task for *Latvijas Finieris*, says A. Pāže. At the moment, the company refrains from making comments on processing birch bark. In 2016, when the project just started, news agency LETA reported: even though daily production has generated byproducts, they are already used rationally and a large part is also exported, *Latvijas Finieris* is interested in expanding the possibilities of using byproducts.

Replacing formaldehyde

After birch bark has gone through the process of extracting, its residue contains suberin. In the wild, suberic acid helps plants create a protective barrier against environmental impact. However, studies have found that suberic acid can be used in binders of natural origin to glue wood composites, for instance, chipboard, and plywood, as a replacement for phenol formaldehyde resin that is used currently, says Jānis Rižikovs, IWC leading researcher. Method for particleboard manufacturing without using formaldehyde has been pa-

tented. «During manufacturing and service life, formaldehyde resin evaporates, it produces harmful cancerogenic compounds,» reminds J. Rižikovs, and adds that in the future its usage could be significantly limited or banned altogether. Even now, several products are monitored for whether they exceed the allowed amount. As, when using natural resources there will be no need for harmful substances to produce composites, the researcher expects that in future the suberic acid will be used, especially because «it would be a logical next step for obtaining an extract from birch bark. What could be done with what is left over?»

Under the leadership of J. Rižikovs IWC carries out the EU Structural Funds project on converting birch bark into ecological fiber biocomposites and products with a high added value. In turn, using Investment and Development Agency of Latvia (LIAA) program *Support for Commercialization of Research Results*, it is expected to commercialize the technology. «We know in what ways to use ecological binders, but we must find evidence for market traction,» says the researcher.

Patent Office advises

What are the things you must absolutely know about intellectual property protection if you want to start a collaboration between researchers and companies?

Confidentiality, and, once more, confidentiality

To obtain a patent, it is important for the invention not to be publicly known. One condition for the patentability of an invention is its novelty (invention must be original and it should not contradict technical-level information that is publicly available).

Research if there is anything similar. Searching *Espacenet* is sufficient.

When the inventor decides that he has made a new invention or even before he has started working on it, it is worth it to search for patents and find out whether the invention has already been made and whether it is protected somewhere in the world. This way, an inventor can avoid patent infringement, save his time and not spend it to create his invention and do the necessary paperwork, thus saving his resources by not paying for the patent that could be legally challenged and avoiding punishment for patent infringement. Search for patents could give impetus to finding new solutions.

Anybody can search for patents using any database, publicly available or paid, or one can entrust it to experienced professionals. One of the most commonly used open access databases is *Espacenet*, developed by the European Patent Office, which currently offers interface customization options for the Latvian language.

Information on patents can help its users to avoid developing an already known solution, evaluate the patentability of their invention, get acquainted with patents submitted by other users, find collaborators and licensors, avoid violating the rights of others by submitting one's invention, identify patents from competitors that are no longer valid, and gain ideas for possible technology improvements.

From 1 October 2016, as part of a pilot project, the Patent Office in collaboration with the European Patent Office (EPO) provide the opportunity for inventors, companies, research and education institutions to find out the *patentability* of their invention.

Any relationships (inventor/applicant, applicant/manufacturer, etc.) must be contract-based

This is the most important prerequisite, especially for situations when disagreements about rights arise between applicants and inventors. In that case, contracts that have been signed at the beginning of cooperation are important. If there are none, it is difficult to prove your rights.

Before starting commercialization, check whether anyone else holds the property rights

In this case, the search query is specific — to search for patent purity or freedom of action. Carry out a dedicated search for all patents that are valid in a certain country to make sure that the inventor does not infringe them with his product. This search will help you make sure that other valid patents are not infringed.

Ask an advice of professionals

The Intellectual Property Information Centre belonging to The Patent Office provides information and advice on intellectual property issues, offers advice on searching for patent information and using databases, as well as searches for patents, trademarks, and industrial designs.

text / Lāsma Vaivare
photo / Zane Bitere, LETA, publicitātes Photo

Science and business accelerator

Even before Latvia becomes a full member of the European Organization for Nuclear Research (CERN), its doors are slowly opening for Latvian companies; Primekss, a company that manufactures innovative concrete, is involved in a collaboration project that could serve as a springboard to unprecedented markets

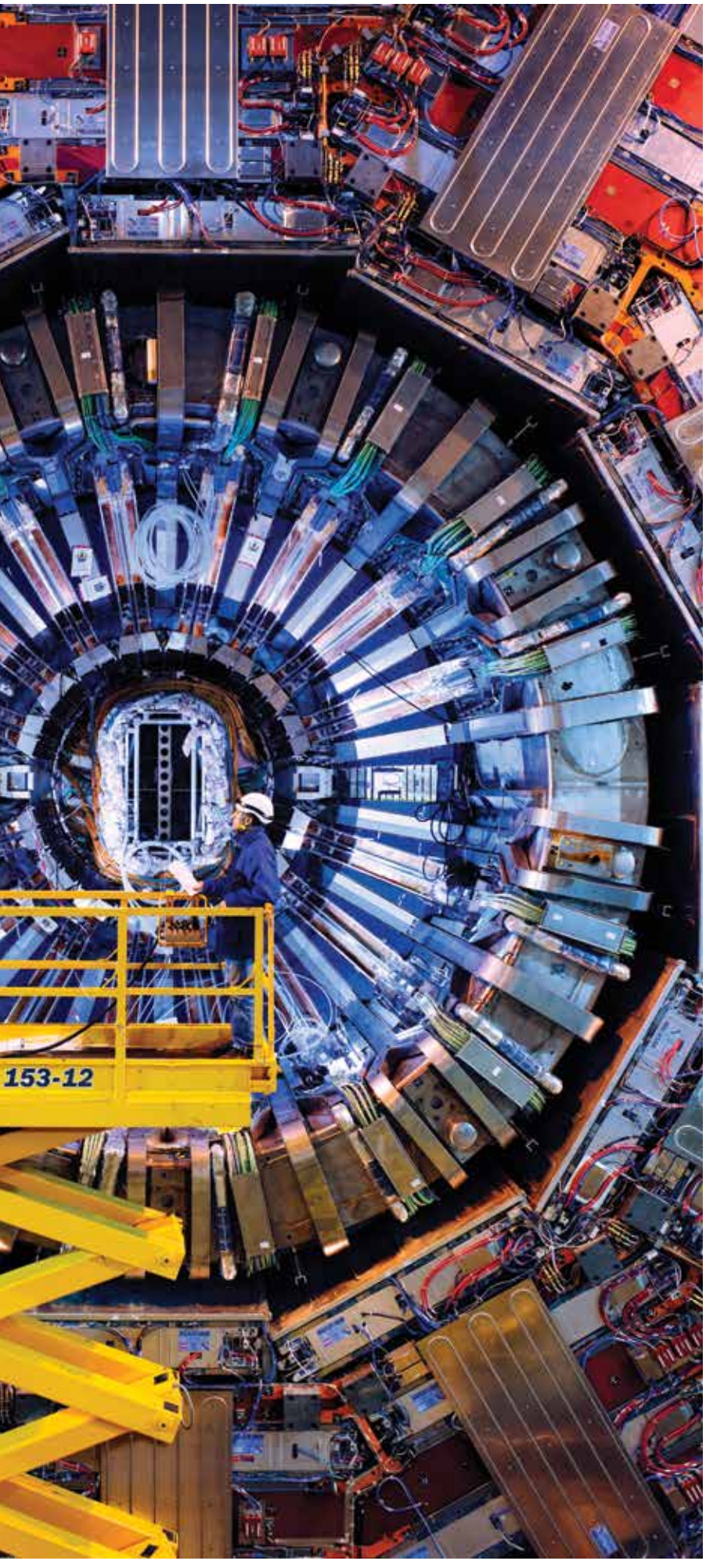
«To be chosen by CERN is a great honour for *Primekss* concrete,» says Jānis Ošlejs, the company's CEO. *Primekss* Ltd. is one of Latvia's most innovative and successful exporting companies, its composite material is acknowledged as a smart material praised for its endurance, flatness, longevity, and sustainability, and the company has earned its place on the global market as an industrial concrete flooring manufacturer.

In collaboration with Riga Technical University (RTU), the Institute of Solid State Physics of the University of Latvia (CFI), and CERN, the company plans to find ways to manufacture concrete with a focus on increased radiation safety as part of a joint research and development (R&D) project. «We must take special measures so that radioactive particles do not enter the environment, for example, because of cracks in buildings. The concrete we make prevents cracking, but we must examine how radioactive materials influence that,» explains Rolands Cepurītis, the company's chief technology officer. J. Ošlejs adds that the concrete is waterproof and gas proof. The research intends to determine the properties of concrete when it gets in contact with gas, especially tritium, whether it is possible to reinforce concrete with other materials, for example, glass fiber that is used today instead of steel fiber. They would have to test the material for its ability to prevent fluid infiltration as well, for instance, heavy water infiltration.

Potential partners have already been assigned their area of responsibility in the R&D project. CERN has the experience and infrastructure necessary to work with radioactive materials, it would ensure end product testing by checking its compliance with the requirements of the organization. *Primekss* would take care of advanced concrete samples, RTU would help with concrete solutions and testing for the evaluation of its mechanical properties, but CFI would carry out gas diffusion measurement for the new material. CFI is experienced, and has developed a technology for measuring how well the material can detain gas (gas diffusion), says Andris Anspoks, Deputy Director for innovations, adding that the greatest challenge for the project is the ability to detain helium. «We are researching diffusion in fuel cells. After discussions with the company, we understood that our technology needs to be only slightly modified so that it could be applied to this study,» he continues.

New opportunities

If after implementing the R&D project *Primekss* has the rights to manufacture and sell concrete with enhanced properties, the company will have access to unprecedented niche markets, admits the technology officer. Even now, *Primekss* is active in export markets, the number of which is nearing two dozen. The solution would have a practical application in business, for instance, in the petroleum industry — Toms Torims, Latvian representative to CERN, Director of RTU Centre of High Energy Physics and Accelerator Technologies, points out a specific



Latvia's Road to CERN

1996 The Institute of Electronics and Computer Science (EDI) takes part in one of the most important scientific experiments carried out by CERN: CMS (*Compact Muon Solenoid*).

Until 2000 The Institute of Solid State Physics, University of Latvia (LU CFI) joins the *Crystal Clear* project.

Until 2011 Researchers of University of Latvia (LU) and Riga Technical University (RTU) successfully participate in the *Baltic Grid* project.

January 2012 RTU decides to start direct collaboration with CERN, Raimonds Jansons, the Latvian Ambassador to Geneva, restores contacts with CERN.

April 2012 Leonīds Ribickis, RTU Rector and Academician, together with RTU delegation visits CERN, meets with CERN Director-General and agrees on the next strategic steps.

