TA.DI

18

Magazine of Technology Agency of the Czech Republic

ELECTRICITY IS NOT JUST ENERGY – IT IS THE INFRASTRUCTURE OF EVERYTHING

INTERNET-FREE FUTURE? REALITY WE ARE UNPREPARED FOR

TA CR AWARDS 2025

FORGOTTEN INNOVATIONS: THE WORLD (UN)KNOWN

česká verze

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Photo by Dashez Yurkivnyuk on Unsplash

INTRODUCTION BY THE CHAIRMAN

T A
C R

Dear Readers,

It makes me happy that you are now reading the 18th issue of our TA.Di journal on the topic of Forgotten Innovations: The World (Un)Known. This issue focuses on technologies that have become an integral part of our lives and that we take for granted. However, we are not looking back nostalgically but rather reflecting on how the world would change if they were to disappear one day. Can you imagine life without electricity, the Internet, high-tech transportation systems, or penicillin? These technologies and innovations, considered guaranteed, have been shaping our lives for decades and were instrumental in achieving remarkable progress.

The aim of this issue is not only to remind you of once groundbreaking inventions that are now commonplace solutions. Above all, we would like to underline how important it is to continuously innovate and seek alternatives to the already established technologies. Their outage could have a fatal impact on society as a whole and its functioning. It is the applied research and further development that can provide us with greater independence and generate new ideas with practical benefits for our everyday life.

I hope you find this an inspiring reading that will encourage you to reflect upon the world we are living in.

Petr Konvalinka

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Electricity is not just energy – it is the infrastructure of everything

Author: **Leoš Kopecký**
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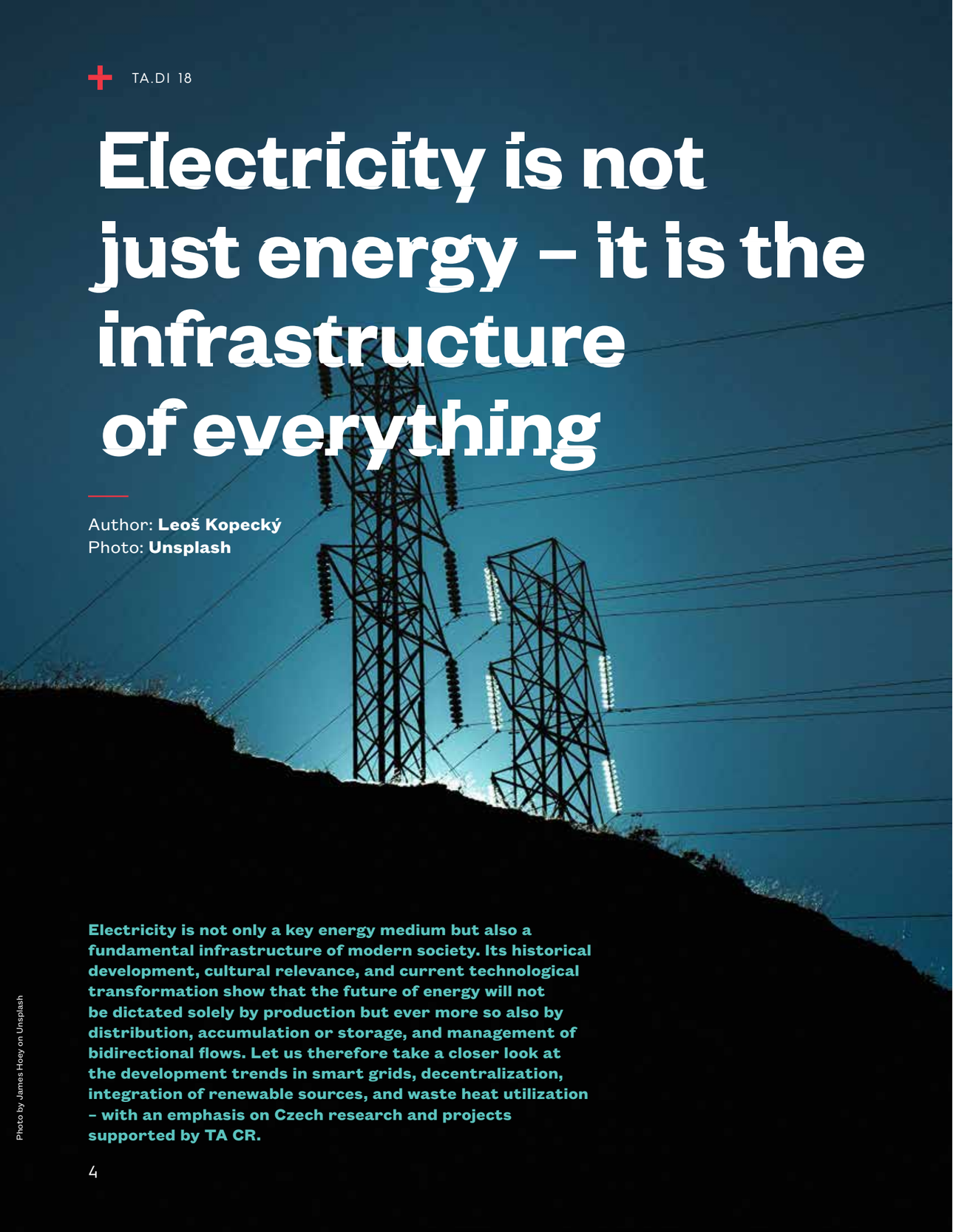