October 2012 CERN signs the collaboration agreement with RTU. Consequently, there is now a possibility to organize guest lectures by various CERN researchers in Latvia, visits of Latvian doctoral students, teachers, and students to CERN, participation in CERN scientific experiments and research projects, and participation in EU-funded projects coordinated by CERN. Students have the opportunity to join summer schools.

January 2015 RTU scientific delegation visits CERN, they identify numerous areas of scientific collaboration – power electronics and energy, material handling technologies, robotics, and materials science.

November 2015 RTU signs the Memorandum of Understanding with CERN on membership in the *Further Circular Collider* (FCC) research project. RTU researchers are actively working on the new concept development for the FCC tunnel, its operation and repair, for example, using robots and telemanipulation, as well as *additive manufacturing* using lasers. FCC research features conceptual design development, which includes integrating FCC in the existing CERN accelerator complex, but with significantly higher energy levels and resolution than previous accelerators (SPS, Tevatron, LHC).

«The concrete we make prevents cracking, but we must examine how radioactive materials influence that,» explains Rolands Cepurītis, the Primeks chief technology officer.

niche market; J. Ošlejs and R. Cepurītis both consider him the catalyst for the collaboration between CERN and *Primekss*. «We had no clue that CERN is interested in us,» J. Ošlejs is being honest.

Collaboration with CERN or being a «CERN supplier» is an internationally recognized mark of quality and excellence for companies. Taking part in CERN projects unlocks the opportunities to work with other scientific laboratories, for example, the space industry, says T. Torims and adds «we are a small country, so this is a huge opportunity for us». *Primekss'* managers agree, stressing that there are opportunities not only for innovative manufacturers or IT companies — CERN outsources a lot of IT solutions applicable for any business. It is a large financially reliable organization that also needs basic things, for example, pencils or toilet paper. In 2017, CERN budget was almost EUR 960 million.

Latvian road towards CERN is possible due to the determined activities of RTU. Since 2012, when the university signed the collaboration agreement with the organization, RTU has been working hard not only to strengthen the scientific links with the European Organization for Nuclear Research, but also to help Latvia become a CERN member state. The main objective of CERN is to ensure the operation of international large-scale research infrastructure for the physics research of high-energy particles. Presently three Latvian scientists work there — the abovementioned T. Torims, Artūrs Ivanovs and Viesturs Veckalns, who work there on their Doctoral theses. Likewise, Latvian scientists have the opportunity to join CERN science experiments and research projects. Even though the founding purpose of the organization was to provide infrastructure for European scientists, it is not simply a large laboratory used for researching high-energy particles, but also a place for research, technology, and innovation collaborations, creating everyday things and services and later introducing them for production. These include now almost commonplace things like the internet, touch screens, CT scans, etc.

Primekss is not the only Latvian company, which is interested or could potentially be interested in working with CERN. *Nuclear Medicine Centre* Ltd., which partly belongs to Riga Stradiņš University (RSU), is interested in joining CERN-MEDICIS, the goal of which is to ensure the acquisition of radioisotopes used in diagnostics and therapy. *Baltics Scientific Instruments* Ltd., a manufacturer of various measuring instruments, is also interested in joining, confirms Vladimirs Gostilo, President of the company. The company develops and makes nuclear electronics, detectors, sensors, spectrometers, scintillators, specific software, and custom

MORE INFORMATION

__European Organization for Nuclear Research (CERN)
__European scientific organization that researches fundamental physics and develops a very wide variety of technologies.
__The most important centre for particle physics research, innovation, and scientific discovery in the world.
__CERN invented the internet, and, using the Large Hadron Collider, found the Higgs boson – an elementary particle that gives things mass – existence.
__Established in 1953.
__It has 22 member states.

SOURCE: RTU

> Latvia sees CERN as an important partner for scientific and technical capacity building and innovation transfer from science to production, and the country can offer its contributions to a series of projects implemented at the organization.
>
> MĀRIS KUČINSKIS
>
> PRIME MINISTER

measuring instruments, and it has experience with CERN projects. Now they wish to renew the collaboration. V. Gostilo knows that presently only US companies can offer equipment of equal worth. The Latvian company could create competition and influence the service prices. «As soon as Latvia becomes an associate member or full member, CERN will be obliged to purchase devices from the Latvian company — this is what we call the European priority,» adds T. Torims.

At the beginning of this year, the government entrusted the Ministry of Education and Science (IZM) to draft a contract for the Latvian government and CERN on Latvia joining CERN as an associate member state in the pre-stage to membership. The Ministry plans to prepare and submit the contract to the government until the end of the year and become an associate member state in the pre-stage to membership in 2019. The status will give Latvian companies and scientific institutions the right to participate in CERN public procurements and research projects, and use the CERN infrastructure. The Ministry of Education and Science analyzed CERN public procurements from member states and associate member states in 2015 and concluded that 25.6 % has been in the field of electronic engineering and energy industry, followed by 16.9 % in civil engineering and construction, 8.8 % in structural engineering, and 8.1 % in computer systems and communications.

In various industries

«It is difficult to name a field that CERN is not willing to collaborate in,» admits T. Torims. The Ministry of Education and Science, too, summarized information on the competence and capacity of Latvia's high-tech companies and named the following range of technology development and services as having potential for collaboration with CERN: accelerators, magnets and cryogenics, detectors and measuring instruments, electronics, information and communications technology, materials science and mechanics. Among the companies interested in getting involved in procurements, are, for example, *Kepp EU* Ltd., a silicon metallurgy company; *SAF Tehnika,* a company that makes unique microwave transmission equipment; *Vizulo,* a company that makes and sells LED lamps; *Hanza Matrix,* a manufacturer of 3D displays, optics, amplifiers, and LCD optical equipment;

March 2016 RTU agrees to participate in the ARIES project coordinated by CERN — together with other European top scientific institutions. It is an integrated project with the goal to develop European particle accelerator infrastructure. It is co-financed in accordance with *Horizon 2020,* the European Commission program for financial instruments for research and innovation. Until 2021, they plan to improve particle acceleration efficiency, availability, and sustainability, by transferring the advantages and usability of the acceleration technology both for the needs of science and society, as well as expanding and integrating European particle accelerator user community. Three RTU research teams take part in ARIES.

October 2016 Kārlis Šadurskis, Minister of Education and Science, and Fabiola Gianotti, CERN Director-General, sign the agreement between the Government of the Republic of Latvia and CERN on scientific and technical collaboration in high-energy particles.

May 2017 Māris Kučinskis, Prime Minister of Latvia, sends a letter to CERN Council, expressing the wish for Latvia to become a CERN member state, but not before becoming a CERN associate member state.

May 2017 RTU collaborates with CERN and the Ministry of Education and Science to hold the CERN science week. Latvia welcomes CERN officials and scientists to discuss Latvia's potential membership in CERN with Latvian officials, and they discuss collaboration with companies. CERN scientists deliver lectures, a unique interactive exhibition is held featuring the large hadron collider's tunnel where the Higgs boson was found.

September 2017 Māris Kučinskis, Prime Minister of Latvia, and Kārlis Šadurskis, Minister of Education and Science, visit CERN and meet Fabiola Gianotti, CERN Director-General to discuss partnership options between Latvia and CERN.

September 2017 RTU Senate's decision to establish the RTU Centre of High Energy Physics and Accelerator Technologies. Its main goal is to develop interdisciplinary fundamental research in the fields of high-energy particles and acceleration technology with the help of scientific and academic staff, industry, and students involved in nuclear research.

December 2017 RTU and LU Consortium becomes a member of CERN experiment — CMS (The Compact Muon Solenoid). The CMS experiment is one of four experiments related to CERN LHC, and its goal is to observe and record new physics phenomena. Membership opens up opportunities for CMS scientists to get directly involved in a world-class scientific experiment, work on par with the world's best scientists.

January 2018 Latvian companies visit CERN, entrepreneurs acquaint themselves with CERN, its current programs, projects, and technology requests.

January 2018 During the World Economic Forum in Davos, Prime Minister of Latvia Māris Kučinskis meets Fabiola Gianotti, CERN Director-General, and confirms Latvia's intention to join CERN in the near future.

February 2018 RTU holds the first meeting, where representatives of leading Baltic universities and CERN management discuss the possibility of creating international study programs; the envisioned program is interdisciplinary, it combines fundamental and applied sciences — particle physics and acceleration technologies. The program is necessary to enable students in the Baltic States acquire knowledge required for collaboration with CERN.

February 2018 Government entrusts the Ministry of Education and Science to draft a contract for the Latvian government and CERN on Latvia's joining CERN as an associate member state in the pre-stage to membership. The status will give Latvian companies and scientific institutions the right to participate in CERN public procurements and research projects and use the CERN infrastructure.

April 2018 RTU holds the CERN Spring Campus, an intensive training course for students, its topic is related to information technology and computing.

May 2018 RTU collaborates with the Ministry of Education and Science and organizes exhibition CERN — Science Accelerator, where Latvians are introduced to CERN activities and scientific achievements.

SOURCE: RTU

> CERN is an important business partner, collaboration with it guarantees stable long-term contracts. CERN is not bound by EU regulations, which makes procurements easier, faster, and designed specifically for small and medium-sized companies. It also observes the principle of «geographic balance», and Latvia would have its own industrial relations representative at CERN, who would be responsible for ensuring that Latvian companies get orders from CERN.
>
> TOMS TORIMS
>
> LATVIAN REPRESENTATIVE TO CERN, DIRECTOR OF RTU CENTER OF HIGH ENERGY PHYSICS AND ACCELERATOR TECHNOLOGIES

EUROLCDS Ltd, which opened the biggest liquid crystal display factory in Europe five years ago in Ventspils. Admittedly, as for the information and communications technology (ICT) industry, which is very important in particle physics, CERN is one of the most important driving forces for ICT achievements, as they invented the internet — *Mikrotīkls* Ltd., and AS *RIX Technologies JSC* may be interested in orders.

As for materials science, potential companies include *Sidrabe*, manufacturer of vacuum coating technology equipment and tools, *Groglass,* a company that makes *invisible* glass, and *Tenachem,* a major player on the construction sealing market, etc. We cannot rule out that orders may be interesting to companies in other fields.

Do your homework

Before we can reap benefits from CERN, Latvia must meet several criteria, and one of them is having commercially viable companies and the ability to show their potential and competence in taking part in CERN procurements. We must also show our political will to join CERN, the state must commit to supporting its membership in this organization long-term. To achieve that, we need considerable financial resources — more than one million euro per year. The good news is that for the most part, CERN budget is spent on developing and maintaining scientific infrastructure that is available to all participating countries. There must also exist a scientific community for high-energy particle physics, and the country must commit to its long-term support. To comply with the criteria, at the beginning of this year, leading universities in Latvia, Estonia, and Lithuania established the CERN Baltic Group, which created international Master and Doctoral study programs in particle physics, so that Baltic students could acquire knowledge necessary for collaboration with CERN and be useful in industry — in companies that work in the fields related to particle acceleration. It will be an internationally unique interdisciplinary program combining fundamental and applied sciences — particle physics and accelerating technologies. The plan is that students will have internships at CERN, University of Latvia could teach particle physics, and RTU will be in charge of the technologies part.

MORE INFORMATION

Since 2012, when the collaboration agreement was signed with CERN, Riga Technical University (RTU) has been working hard not only to strengthen the scientific links with the European Organization for Nuclear Research, but also to help Latvia become a CERN member state.

SOURCE: RTU

text / Dita Arāja
photo /personal photo

The green life of vessels

A solution found in the depths of the European Organization for Nuclear Research (CERN) — an innovative technology for exhaust gas cleaning developed by Polish scientists

Polish scientists offer to clean emissions by placing a particle accelerator inside the vessel's mechanism. Toms Torims, CERN scientific associate, RTU Professor and Director of the Centre of High Energy Physics and Accelerator Technologies (second from the left) with Polish scientists.

Vessels are one of the world's largest ocean pollutants — they use cheap fuel which produces harmful emissions. But it will not stay like that for long — the International Maritime Organization has introduced rules setting that until 2020 it is necessary to reduce leakage of toxic chemicals, so sailors will have to find new solutions. An international team of researchers, together with the maritime transport industry, has started working on its implementation, and Riga Technical University (RTU) Centre of High Energy Physics and Accelerator Technologies has been appointed the project coordinator, and the development of the prototype for the new technology will be carried out at the Riga Shipyard, in Latvia.

SOx and NOx are hard to clean

The maritime transport industry is a notable business — around 90 % of cargo flow takes place along the sea routes. The IFO 380 marine fuel combustion creates sulfur dioxide (SO_2) and nitrogen monoxide (NO) which are respectively referred to as SOx and NOx. However, based on the UN regulation, after two years, its leakage will be limited and sailors, if they want to continue their business activities, will have to clean the emissions before they get into the atmosphere, says Toms Torims, CERN scientific associate, RTU Professor and Director of the Centre of High Energy Physics and Accelerator Technologies. Known emission treatment technologies are expensive, so no one in the industry is in a rush to implement them. For example, to clean up SOx, we need a large amount of energy and ammonia. It is a financial burden because a medium-sized vessel would need one filter that costs around EUR 1.5 million, and it is dangerous as well, because ammonia would have to be kept on board. It is also difficult, as none of the methods we know about can be used for both sulfur dioxide and nitrogen monoxide. Each of them needs its own method — this is expensive and difficult.

Key word — particle accelerator

While becoming aware of the technologies created by CERN, T. Torims identified the technology developed by a ARIES (Accelerator Research and Innovation for European Science and Society) partner the Warsaw Institute of Nuclear Chemistry and Technology, which can clean up harmful vessel emissions for half the cost of currently known and used technologies.

Polish scientists offer to clean emissions by placing a particle accelerator inside the vessel's mechanism, to be more precise — inside the funnel— that would use an electron beam to irradiate exhaust gas created after burning the fuel, dividing it into «easy fractions» The «processed» emissions can later be cleaned with traditional methods, consuming much less energy and not using ammonia, as well as, which is particularly important, cleaning both SOx and NOx at the same time.

After identifying the technology, T. Torims has received a CERN mandate to bring the project forward, and it has given him the opportunity to meet Polish scientists. «They have carried out tests, combusted the fuel, and proven that the technology works,» says T. Torims.

Cleaning of vessel exhaust gas is an acute problem, a bomb with a timer for any seaman, that is why exhaust gas cleaning project involves all stakeholders — European Commission, which is responsible for maritime surveillance; the most significant shipping lines, such as *Mediterranean Shipping Company,* which is the largest container carrier in the world, and passenger carrier company *Grimaldi Lines*; accelerator technology manufacturers; and scientists. Project funding is provided both from CERN ARIES, whose goal is to develop European particle accelerator infrastructure, and from contributions made by the members of the project.

The above-mentioned invention is undergoing a patenting process, but we do not have the answer to the question whether the innovative technology is going to work on a vessel that is vibrating and swaying. That is why the prototype for the new technology will be created and tested at the Riga Shipyard in the coming months.

Invention of Warsaw scientists created while collaborating with CERN, is much more versatile and can be widely used — not only in vessel mechanisms, but also, for example, for cleaning ballast water and heating plant exhaust gases, so it will, most likely, have a significant impact on creating and implementing greener technologies both on water and on land.

HUMANS ARE IMPORTANT

The pharmaceutical industry depends on human laziness: we want pills to do the work for us. But laziness is not going to help fight cancer

Vitālijs Skrīvelis, Chairman of the Association of Latvian Chemical and Pharmaceutical Industry, *Nukleārās medicīnas centrs Ltd.* (Nuclear Medicine Centre) and *PharmIdea, Ltd.* admits it in the interview. His professional activity for years has been related to attempts of defeating cancer and he shows no signs of stopping. Initially positioned as a company that makes anticancer drugs, *PharmIdea* has become a fast-growing pharmaceutical company that is developing, manufacturing, and selling sterile dosage forms all over the world. Nuclear Medicine Centre was opened two years ago and is the first Latvian research centre with the objective of increasing the number of cured oncological patients using a progressive and precise technology — positron emission tomography / computed tomography (PET/CT) — that makes it possible to visualize the disease at a very early stage, namely, when there are changes in cell metabolism. The method lets us see growths as small as a few millimeters, as well as gives us information on cancer «behaviour», for instance, how aggressive it is, whether it is growing quickly or slowly, or whether metastatic growths have developed; it also lets us early determine the efficiency of radiotherapy and chemotherapy. One of the most important devices of the Nuclear Medicine Centre is

Text / Lāsma Vaivare
Photo / Zane Bitere, LETA

We must be there, in CERN, says Vitālijs Skrīvelis, Chairman of the Association of Latvian Chemical and Pharmaceutical Industry, *Nukleārās medicīnas centrs*, Ltd. and *PharmIdea*, Ltd..

the cyclotron. The cyclotron complex is providing development of different radiopharmaceuticals for onco-diagnostics

V. Skrīvelis is convinced that we would be able to fight the evil disease more efficiently if we used benefits from Latvia's membership in the European Organization for Nuclear Research (CERN). With the co-owner — Riga Stradiņš University (RSU) — serving as the intermediary, Nuclear Medicine Centre wants to take part in MEDICIS, a CERN project with the goal to secure the acquisition of radioisotopes used in diagnostics and therapy.

Cancer remains unbeaten. Why?

We do not really know why. Some say the cause is genetics, others say it is pollution, and then there are those who say the lifestyle is to blame. The most important factor probably is that our immune systems are so weakened that they cannot control what is happening. Cancer cells keep forming all the time, our bodies are big and complex... Human skin replaces itself in a week, hair grows all the time, gastric mucosa does too, blood completely replaces itself in a month... Of course, this process might have errors. The bigger and more complex a machine is, the more often it tends to break. Our body is a biological machine, and our immune system is the one that recognizes overexcited cells, and, as long as the immune system is in good condition, it kills the cells on its own. But what happens if the immune system is weakened? It is my theory. We damage our immune systems ourselves. What do we see around us? Complete urbanization. Sedentary lifestyle, mass-produced food, nonstop stress — it all builds up. You must be disciplined to keep yourself healthy. Ideally you would do sports

at least twice a week, and every day, in the morning or in the evening you would have a session to get rid of stress. But our lives are different... The rhythm of life in capitalism is very rapid, we are bombarded with a huge amount of information. There is no time left. Meditating in the evening, doing yoga, taking a walk in nature — each of us must find a way to get rid of stress. Yet we are not doing it. I also do not always practice what I preach. Sometimes it is easier to drink a glass of wine in the evening. At the same time in Europe the five-year survival rate has reached 56 %, which makes cancer a chronic disease instead of a lethal disease in Europe and the US, similar to diabetes or high blood pressure. We have not reached that level yet.

In oncology diagnostics we use ultrasonography, CT scans, MRI, biopsy tests. The crazy part is that cancer is not one disease — there are hundreds of them. PET/CT scans bring together radiology and histology.

We had a patient, the man was 68 years old, he had a surgery to remove prostate cancer and he should have been fine, but after three years he was tested again, and we found an increased cancer marker. The cancer has returned. Cancer sooner or later will return anyway if the patient is not disciplined, if he does not follow a ketogenic diet — proteins and fat, excluding carbs. This diet makes cancer starve, because it wants carbs, it wants sugars, it makes his growth easier. Test results of the man mentioned above showed the precise location of cancer and we could choose what kind of treatment to perform — operate, use rays, or radiosurgery.

Why elsewhere cancer is a chronic disease and not a lethal one?

It is discovered at an early stage, it is not allowed to develop. This is the number of PET/CT tests in other countries per one million inhabitants (showing statistics) — almost 4000 in Italy, the Benelux Union, almost 2000 in Scandinavia. As soon as a patient's cancer markers begin to increase, they are sent to undergo tests.

The good news in Latvia is that we at Nuclear Medicine Centre are working on the next step — *theranostics*. It combines diagnostics with therapeutics. This will allow us to diagnose cancer and irradiate it at the same time. If the immune system is at least somewhat alive, after irradiation it will recognize cancerous lesions as a foreign substance and will kill them on its own. At the same time the body starts to create antibodies, which means that the body forms additional immunity to cancer cell fragments and the next relapse time regresses.

Now *theranostics* is developed for prostate cancer. A prostate cell is round like an egg, and when it turns malignant, it becomes similar to a hedgehog, radioisotopes sit down on «hedgehog's» spines and «pull out» from third or fourth cancer stage.

> We must cure people and make them reenter the workforce as soon as possible. We cannot let them die or become disabled!
>
> VITĀLIJS SKRĪVELIS
> CHAIRMAN OF THE ASSOCIATION OF LATVIAN CHEMICAL AND PHARMACEUTICAL INDUSTRY, NUKLEĀRĀS MEDICĪNAS CENTRS, LTD. AND PHARMIDEA, LTD.

CERN have researched numerous radioisotopes. Member states that jointly pay the organization over a billion push CERN to focus more on medicine. I was surprised when I got there — they were creating antimatter in the same hangar. Can you believe that? Negative protons.

Is it possible?

Turns out that, it is. And they say that at some point they will use it to cure cancer. I asked them how – proton flow will come into contact with my skin and inflict a burn, but how will it affect the internal organs? They explained that it would not happen, from a proton's point of view humans are transparent because humans have space between molecules and atoms. Depending on how much energy is given to the antiproton, it will go through, it will push normal electrons away with its elbows, and the moment it runs out of gas, it will stop and explode. We must only calculate and focus the beam so that the explosion happens in the cancer cells. They work at that level.