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Electricity is not only a key energy medium but also a fundamental infrastructure of modern society. Its historical development, cultural relevance, and current technological transformation show that the future of energy will not be dictated solely by production but ever more so also by distribution, accumulation or storage, and management of bidirectional flows. Let us therefore take a closer look at the development trends in smart grids, decentralization, integration of renewable sources, and waste heat utilization – with an emphasis on Czech research and projects supported by TA CR.

It is pointless to make a list of everything that would not work without electricity. Electricity is undoubtedly the most powerful force in the history of mankind. While fire got us out of caves and steam out of villages, electricity connected us, set us in motion, and made us independent.

Electricity has for long been a mystery

The word “electricity” dates back to ancient Greece. At about 600 BC, the ancient Greeks noticed that when a piece of amber is rubbed with a cloth, it could attract light objects such as leaves of grass or feathers. Amber thus became magnetic. It was not until around 1600 AD when the English scientist William Gilbert used the Latin term “electricus” in his work De Magnete to describe substances that behaved similarly to amber – that is, when rubbed, they gained the ability to attract light objects. The Latin word “electricus” gave origin first to the English word “electricity,” from which similar terms were later derived in other languages, including the Czech term “elektřina”.

Nonetheless, at the beginning of the 19th century, for most people, electricity was still a completely mysterious and fascinating phenomenon – something between magic and science. At that time, a bunch of “electric exhibitions” and scientific and theatrical performances took place, which were very popular, especially among the upper classes. Although their aim was often to entertain, these public demonstrations also helped bring science to the general public. Sometimes it involved actual research – for example when Alessandro Volta (Italian physicist) and Luigi Galvani (Italian physician and physicist) started their experiments with “animal electricity” using similar demonstrations. Benjamin Franklin conducted his famous experiments with static electricity, which were also spectacular in nature – including his famous experiment with a kite during a storm conducted in 1752, which proved that lightning was an electrical discharge. This paved the path for atmospheric electricity research and the invention of the lightning rod.

The knowledge has incited unparalleled development

Today, electricity is an invisible force driving civilization – ubiquitous, indispensable, yet constantly threatened in terms of climate, technology, and geopolitics. That is why electricity must be viewed not only as energy but also as a cultural and existential power, in whose development and application the Czech people have played a fairly significant role. Whether it was František Křižík and his arc lamp, power plants, electric railways, and electric lighting for cities and industrial plants, or Zdeněk Kunc and his pioneering work in the application of superconductivity and the construction of equipment operating at low temperatures. We were among the first countries to start building alternating current power grids based on Nikola Tesla’s model and to introduce new technologies in energy transmission and distribution. One of the first alternating current power plants was the municipal power plant in Holešovice in Prague, built in 1900. It became one of the largest power plants in Austria-Hungary and supplied the whole of Prague with electricity. In 1919, the Electrification Act was adopted since the strategic importance of electricity was recognized by the newly founded Czechoslovakia. This law laid the foundations for the systematic electrification of the country and was forward-looking enough to provide for state aid for the construction of power plants and distribution grids with the aim of ensuring cheap electricity for all.