We must be there (in CERN). I was also skeptical at first, why do we need to pay a million? But, after being there, I understood that it is a must to rise from our duck pond level to the level of thinking of people at CERN, and to how they create technologies. If this million has my tax money, I am voting for paying.

Taking part in MEDICIS would give us an opportunity to try and use isotopes?

Yes. A membership would grant us access to already patented technologies, otherwise we — patients' wallets or state budget — would have to pay for them. Now funds for innovations are available, why would we not use the money and take part in CERN-MEDICIS, as top 20 universities in Europe are already taking part?

Nuclear Medicine Centre cannot directly take part in MEDICIS, it must be a non-governmental organization, scientific organization or a university. It would be logical for RSU to take part.

It is thanks to RTU Professor Toms Torims that we know CERN. He motivates us to go ahead and get involved, because it is an opportunity to jump on the CERN train before Latvia joins the organization.

So far, the Nuclear Medicine Centre has had no relation to CERN?

No. Our cyclotron is a baby compared to the ones at CERN.

In 2007, I established a pharmaceutical laboratory that develops anticancer drugs, but I quickly understood that chemotherapy poisons people more than it cures them. At least I think so. I am continuing to develop other drugs that need to be injected, those that are used in, for example, gynecology, resuscitation. I have not discarded the idea to fight cancer, I am looking into what else can be done for the sake of Latvian people. In 2011, I put together funding from European Structural Funds, bank loan, RSU funding, and my own savings to create a positron emission centre, thinking long term. That is why we decided to add a cyclotron, so that we do not have to ship the necessary short-lived isotopes from Germany or Finland, which is expensive, but produce them on our own. This is how the first Baltic cyclotron complex was created.

Is the pharmaceutical laboratory you just mentioned *PharmIdea*?

Yes.

It is no longer a small laboratory, it is an important company.

We had five people when we started. Now there are 70, our revenue is growing.

«We damage our immune systems ourselves. What do we see around us? Complete urbanization. Sedentary lifestyle, mass-produced food, nonstop stress — it all builds up,» says Vitālijs Skrīvelis, Chairman of the Association of Latvian Chemical and Pharmaceutical Industry, *Nukleārās medicīnas centrs* Ltd. and *PharmIdea*, Ltd..

The Nuclear Medicine Centre has been active for two years. Do patients believe in the efficiency of services and use them, considering the price?

For the most part, patients are sent by their doctors. Considering the poverty of our health financing, doctors send relatively few people to us. They say — patients do not have money even for medication, how can we recommend a 1000 euro test to a patient? But the test price is justified — isotopes are expensive, they must be radioactively synthesized with glycose under sterile conditions. Glycose helps mark cells — cancer eats the sugar and flashes like a Christmas tree.

We have an average of 30—40 patients per month, to live somewhat normally we would need 100—120 patients. Doctors send patients to our centre when all other tests fail to give a clear answer. Imagine a situation — a doctor suspects a disease, and to make sure, he sends a patient to perform an ultrasound test, which shows something, but there is no certainty if it is a disease. Then they send the patient undergo a CT scan. Even taking into account fast access to cancer treatment, there are situations when a patient is waiting in line for a state-funded test, and even the test does not give an explanation. Then they do an MRI, which is a very good diagnostic test. Patients wait in line again. Several tests may take up six, even eight months, but an aggressive tumor can double its volume in 40 days! There are two million inhabitants in Latvia, a large part of them are senior citizens and children. We must cure people and make them reenter the workforce as soon as possible. We cannot let them die or become disabled!

In Lithuania, the state pays for 2000 patient tests per year, in Estonia the number is 1200. This year our government also promised to pay for services and provided EUR 240 000. This means paying for 250—270 patients. Considering the total number of cancer patients – nearing 80 000 — it is insufficient. Yes, even European guidelines say it is an expensive method, but the timely detection of relapse should definitely be encouraged.

Our patient data also shows that chemotherapy does not help or helps partially in 40 % cases, we should stop doing it and use something else. This too must be detected in a timely manner. And this data comes from 30 patients per month.

When the centre was opened, you had three key areas — diagnostics, radiopharmaceutical manufacture, and research. You are manufacturing radiopharmaceuticals and have received a certificate of good manufacturing practice. Can you sell the drugs to someone else?

Not yet, right now we are going through the registration process. Radiopharmaceuticals must be registered like medicine. Maybe we should have started sooner, but we hoped for a higher number of patients and we did not pay that much attention to exports. Now it is clear that exports are needed. There are Lithuanians, some Ukrainians, but mostly local patients. It is clear that we cannot only diagnose, especially if we think about medical tourism, we must offer treatment, which we will provide using the *theranostics* method.

Research — how is the segment developing?

Right now, by research we mean development of new products. We do not do academic research. We are thinking about offering new diagnostic drugs for neuroendocrine tumors and one therapeutic drug for curing prostate cancer. We must return a loan of EUR 3.4 million, it is not a walk in the park. That is why we are considering solutions for widespread oncological diseases, for example, prostate and breast cancer.

In recent years, Latvia received considerable private investments for cancer diagnostics and medical services. Why? Is the country not able to manage on its own?

The calculation is quite simple. In every country, even the poorest, on average 5 %

of inhabitants are wealthy. You can calculate whether the business will flourish.

A very successful example of private investments in health care in the recent years is the *Orto Clinic*, and it is straight across the road from the Hospital of Traumatology and Orthopaedics.

No one wants to wait in line for a hip replacement surgery.

Exactly, everyone wants things now, they want a rapid rehabilitation. Today's philosophy is that we live in the present, we enjoy every day because we do not know what might happen after five years.

***PharmIdea* product portfolio has things other than anticancer drugs.**

I understood that chemotherapy is not the best decision. In curing cancer, there are three equal components. One third is medications and doctors, second is diet, and the third is a physically and mentally positive and active lifestyle. Only then you can overcome the disease. But we are lazy. The pharmaceutical industry depends on human laziness: we want pills to do the work for us. From a biologist's point of view, I can say that a human's natural state is being lazy. That is why I bought a wristband that counts my steps, monitors my heart rate, and tracks my sleep.

Does that make you more disciplined?

Yes, somewhat. I feel a rush when I pull myself together and walk at least 10 000 steps, climb the stairs, do not take the elevator. In recent years my business projects were difficult, developing *PharmIdea* also was not simple, *Nuclear Medicine Center* is also having a tough time, I am nervous, I cannot fall asleep during some nights, so this wristband disciplines me, it makes me think about what I should do to make my sleep quality better — might as well ride a bike in the evening or take a shower and let water wash off the stress and bad thoughts. Think, discipline yourself!

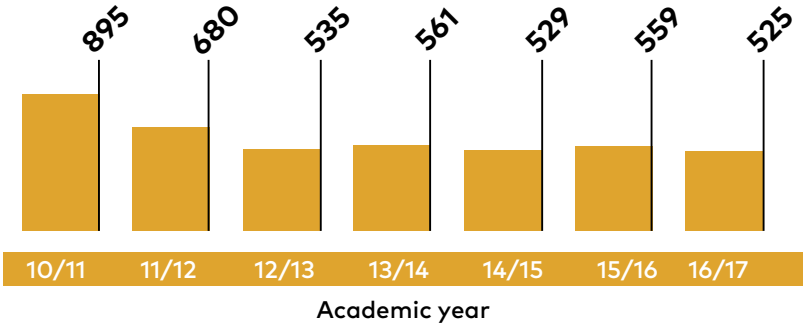
You mentioned that the country needs people. The Association of Latvian Chemical and Pharmaceutical Industry has for several years been loudly proclaiming that the industry lacks experts.

It is a very sensitive issue since chemistry and physics exams are no longer mandatory. Last year around 12 000 teenagers graduated from high school, and only 500 took the chemistry exam. Having talked with intelligent teachers, turns out that every class has at least six children that are good at exact sciences, six more can be motivated to study. Roughly they make up around 40 % of all children. 40 % of 12 000 children equals to five thousand, not 500. Teachers, do you want higher wages? How do we achieve this? We must generate more taxes. It is possible if we manufacture and export, because there is money where seven billion live. To manufacture, we need people that are good at exact sciences. We either import Belarusians, Ukrainians, and Russians, even if we do not want this, because Greeks and Spaniards will not come here because of low wages and climate, or we motivate our teenagers. Universities, too need to fill state-funded places, so they take students with English and math exam grades... and during the first semester, the majority drops out, because they are not able to study, as they have not done it in school. If we want skilled young people, we need to give up the idea that everyone should get a little extra: we only give bonuses to physics and chemistry teachers, so that they can teach better. There is a shortage of teachers. If we are working towards the economics of knowledge, let us go for it instead of just talking about it.

> In curing cancer, there are three equal components. One third is medications and doctors, second is diet, and the third is a physically and mentally positive and active lifestyle. Only then you can overcome the disease. But we are lazy.

VITĀLIJS SKRĪVELIS
CHAIRMAN OF THE ASSOCIATION OF LATVIAN CHEMICAL AND PHARMACEUTICAL INDUSTRY, NUKLEĀRĀS MEDICĪNAS CENTRS, LTD. AND PHARMIDEA, LTD.

The number of students who have taken the centralised exam in chemistry



SOURCE: ASSOCIATION OF LATVIAN CHEMICAL AND PHARMACEUTICAL INDUSTRY, NATIONAL CENTRE FOR EDUCATION OF THE REPUBLIC OF LATVIA

step 1

BUSINESS PLAN DEVELOPMENT

- Performance of technical and economic preliminary study
- Preparation of commercial strategy

step 2

PERFORMANCE OF SCIENTIFIC WORK AND TECHNOLOGY DEVELOPMENT

- Performance of industrial study
- Experimental development
- Prototyping

step 3

IMPLEMENTATION OF COMMERCIAL PLAN

- Participation in international exhibitions, contact exchanges, conferences and seminars abroad, individual visits, participation in LIAA-organised national stands and trade missions
- Strengthening of industrial property rights
- Preparation of commercial offer
- Preparation of licence agreement and other agreements for transfer of intellectual property
- Submission of property rights patent, signing of licence contract or establishment of company

SOURCE: LIAA

Go bananas

text / Lāsma Vaivare
photo / Sintija Zandersone, LETA

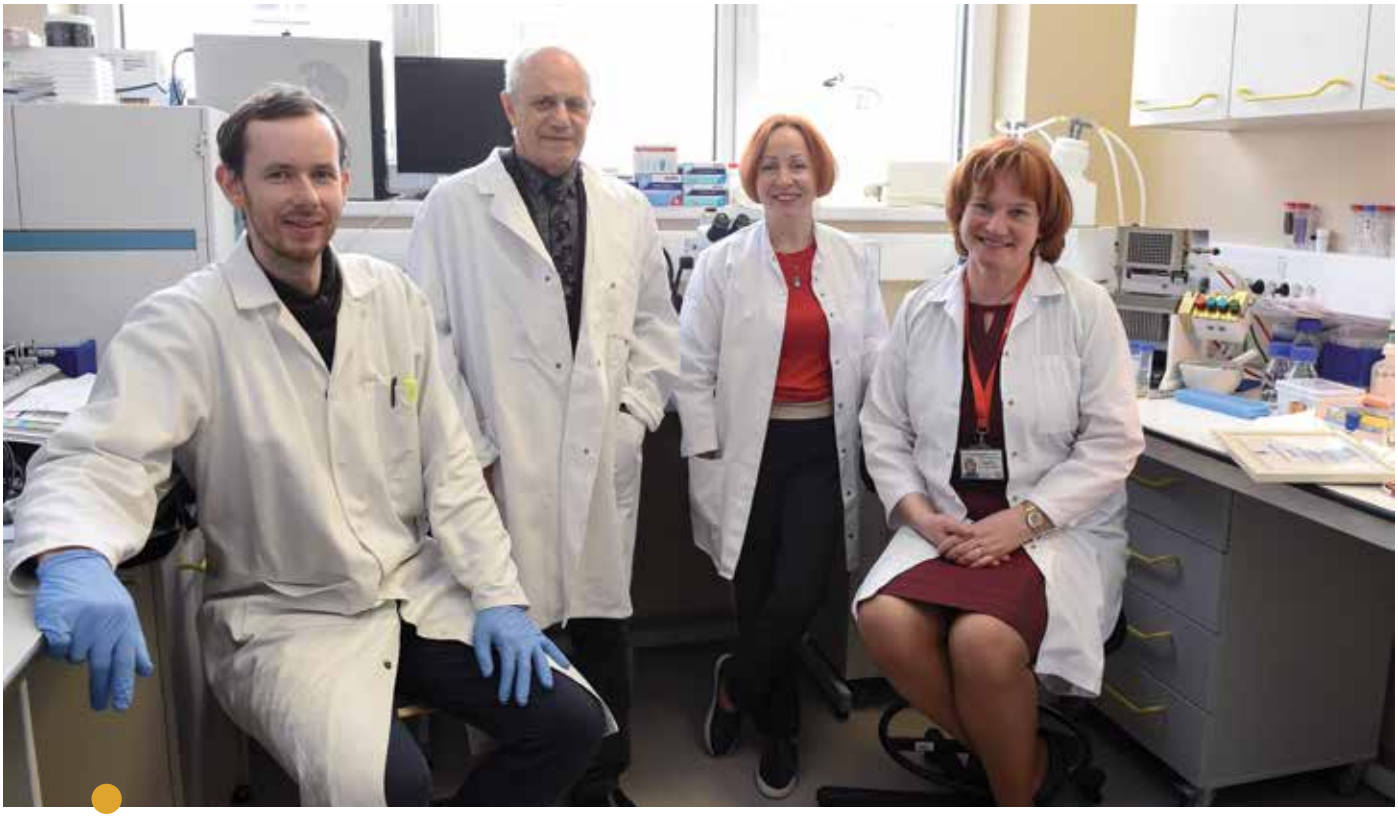
Business consultants help Latvian scientists sell new medications, medical devices, special diagnostic services, and vaccinations that could be used to cure serious illnesses and save lives

«This is an attempt to make our product more attractive to prospective buyers with the help of business experts,» admits Maija Dambrova, Head of the Laboratory of Pharmaceutical Pharmacology of Latvian Institute of Organic Synthesis (IOS) and academician about IOS membership in the *Support for Commercialization of Research Results* program administered by the Investment and Development Agency of Latvia (LIAA). The product M. Dambrova mentioned is a new candidate medication for treating epilepsy that is ready for clinical trials.

IOS have synthesized compound E1R or methylphenylpiracetam, which is the first known positive allosteric modulator of the sigma-1 receptor that improves memory processes and prevents seizures, which could be used not only for treating epilepsy, but also Alzheimer's. It was viewed favourably by the Latvian Academy of Sciences, recognizing it as one of the most significant scientific achievements of the past year, having various patents and publications. However, they were developing the commercialization strategy and having discussions with experts, and the conclusion was that they needed to focus on one diagnosis only — epilepsy. The funds provided by the program are not sufficient for developing candidate medications for both diagnoses; another limiting factor is time, Līga Zvejniece, leading scientist, explains the reasons. At first, they tested and patented the compound's effect of memory improvement, research related to preventing seizures followed later. In addition, clinical trials for treating Alzheimer's are expected to go on much longer, it is more difficult to recruit patients for testing Alzheimer's compared to epilepsy, adds M. Dambrova. As a result, a pharmaceutical company interested in buying candidate medication would be pressed for time to be able to make money with their new drug before patent protection period runs out. This would definitely make the candidate medication less attractive. As for epilepsy medication, the fact that the potential drug also has a memory improving effect is a huge advantage, continues L. Zvejniece, adding that the drugs used now have several side effects, including memory impairment. «Current drugs help around 70 % patients, 30 % remain untreated. Same patients are susceptible to side effects. Around 45 % of all patients would be happy to use other methods," the researcher estimates.

Chemists were not thrilled

Developing E1R took a long time, it started with researching phenylpiracetam, but the turning point, according to M. Dambrova, was L. Zvejnieces's naïve question about whether they could modify the compound. Chemists were not particularly thrilled. «I nearly lost all hope. Synthesizing is difficult. Young researchers, who took on the project, after a couple of months called me and said that there was a compound. I could not believe it, it was impossible. When I reported it to the director, he reacted the same way. But they managed to develop the compound. This was the first good news. We received the second after a few years, when an original molecular-level reaction mechanism was discovered,» notes Academician Grigorijs Veinbergs. Even though synthesizing E1R cannot be called a coincidence, nevertheless, IOS representatives admit that they cannot deny the success story of discovering a new drug. Good luck and hard work must go hand



Latvian Institute of Organic Synthesis have synthesized compound E1R or methylphenylpiracetam, which is the first known positive allosteric modulator of the sigma-1 receptor that improves memory processes and prevents seizures, which could be used not only for treating epilepsy, but also Alzheimer's. Part of the researcer team: (from the left) Edijs Vāvers, Grigorijs Veinbergs, Līga Zvejniece un Maija Dambrova.

in hand to make a drug that ends up on pharmacy shelves. «You can go bananas if you join the pharmacy business,» says M. Dambrova smiling. It is risky, it needs a lot of time and money, so IOS continues to «improve our sales package so that prospective buyers can be sure about the diagnosis and that the substance is really working and is harmless. As evidence we still require separate preclinical studies,» L. Zvejniece adds. Prospective customers are pharmaceutical companies interested in neuroprotective agents.

Even though IOS closely collaborates with the industry, they carry out commercial research, regularly communicate with industry representatives, scientists admit that the technology transfer program is a new experience for the whole institute. To obtain successful results, they invited an experienced foreign expert, who has worked in a variety of projects: from academic collaboration to selling candidate medication to business sharks.

Vaccine against Lyme disease

It is possible that the development of the commercialization strategy might help Latvian Biomedical Research and Study Centre (BMC) researchers choose their area of focus while developing a vaccine candidate against Lyme disease. That is, both pharmaceutical and veterinary medicine companies may be interested in it, as now, there exists no vaccine-against the tick-borne Lyme disease for people, but the one made for animals has some side effects, explains Kaspars Tārs, leading BMC researcher and academician. He admits that in a sense, veterinary medicine is more attractive. Developing vaccines for people is very expensive and time-consuming; creating new products in veterinary medicine is also difficult, but the likelihood of coming to a final product is far greater. Andris Zeltiņš, BMC leading researcher, chairman of the scientific council, adds that if a vaccine can effectively protect animals from contracting a disease, it is a sign that it could work on people.

«Lyme borreliosis is a widespread disease both in Europe and North America, it has no vaccine, there are antibiotics that help, but after a successful treatment for some time people still feel like they have not fully recovered yet. It would be worth it to develop a vaccine, similar to how it is with tick-borne encephalitis now. In the 90s of the last century, the US had a vaccine, but patients complained about its side effects, so it was removed from the market,» recounts K. Tārs. After having carried out research and worked on projects for years, researchers have come to creating a vaccine candidate that has already been tested on bacterial preparations and on animal models. In collaboration with New York State Department of Health, they have successfully tested it on mice. As part of the technology transfer program, they intend to carry out an in-depth study and improve the vaccine candidate based on virus-like particles. Virus-like particles are virus coat proteins without the nucleic acid, and you can attach, for example, proteins taken from other surfaces to their surfaces, as well as using them as carriers for foreign antibodies. «Lyme borreliosis causes bacteria, their surfaces have a lot of proteins. We have, so to say, borrowed several proteins and mounted them on virus-like particles cause an immune response,» K. Tārs briefly explains the process.

As for developing new vaccines, we can also use plant-derived virus-like par-

MORE INFORMATION

Who conducted the study on the compound E1R?

Photo gallery

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ticles as the main component, adds A. Zeltiņš. Under his leadership, BMC hopes to commercialize idea about a technological platform for vaccines based on plant-derived viruses. Virus-like particles are structured like macromolecules, which visually resemble viruses; when such structures enter human or animal bodies, they cause a virus-like immune response. That is, the human or animal body thinks that it is a viral infection, so it reacts with a strong immune response, which results in producing antibodies for eliminating the virus. «You can use it not only for developing preventive, but also therapeutic vaccines, in addition it works against not only infectious diseases, but also against allergies, including food allergies, as well as autoimmune diseases,» explains the researcher. During the project it is expected to find one or several plant-derived virus-like particles that have not been patented or publicized and could serve as a base for various vaccines, so the project is called a «technological platform for vaccines». «As an analogy, a car engine made by one manufacturer can be built into cars made by several manufacturers,» A. Zeltiņš draws a comparison.

The first attempt was a dud

The technical and economic feasibility study and commercialization strategy for both projects accepted during the second selection round organized by LIAA are intended to be developed by the middle of summer. Until then, the strategy for development of personalized breast cancer molecular diagnostic test for selecting drugs and monitoring the course of the disease must also be ready. This BMC project was accepted by LIAA during the first selection round last year, however, the business person in charge of the strategy development could not finish his work on time and his work was of substandard quality. Consequently, the contract had to be terminated and the procurement procedure repeated, admits Aija Linē, cancer test project manager, leading researcher at BMC, and Academician.