Sustainable energy generation and efficient and reliable distribution

This remains one of the fundamental issues of the electric power industry – transporting electricity from the place of production to the place of consumption. Due to the decentralization of sources and the emergence of local electricity producers, this issue has become more pressing, as it is no longer enough to transport electricity in one direction only, from the producer to the consumer. Current power grids require bidirectionality since many consumers are also producers who supply electricity to the grid (the so-called prosumers). Smart grids, which enable these bidirectional electricity flows, are being developed by numerous research and development centers globally. Major advancements are therefore seen in new information technologies and measurement and control systems. A wide range of projects focusing on all aspects of the technological transformation of our energy sector are naturally supported through TA CR in our country. One of the key principles of smart grids is the fact that not only does electricity flow in two directions, so does information. This requires new technologies and procedures such as active power flow management based on supply and demand according to current conditions, increasing network flexibility, its resilience to power outages, and optimizing the use of resources. Smart meters and advanced communication technologies are used to enable real-time data collection and efficient communication between all components of the network. Of course, this also includes the integration of new energy storage facilities and electric vehicles, as well as consumption management systems. Complexity of functions and demandingness of control rank among the reasons behind the electric power distribution challenges – whether a blackout in Spain and Portugal or a grid failure in the Czech Republic. ›

Examples of research and development projects supported by TA CR in this field:

TK01030094
Smart energy network
Project implementation period: 2018–2023

TK02030039
Energy system for grids
Project implementation period: 2019–2023

TK02030146
System for monitoring and management of the smart electricity grid of smart cities
Project implementation period: 2019–2023

TK02020005
Flexible AC/DC microgrid for collective housing
Project implementation period: 2019–2022

In the future, the Czech energy sector will undoubtedly need not only new sources of electricity but also extensive digitization and physical modernization of grids for the distribution of the generated electricity. Distribution grids will be transformed into smart platforms that will enable controlled, two-way distribution with the integration of production, consumption, storage, and ancillary services. The aim is to cope with the expected increase in consumption, particularly due to e-mobility, air conditioning, and heat pumps.

Can we rely on renewable energy sources?

The Czech Republic has quite a potential for the development of renewable energy sources, even though this topic is often debated and its benefits are frequently questioned. A comparison of various conditions (climatic, geographical, etc.) shows that some energy technologies are more promising for our country than others, and thus a mix of various solutions must be sought. The Czech Republic does not avail of many large rivers, favourable wind conditions, or a high number of sunny days, but a solution can definitely be found. At first glance, it is obvious that the appropriate solution for the Czech Republic in terms of alternative energy sources will be a combination of solar energy, biogas, and biomass together with wind energy. Development of electricity generation from wind power can be counted on, despite its limitations due to low number of high-wind areas. The same applies to the development of solar power plants, the potential of which is much higher and so far largely untapped. On the other hand, further development of small hydropower plants cannot be anticipated since most of the suitable locations and capacities have already been utilized.

Many countries worldwide, including neighbouring Austria, have various sources of geothermal energy at their disposal that are also used to generate power. Sadly, we are not so fortunate. Nevertheless, even though the volcanic activity in Austria is not as strong as, for example, in Iceland or Italy, they use mainly medium-temperature sources and binary cycle technology (known as ORC – Organic Rankine Cycle), which enables power generation even from lower-temperature water. This technology could become an inspiration for us and could be applied to the use of waste heat otherwise released into the environment. Waste heat is generated in numerous processes, such as industrial processes (food industry, manufacturing industry, coke manufacturing), but also during the operation of data centres and supermarkets. The heat obtained in this way could be used to generate electricity using the organic Rankine cycle, which uses a working fluid with a lower boiling point than water. Waste heat, however, can also be utilized to heat workplaces, residential buildings, water, or in various industrial processes. It is difficult to estimate how much waste heat there is and how much remains unused, and the results vary depending on the prediction method used. In any case, it amounts to at least tens of TWh of energy per year, and some estimates suggest an amount of energy comparable to that produced by one Temelín reactor annually. According to the estimates, 20–50% of industrial energy input, depending on the industry, is wasted as heat.

One of the recently completed research projects on this topic, supported by TA CR with CZK 5.5 million, is a ZETA Programme project called “Waste heat utilization for energy storage based on the concept of Carnot batteries.” A Carnot battery essentially uses heat to store electrical energy. This project aimed to develop a method for how to store electricity using the heat generated as waste heat in industry. Instead of conventional batteries, it uses a storage with stone dust, which is heated and subsequently allows the heat to be converted back into electricity. The researchers proposed a solution of this being used in factories and tested the individual components to minimize the costs of equipment and maximize the overall efficiency. The results are very good, and their application in practice is feasible.

Electricity accumulation or storage is a separate and extremely broad topic, covered by numerous research projects supported by the Technology Agency of the Czech Republic. Development of all kinds of new technologies for the energy sector is our utmost priority.

To promote new technologies and their advancements in the energy sector, TA CR has launched the THETA 2 Programme, which focuses on transformation and innovation in the energy sector aimed at reducing dependence on fossil fuels and strengthening energy security. The programme includes three sub-programmes focused on research, competitiveness, and sustainability of the energy sector.

Examples of completed research projects supported by TA CR, the results of which are gradually being implemented.

TK01010119
Integrated models for analysis of regulatory impacts and simulations of long-term scenarios of energy sector development (RegSim)
Project implementation period: 2018–2022

TK01010188
Development of new regulatory methodologies in terms of decentralization in the power and gas sector
Project implementation period: 2018–2022

FW03010351
Technology of low-emission local heater burning biomass for houses with almost zero energy consumption
Project implementation period: 2021–2022

TH04020043
Innovative technology for the use of inorganic industrial waste materials or by-products
Project implementation period: 2019–2022

TK02010048
Energy active consumers – opportunity to use local energy sources
Project implementation period: 2019–2022

Martina Altera Krčová: Young people may bring about change in the energy sector. They are committed to sustainability and open to new technologies

Author: **Šárka Kováříková**
Photo: **Archive of ERO, Unsplash**

The energy sector is undergoing a major transformation, which is inevitable given the push for decarbonization, digitalization, decentralization, and democratization. The Czech Republic is faced with the challenge of modernizing its infrastructure, leveraging new technologies, and supporting the community energy sector to ensure a secure, sustainable, and self-sufficient future. In an interview, Martina Altera Krčová, the member of the ERO Board and a long-time expert on decentralized energy, elaborated not only on the taboos in the energy sector and the optimal energy mix for our country but also on the younger generation's attitude towards energy and resources.

If you had to choose one technology or idea from the history of the energy sector that has been abandoned but would be useful given today's developments, what would it be, and why do you think it was rejected by society?
There are many technologies that were investigated in the past and subsequently abandoned, such as thorium reactors, pneumatic conveying systems, compressed air energy storage, solar towers, etc. We are now turning our attention once again to some of them, and they could have a great impact on the current development of the energy sector. If I had to choose one, it would definitely be the technology of small modular reactors (SMR). The SMR concept dates back to the mid-20th century when, however, preference was clearly given to centralized and higher-capacity nuclear power plants. Put simply, SMR was rejected because of the then-belief that "the bigger, the better" and the lack of political will to diversify development in nuclear energy. Nowadays, with pressure for decentralization, security, and decarbonization, such sources would have been available and extremely useful due to their more flexible and faster construction. That is why they are now becoming attractive again, and their construction is also being planned in the Czech Republic.