Faster and more efficient

«We want to create a test that would allow us to help breast cancer patients choose the most appropriate treatment, monitor the course of the disease during treatment, and detect its relapse,» explains the researcher. The test would consist of three parts — the first would determine mutations in tumor cells helping to determine precisely what kind of

As for developing new vaccines, we can also use plant-derived virus-like participles as the main component.

ANDRIS ZELTIŅŠ
LEADING RESEARCHER AND CHAIRMAN OF THE SCIENTIFIC COUNCIL OF LATVIAN BIOMEDICAL RESEARCH AND STUDY CENTRE

targeted therapy is necessary, the second could assess how immunosuppressed is the tumor microenvironment. That could help patients make a decision about taking part in cancer immunotherapy clinical trials. «At the moment breast cancer treatment has no approved immunotherapy, however, there are a lot of clinical trials. Once drugs are approved, it will not be a recommendation to take part in clinical trials, but a recommendation for therapy,» A. Linē continues. Whereas the third part of the test would allow to test mutations found in the tumor in the patient's blood plasma, this way monitoring the effectiveness of the treatment and timely predicting the relapse, to change treatment methods if the need arises. «We would like to optimize the test and use it on patients to prove that it is clinically applicable. We are thinking about commercializing it by creating a spin-off company,» says A. Linē.

Riga Stradiņš University (RSU) is also on the way to commercializing a special genetic testing. RSU Scientific Laboratory of Molecular Genetics have developed a new genetic testing that is far quicker and cheaper in helping find out whether and which common genetic causes are to blame for infertility than laboratory tests used until now, informs the university. According to Inga Kempa, leading researcher at RSU, the testing conducted over one day allows them to administer a wide variety of examinations with 30 most common genetic variations that cause infertility. Up to now, tests were generally carried out separately, administered in a certain order, waiting for each answer up to several weeks, and only then deciding on further tests. Analyses had to be done with the help of a variety of facilities and often in different laboratories. The new method would make undergoing these extensive tests more efficient, moreover, it would happen at one place, using standard laboratory equipment. Consequently, the patients will have the opportunity within one day to receive an answer whether infertility is related to genetic causes, it would potentially reduce costs for carrying out various genetic testing as well. Infertility treatment is a rapidly growing industry, as both diagnostic and treatment methods are developing, the demand is also growing, as it is increasingly common for people in developed countries to want to conceive at a later age when getting pregnant is more difficult, explains RSU.

Large market

The target market for genetic testing is broad. Referring to research, RSU notes that every tenth couple is affected by infertility problems, and the reason is unknown in around 15 — 20 % cases. Researchers continue discovering new genetic variations that are to blame for infertility, but this area is still largely unexplored.

Taking into account the large market, at the end of 2016, when RSU announced the creation of this test, it hoped to patent its worldwide protection. By developing the commercialization strategy and the technical and economic feasibility study, the situation was explored, and the conclusion was that medical devices of this kind are rarely patented in other countries. RSU is searching for a potential manufacturer for their testing to sign a license agreement with, giving them the know-how and clinical data for product development and introducing it into the market, says Linda Gabrusenoka, contact manager of RSU Technology Tansfer Point. Potential licensees are already identified, negotiations have not yet been started though. Practical clinical trials are also continuing at Latvian clinics, the feedback received from them was good. Along with receiving funding for the second stage of the project for developing the commercialization, «these tests can be implemented in a new quality,» says L. Gabrusenoka.

BMC PUBLICITY PHOTO

To perform better on the thermal and power market, the development of thermal storage options in Riga near thermal power stations has been considered, says Māris Balodis, Director for Research and Development of *Latvenergo*.

text / Lāsma Vaivare
photo / Andrejs Zihičs, Latvenergo

Towards flexible and efficient production

Energy storage, optimization programs, distributed generation – Latvenergo AS pays attention to game-changing ideas that will help increase its competitive edge in the field of electricity and heating services

Decarbonization increases energy efficiency thanks to a greater use of renewable energy sources, and it is one of the goals stated in the European Union's (EU) energy policy. This entails changes in the structure of the energy industry. Participating countries optimize their power generation portfolios and the existing production capacity, increasing its efficiency and flexibility. At the same time microgeneration technologies are gradually evolving, people are looking for solutions that would reduce transmission and distribution costs. *Latvenergo* AS not only introduces innovations, but also researches potential development directions and practical applications of innovations, says Māris Balodis, the company's Director for Research and Development. The company has for decades collaborated with researchers and universities.

Future niche business

Currently a topical research is carried out in collaboration with experts from Latvia University of Life Sciences and Technologies (LLU) on energy storage and the efficiency of distributed generation sources in electrical grid. Information gathered by the Public Utilities Commission shows that the quality of power supply is gradually getting better, however, there is still room for improvement in a number of locations. For instance, the reason for its substandard quality in rural areas is long power lines built in the 70s that were meant for small loads and do not fit contemporary electric power quality requirements. Installing energy storage systems could be one of the solutions for improving power quality in long power lines that are unable to properly cover customer peak demand times. Storage systems can be combined with microgenerators (small stand-alone power generation sources). That would create an alternative power supply in areas where building power supply connections is disproportionately expensive. M. Balodis thinks that energy storage technologies in the field of electricity can be batteries made from various materials, capacitors, and flywheels. LLU study analyzes storage technologies suitable for various consumer profiles. They also plan to carry out hands-on experiments — to set up a storage system for individual customers. Sustainable system management is ensured by using modern power electronics, IT and telecommunications solutions, which is an integral part of such studies. Study results, synergized with the evaluation of using microgeneration systems, will be used for developing the «micronetwork» concept and implementing its pilot project. Potentially it will be one of future niche businesses for energy companies that will offer competitive products.

Accumulate wisely

Considering the development of power plants that use renewable resources for generating alternating current, cogeneration power plants with their efficiency determined by thermal energy sales, and the increasing changes in market dynamics, there is a need to pay attention to increase the operational flexibility of existing power plants while keeping the operating costs as low as possible.

Integrating high-capacity power and thermal energy storage technologies into existing infrastructure is of high priority worldwide, for example, *Nord Pool,* a power market, has both intraday and day-ahead markets for determining power usage. *Latvenergo* AS production consists of two major divisions — electricity generation and thermal energy production. Electricity generation depends on sales opportunities on the competitive intraday market. Whereas thermal energy production and supply to *Rīgas Siltums* is provided in accordance with demand regardless of gas prices and electricity prices on the market. Five years ago, thermal power stations in Riga (TEC-1 and TEC-2) were powered in cogeneration mode during the heating season without significant changes to their capacity, but now, according to the hourly price changes on the electricity market, the output is significantly changed, it is now in cyclic mode, as we stop the stations during the night and during holidays when demand for electricity is low and consequently the price is also low. Since the market electricity price changes every hour, but the thermal energy price changes every week, as a manufacturer of two products, when planning the operating modes for the cogeneration stations, there should be equal opportunity to operate every hour, for heat and electricity. This way, as the energy market is developing in Riga, it will ensure a more efficient use of cogeneration capacity and, accordingly, costs will be reduced both for electricity generation and thermal energy production.

To perform better on the thermal and power market, the development of thermal storage options in Riga near thermal power stations has been considered, says M. Balodis. Namely, a large volume (20 000 — 30 000 m^3) thermal battery could be built near thermal power stations. This «vacuum flask» would allow generating increased volumes of electricity using cogeneration by accumulating surplus heat, when electricity prices are high. The accumulated heat can be used for urban heating during the period when electricity prices on the market are low and cogeneration is switched off, This is the best possible way we can use cogeneration, by optimizing production and offering more competitive prices on the market. Similar projects are carried out in numerous European countries, particularly in Denmark and Germany. Operating thermal power stations in a flexible way is essential to ensure the planned synchronisation of the Baltic electricity grid with the continental Europe network (CEN).

For the needs of the local market

To optimize production, experts in collaboration with Riga Technical University (RTU) created software for planning the most cost-effective and most suitable operating mode for *Latvenergo* thermal power stations and hydropower plant, working with *Nord Pool*. «If we use optimization software, it is possible to implement mutually beneficial interplay of power used by thermal power stations and hydropower plants. All three Daugava hydroelectric power stations operate as a cascade and their operation, including water accumulation and actuation, is correlated. Taking into account Daugava's tributaries, demand for electricity, and next day market price forecasts, it is very important to plan how each station operates. Hydro generator output and efficiency factors change depending on water levels in reservoirs, which we take into account to use resources in the most optimal way. When putting into effect new power system transmission connections with Scandinavia and Poland, there has been an increase in price volatility. It increases the importance of optimization, so that producers can use all opportunities and benefits,» explains M. Balodis. The software is going to be updated with new modules. It will combine optimization options for electricity, heat energy, and natural gas markets. There are several types of optimization software in the world, but we cannot blindly copy them and use in Latvia, because of the spcifics and needs of the local market. Their customization

would require an insane amount of work. «It would be more valuable to use local scientific potential, at the same time educating these people, giving teaching staff and students an opportunity to obtain additional information, knowledge, and upgrade their skills,» says the *Latvenergo* representative.

Future transport

In the context of decarbonization, development of electric vehicles will play a big role in the energy sector. M. Balodis predicts that in the future, electric cars could become one of the components of the power supply infrastructure — «batteries on wheels». The batteries could serve as a source of energy, allowing to store energy in their «surplus moments» and use the accumulated energy without transporting it for other needs, as well as sell it. Furthermore, he speculates that future electricity markets could feature mutual transactions — selling electricity to your neighbors — that could work as small microgrid blocks in parallel with the existing trading methods. This kind of platform is a new niche business, in the future distribution system operators could also offer new products, says the Director for Research and Development. Microgrid development opens a vast field for research.

At the moment, even though electric vehicle development in Latvia is slow, there is growth potential for it both in public and private auto sectors, and M. Balodis is convinced that the time will come when electric vehicles become more profitable than fossil fuel-powered transport. This is why right now the company is doing research and working on possible scenarios for development, as well as keeping up with worldwide innovations: «We have researched the necessary substation sites and expected consumption together with *Latvijas Dzelzceļš*. When a locomotive is gaining momentum, it needs a lot of power, which creates certain network demand — it needs a high power connection, even though total consumption is not so big. However, as electric vehicles are developing, the greatest challenges await distribution system operators. If, for instance, one fifth of a small residential district chose electric cars, currently the network capacity would be insufficient for their simultaneous charging.» Because of electrification of the transport system future energy balance will see an increase in power consumption, he estimates, while thermal energy consumption can only be reduced as a result of various efficiency measures.

Researchers and entrepreneurs will meet in Riga

The power electronics industry is rapidly evolving, and in September Riga will host the largest European conference on power electronics EPE'18 ECCE , where researchers, experts, and developers of new technologies will discuss innovative ideas

The conference is organized by European Power Electronics and Drives Association (EPE) in collaboration with Riga Technical University (RTU) Institute of Industrial Electronics and Electrical Engineering. It will be offering both lecture sessions on a wide range of topics, and an exhibition that will gather industry leaders. Electricity generation and supply right now is in a process of transition to distributed generation — from traditional to renewable energy sources, and smart grid development on macro and nano levels. Smart AC & DC current research and development is complicated, and power electronics is the driving force behind new technologies. Similarly, we should not underestimate the role of power electronics in power systems — it contains different types of energy storage technologies. The conference will also focus on the issue of increasing the efficiency of energy sources by reducing electricity consumption, which is especially significant for the industry. Whereas mechatronics and adaptronics are focusing on developing industrial robots, a wide variety of health care robots and biorobots powered with AI.

The main goal of the conference is to serve as a power electronics industry forum that facilitates interdisciplinary discussions, information exchange on the newest ideas, studies, technology developments and applications.

Even though Latvia cannot boast a very big power electronics industry, it is developing and creating high added value for its national economy, young experts are being trained. The conference will give them opportunity to meet international experts, to discuss ideas and share experience. In addition, this field in Europe has very large investments for research and development of new products, and it can be an opportunity for Latvian scientists and companies.

OSKARS KRIEVS

ASSOCIATE PROFESSOR, DEAN OF THE FACULTY OF POWER AND ELECTRICAL ENGINEERING OF RIGA TECHNICAL UNIVERSITY

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RELYING ON TECHNOLOGIES

text / Lāsma Vaivare
photo / Gundega Preiss, publicitātes Photo

Where do innovations come from? How do they work? How are they different from existing solutions? Developing science-based companies is not an easy task, but it generates added value both for the economy and Latvia's image as a potential centre for technological startups

The Jury has a lot of questions for scientific startups that in a short span of time must present their company's idea, business model, development phases, and the amount of funding needed for future activities. As soon as one interrogation is over, the next person representing his startup comes forth. And questioning starts again. This is happening during the innovative technology startup competition of the international technology conference *Deep Tech Atelier* held for the first time by *Magnetic Latvia.* The Investment and Development Agency of Latvia (LIAA) organizes the conference in collaboration with the *Commercialization Reactor* — a commercialization platform — hoping that in the long term Latvia will be internationally recognized as a country with developing science-based startups that are able to attract the attention of representatives of high-tech industry and promote sustainable science and research based startups in Latvia, especially in the fields of smart specialization.

In a sense, the competition is similar to a micro-level model of the road that science and technology based startups have to take. Nikolajs Adamovičs, founder of the *Commercialization Reactor*, has admitted that turning an innovative idea into a product that can be used is difficult, time-consuming, exhausting, and bureaucratic, but the effort pays off and businesses like these contribute greater added value to the economy. The *Commercialization Reactor* has extensive experience in bringing together scientists and entrepreneurs, thus creating functional teams. At the moment LIAA carries out activities with the financial support from the European Union for commercializing scientific ideas; funding, support, and mentoring for entrepreneurial growth are also available also through various acceleration programs.

The Ministry of Economics believes that the availability of investment has a crucial role in startup growth this year — public funding of newly started acceleration funds is EUR 15 million and of the venture capital funds EUR 60 million. «The essence of acceleration is to support emerging promising ideas with high added value. In addition, acceleration funds will act as a missing link — state aid for ideas during their commercialization stage. The new funds are focused on this stage, in addition, they are focused on the segment of innovation and technologically-intensive companies,» admits Juris Vaskāns, a Board member of *Altum,* a development finance institution. *Altum's* fund managers — *BuildIt Latvia*, Acceleration Fund in collaboration with *Lattelecom* and *Accelerace,* and the Commercial Reactor Fund — selected by means of public procurement have received EUR 5 million from the European Regional Development Fund.

BuildIt Latvia program is intended for teams developing technological solutions for the industry needs with a potentially high degree of international competitiveness; the Acceleration Fund, operating in collaboration with *Lattelecom* and *Accelerace*, will primarily invest in Central European and Eastern European startups focusing on efficiency of work environment and automation; whereas the priority of Commercialization Reactor Fund is high-tech and science startups in Latvia and in the Baltics, as well as Eastern Europe and other neighbouring countries in the region. The *Deep Tech Atelier* startup competition participant *Lung Passport,* established by Belarusian scientists, engineers, and medical professionals, is the first startup approved to take part in the pre-seed acceleration program carried out by the Commercialization Reactor Fund, reports LIAA.

Breathing deeply

By combining the knowledge of Belarussian scientists, engineers and medical professionals, an application and a digital stethoscope *Lung Passport* based on machine learning technology was developed for early diagnostics of pneumonia, asthma and chronic obstructive pulmonary disease (COPD). The director and co-founder of the start-up *Healthy Networks* Helena Binetskaya was motivated by her daughter's cough to turn to searching for a new solution. She says that the new medical device allows the patients with asthma and COPD to self-assess their state of health, understand the causes for changes and the course of the sickness based on symptoms, outbreaks of disease and the surrounding environment. For families it can serve as a sort of thermometer to differentiate between pneumonia and a common cold, but for doctors — to fill in the blank spots or obtain objective information on the patient's health between the visits and symptoms that are to be paid attention to. Timely diagnostics of illness could decrease the necessity to hospitalize a patient, but the ability to differentiate between a small cold from a serious lung disease — the regularity of seeing a family doctor. H. Binetskaya assumes that it could also result in decrease of costs for health care, mentioning that the costs for approximately 500 million patients suffering from asthma and COPD are the ones that could decrease by 19 %.

Lung Passport is class IIa medical device developed in a close collaboration with the Department of Pulmonology and Physiology of the Belarussian Medical Academy of Post-Graduate Education. The main medical consultant is the Head of the Department, Pulmonologist Elena Lapteva. Clinical trials have also been carried out. The company *Healthy Networks*, which was established in the summer of last year when it attracted the pre-seed financing in the amount of 100 thousand dollars, is starting the trials in collaboration with clinics and providers of telemedicine services in May.

Deep Tech Atelier Start-up Competition finalist

Make robots work in teams

SIA *Squad Robotics* is developing a technology that allows several robots communicate with each other and work in teams, says Matīss Brunavs, the company's CEO. Currently the *Squad Robotics* is focusing on companies that produce cleaning equipment that operates in a certain way, for instance, the automation of cleaning floors would allow saving a considerable amount of money that is usually paid to cleaning operators. The company estimates that the European floor cleaning market spends EUR 7.2 billion per year for salaries to equipment managers. The system is also suitable for other business areas, for example in logistics that use indoor manually controlled machines.

Since at the moment multi-agent robot systems are not yet that widespread, *Squad Robotics* is taking small steps to reach their customers — they target cleaning companies and cleaning equipment manufacturers and offer an indoor positioning system, which unlike the Global Positioning System (GPS) used by individual manufacturers in their monitoring systems, works indoors as well.

According to M. Brunavs, «the company has long-term and short-term goals». The positioning system is a short-term goal, and if there is mutual interest, it could lead to long-term collaboration and device robotization. Equipping the presently used cleaning equipment with the positioning system, creates an opportunity to track and evaluate their operational efficiency, as well as prepare the equipment for automation.

Squad Robotics team consists of business developers and researchers from Riga Technical University (RTU), who are the technical developers of the solution. They are united by passion for an automated future.

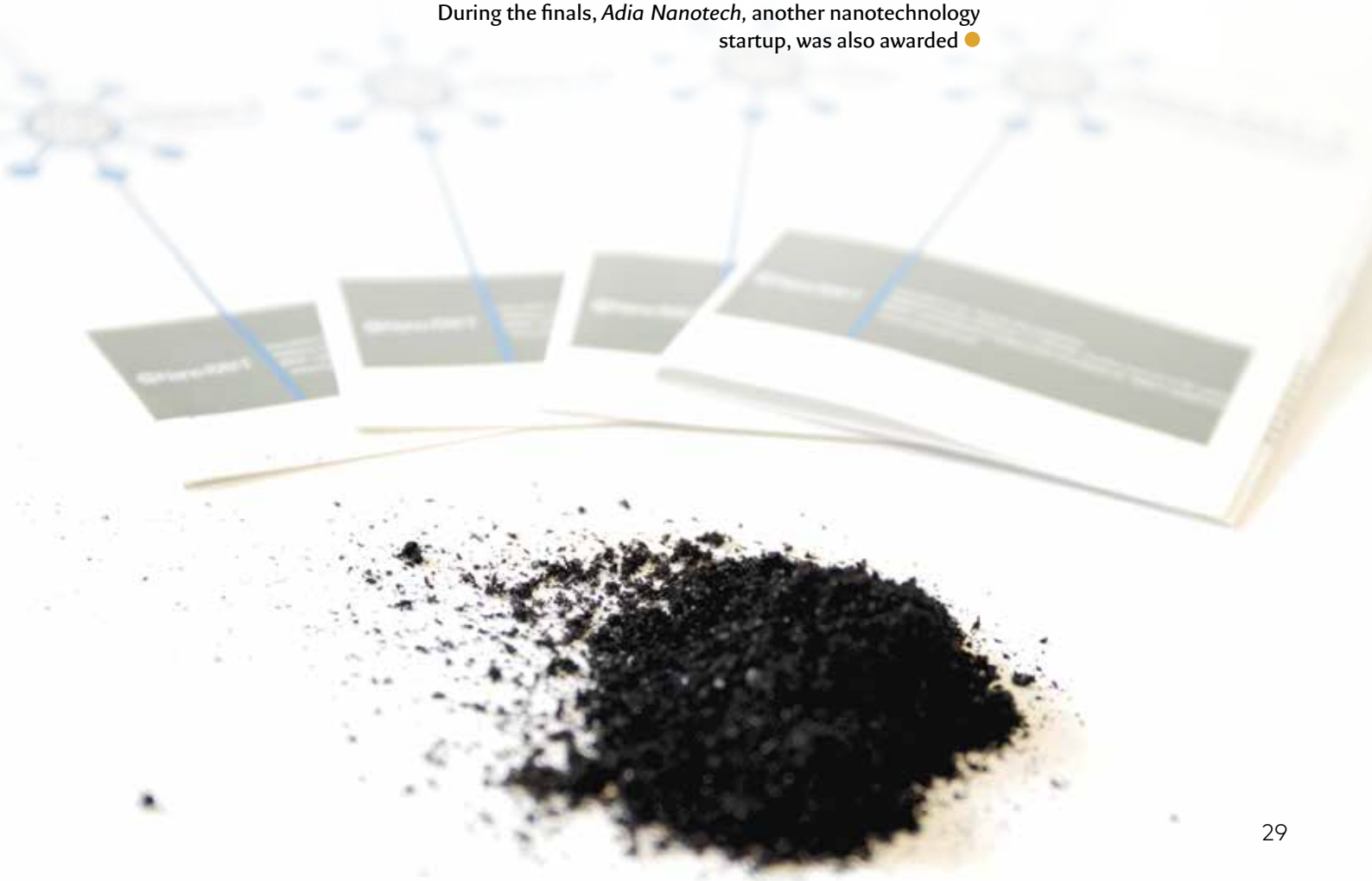
Deep Tech Atelier Start-up Competition finalist

Longer, more powerful, better

Nano RAY-T Ltd. is a Latvian high-tech company that produces carbon nanotubes with a very high degree of purity and graphene with very diverse industrial applications. That is, carbon nanotubes look like black powder, but they can be used in medicine, for example, as a part of x-ray equipment, implants, in energy storage technologies, telecommunication equipment, in explosive detection, in robotics, unmanned aerial vehicles, military equipment, etc. Laboratory prototypes for three technologies developed by the company are related to energy storage, resulting in significant battery capacity for electric cars and smart devices; x-ray technologies, extending x-ray lamp life and reducing the radiation area; and 3D printing materials, making the finished product sturdier, explains Marija Korabovska, company co-founder. *Nano RAY-T* are looking for investors to move forward – to finish their prototype and offer it to potential customers. To achieve that, the company participates in various exhibitions, and try their hand at acceleration programs. Several years ago, *Nano RAY-T* drew attention to themselves by reporting that they had sold to a French university a chemical vapor deposition (CVD) reactor meant for growing carbon nanotubes.

Nano RAY-T team consists of M. Korabovska and Marina Petričenko — both experienced entrepreneurs — and researchers working under the guidance of Aleksandrs Okotrubs, Head of the Laboratory of the Nikolaev Institute of Inorganic Chemistry of the Siberian Branch of the Russian Academy of Sciences. A. Okotrubs has been active in nanotechnology for many years.

Deep Tech Atelier Start-up Competition finalist. During the finals, *Adia Nanotech,* another nanotechnology startup, was also awarded



text / Lāsma Vaivare, Elīna Sprūde-Nesenberga
photo / LMT publicity photo

Traffic through computer's eyes

«The application areas of computer vision are very extensive increasing both the quality of traffic and life»

It is the certainty of Business Management Department Director of *Latvijas Mobilais telefons* Ltd. (LMT) Vīgants Radziņš, who does not have to look far for an example as the company partnering with Latvian and international companies and researchers brings to light one innovative solution after another in such fields as traffic and logistics, drones, security and others. LMT is certain that mobile technologies are the basis on which innovation can bloom and transform into new products, services and business models. In computer vision services, data are analysed in real-time; moreover, for instance, in traffic-related projects the units rather than particular traffic participants are counted. «The service does not care, whether a black Mercedes or a red Fiat entered the parking lot,» explains V. Radziņš. Radio network analysis also takes place in a unique research platform for big data analytics and making economically based decisions on a regional and national scale developed in mutual collaboration by LMT and the University of Latvia (UL) and having been presented this spring. The developers indicate that it can be a tool for development of municipality growth strategies, solving issues of national scale, for instance, road network optimisation and planning of infrastructure development.

Smart transport

Transport flow management technologies, smart traffic lights and parking lots, digitally connected and partially autonomous cars — this direction is mentioned by some experts as the most significant one that will change the city in the relatively near future facilitating inhabitants' movement, improving the environment, encouraging the inhabitants for using more environmentally friendly technologies.

V. Radziņš illustrates the explanation of the gains of smart traffic light and traffic management system by using a very real situation for improving traffic flow in an intersection where there are always huge traffic jams. To introduce changes in the traffic light

Testing and development of connected and unmanned car solutions are the most innovative projects undertaken by LMT.

LMT INNOVATION PROJECTS

__Connected cars test platform
Testing and development of connected and self-driving vehicles solutions
__Smart solutions for road traffic
Solutions for more efficient transport flow management
__Drones
Development of solutions for drone traffic and air space control
__Mobile cyber testing range
Mobile network infrastructure testing ground for protection from cyberattacs
__Big data
Unique research tool for mapping data flow in real time
__Call manager
Wholesome office switchboard functions in a mobile phone
__LMT home smart television
The first Android home television in a mobile network
__Application for communities
Easily adaptable mobile applications for promoting civil involvement

SOURCE: LMT

LMT, as a telecommunications company getting involved with innovation directed projects, sees the challenge in the partnership of infrastructure elements, says Business Management Department Director Vīgants Radziņš.

mode, the transport flow observation in this road section was done by a human. Computer vision solution could improve the traffic flow in a more operative way — equipping the road section with cameras, the data acquired by which are analysed by a computer, it would be possible to constantly follow the change of traffic and regulate the traffic lights in real-time according to needs. He has another example in mind — to create a possibility for a public transport to make a manoeuvre, a traffic light is installed in a place where the traffic is otherwise fluent. However, the traffic light does not react to the bus by stopping the traffic flow when it is necessary for the manoeuvre of the public transport, but it works by a programmed plan. Drivers grow unhappy as the traffic flow is hindered without an obvious reason. «One driver loses half a minute that is not much, but looking at the big picture, traffic congestions take place in other places. One separate point creates such a critical influence that here the already available technologies should be used for a more sensible solution to a problem,» V. Radziņš says. Significant traffic improvements cannot be achieved by optimising only one traffic light, the value would be gained with a smart and all-inclusive traffic management system. «Currently we are working so that it would be possible to identify the flows of traffic participants and the ways and loads on traffic arteries by using computer vision,» he continues.

Connected in the IoT

LMT as a telecommunications company joining in innovation-tended projects sees a challenge in «collaboration of infrastructure elements». It also relates to the traffic innovation project possibly grabbing the most of society's attention —creation of connected cars test platform in Latvia. As V. Radziņš indicates, currently talks are not about self-driving cars, but connected cars: «We are not in that stage of development when we get into a car, enter the final destination and play chess with the person in the passenger seat. We are talking about a stage where the car significantly eases the safety and helps improving it. We see our role in the collaboration of infrastructure elements – how to connect the road signs, traffic lights, the road sensors and the driver». The LMT project provides communication infrastructure appropriate for try-outs and also develops 5G mobile communication technology compatible network for self-driving car needs. The range of project partners is extensive — the Institute of Electronics and Computer Science (EDI), *Riga High Tech* association, *Pilot Automative Labs*, *Microsoft*, *Nokia* — lists V. Radziņš. The range of partners could extend by allowing use of the developed infrastructure by other universities and startups that could be interested in it.

The Institute of Electronics and Computer Science (EDI) has been conducting research in the field of cooperative driving cars for many years and has developed a prototype of car control system that has been tested in Biķernieku track in collaboration with Road Traffic Safety Directorate (CSDD) as currently driving a self-driving car on Latvian streets is not legally put into order. Development of fully self-driving cars on public roads is a very time-consuming job that is not achievable by a single company; therefore, EDI is working on this project in collaboration with more than 60 partners from all around the world and is focused on two narrower sub-directions to facilitate the development of such a car. EDI is working on the improvement of data transfer security of communication devices by applying redundancy. Communication among cars and between a car and the infrastructu-

INFORMATION

__The contents of video and the option of computer vision to process a large amount of data are currently to be regarded as an efficient and relatively cheap solution, which can, moreover, be applied to a range of very different purposes, including guarantee of security. Riga Technical University (RTU) is developing a computer vision solution, which will allow identifying objects and people online using a thermo camera video stream with the help of artificial intelligence for the needs of a state security mobile platform *Viedsargs* developed by LMT.

__Viedsargs is being developed in collaboration with LMT, Ministry of Defence, National Armed Forces and RTU.

SOURCE: LMT

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re is important so that in complex future driving scenarios the car could plan out its own route and behaviour on the road by taking into account the plans of other cars, thus making traffic more efficient and safe. Within the framework of this project, an experimental communication device is being developed that allows for the exchange of information between the car and the road infrastructure devices. To provide that the communication is always available, the system can simultaneously use three various types of wireless transfer and one of the *IoT* (*Internet of Things*) protocols, EDI indicates.

Experiment field

The Latvian climate conditions are said to be very appropriate for testing self-driving cars. The same can be said for the computer vision solution tests. «In winter, a white car enters a snowy parking lot or a bunch or seagulls fly over the camera —how the smart parking allocation will react to this? It is good that there are four seasons in Latvia that allows testing the activity of the solution in all the possible situations. We can also test the drone prototypes in a full range — heat, cold, snow, hale, rain, dark, bright sunlight. It is important that not only we, but also the developers understand these challenges,» V. Radziņš indicates.

The first electric minibus created

A team led by car engineer and designer Andris Dambis has created an electric gear passenger minibus OPP that is appropriate for city transport and is to be charged via pantograph. The minibus along with other transport industry innovations made in Latvia — Pikes Peak sports' car, Go-Kart electrical race car — was presented at the international conference Global Transport Security and Safety for a Century that took place this spring. Electric bus may be tested in Ventspils, where this spring a project has been initiated, which is co-financed by the European Union for providing more environmentally friendly public transport. The city plans to purchase 15 environmentally-friendly buses and building of three charging stations.

PHOTO / SATIKSMES MINISTRIJA

Traffic planning and flood prediction

In the dark time of the day, the sensors register the car approaching the intersection and if the traffic flow allows it switches on the green light, not making the car to excessively wait in the intersection. Whereas during the day these sensors summarise information on car flow. Street equipment with sensors is only one of the intelligent solutions in the field of traffic that is applied in Jelgava. Other solutions are applied as well — street traffic management, smart photo and video cameras with automatic car number recognition function, mobile meteorological station, parking solutions, and pedestrian crossing lighting solutions for improving safety. Namely, special LED lighting is used on pedestrian crossing — at times when the crossing is not being crossed the intensity of lighting is lower, when a pedestrian approaches the sensor senses the closeness and switches the lighting to active mode. Similarly, the main intersections are monitored by video cameras. Ultrasensor parking indications were also tested in Jelgava. The municipality indicates that when there are mass events planned in the city, *Waze* application solution is also applied. In Jelgava city buses, the monthly tickets are replaced with e-cards, passengers can also pay with the city inhabitant's card, pupil's card or payment card. Transport stops are gradually being equipped with QR codes. Jelgava smartly manages other city utilities-related issues. For instance, pump stations have limited street flooding, which occurs due to heavy rainfall by using the newest technologies and working at the intensity appropriate for a given situation. Moreover, the water level meters installed on Lielupe Bridge continuously transfer data to Municipality's Operative Information Centre, the employees of which can follow the water level rise via interactive maps, model the flooding threat and act in the case of necessity, thus delaying the occurrence of flood. For adjustment of urban environment, a geospatial platform *City's Interactive Map* has been developed that allows the inhabitants to submit the issues digitally.

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