Ing. Martina Altera Krčová, MBA
Martina Altera Krčová graduated from the Faculty of Economics and Management of the Czech University of Life Sciences in Prague and got an MBA degree at the International Business School in Brno. In 1997, she started working at the Ministry of Industry and Trade as the Ministerial Officer for Regulation in the Energy Sector. Since 2001, she has been employed with the Energy Regulatory Office, where she was appointed a member of the ERO Board in 2019 and has held this position until today. She keeps promoting the decentralized energy sector and strives to explain these matters to experts as well as the general public. She is fully engaged in building bridges between the world of centralized energy systems and the energy sector undergoing transformation. She has been consistently furthering the transition of regions, cities, and municipalities towards energy self-sufficiency. For many years, she has collaborated with the Technology Agency of the Czech Republic in supporting research, development, and innovation in the energy sector. From the very beginning, she has been an active member of the Expert Advisory Body of the THETA Programme and the Coordination Group of the SIGMA Programme. She is a member of the Council of the National Center for Energy II. In 2022, she got shortlisted for the Josef Vavroušek Award for her unflagging efforts to promote systemic changes in the energy sector, and in 2025 for the Heroine of Modern Energy Award.

Is there any source of energy that is, in your opinion, underrated by the general public, even though it has enormous potential (e.g., locally)?
Speaking of the Czech Republic, geothermal energy, both shallow and deep, is an underrated source of energy. Although it has local potential in various parts of the Czech Republic, it is still of peripheral interest. Yet it is a stable and emission-free source with minimal dependence on weather conditions. The reasons behind its undervaluation are the very complex and costly initial investment, low public awareness, and inadequate infrastructure.

Heat from wastewater in the sewer system, i.e., "*sewer thermal energy,*" also has a high potential. Wastewater, for example, from households, industry, or rainfall, has a stable temperature between 12 and 20 °C. This heat can be effectively used for heating or hot water in buildings through heat exchangers and pumps.

There are also interesting projects on the use of horizontal geothermal energy in tunnels. It is a promising way to obtain heat for heating and cooling buildings. In Prague, the possible use of heat from the D metro line is being explored.

Do you remember a specific moment or a project that convinced you once and for all that a community energy system has a future? What was it that convinced you – the technical aspects, the social impact, or something entirely different?
The idea of community energy — that is, sharing energy at the point of production to cover local consumption, so that the balance between production and consumption is maintained and leads to the self-sufficiency and resilience of the area — has had my support from the very beginning. I believe in it and have been supporting it for almost eight years.

In the framework of decentralized energy, community energy is an important tool for utilizing the energy produced in the given location, preventing its waste or loss. It also has a secondary impact, namely the creation of new jobs in such locations, energy savings in buildings, and increased energy literacy. In practice, this means that citizens, businesses, and municipalities jointly produce and share energy at different times that are complementary due to different consumption patterns of individual consumption points. For these reasons, not only different consumption patterns of individual members of the energy community are essential but also the choice of different types of production sources participating in the community. It is clear that you cannot build a full-fledged community energy system with photovoltaics on roofs alone. On the very contrary, involvement of other stable production sources and use of battery storage are needed. However, the system also relies on smaller energy producers and offers sharing solutions both to apartment buildings and individual producers through the so-called active customer concept. I would like to add that it was apartment buildings where the whole concept of sharing essentially began.

Can you see anything in the younger generation's approach to the energy sector and sources that could bring about a change of the system?
Young people have much better digital skills than people of my generation, regularly use artificial intelligence, and are environmentally conscious. They are aware that the effects of global warming and ever-increasing energy consumption will affect their future. They are not afraid to share and use new platforms and to address energy issues in the community – which could lead to a major transformation of the entire system in the future. Young people are not burdened by the development of centralized energy systems of previous decades and instead show pragmatism, interest in sustainability, and openness to new technologies. ›

Let us imagine that tomorrow all large-scale central power plants shut down and only small, decentralized sources remain in operation – what would the first week of life in the Czech Republic look like? What would work and what would not?
To be honest, I don't even want to imagine such a situation. We must admit that our energy sector is hardly prepared for it. If centralized sources failed, we would experience a blackout with only island systems working, which are certainly not many. Otherwise, we would be left in the dark. Backup sources would supply electricity to critical infrastructure only, i.e., hospitals, until their generators ran out of fuel. Today, the society is so much electricity-dependent that a week without it would cause a total collapse, and I am afraid it would also result in a high death toll.

Is there any taboo in the energy sector that should, in your opinion, be broken?
There are several "taboos" in the Czech energy sector, i.e., topics that are rarely discussed publicly or are consciously or unconsciously avoided, even though they are crucial for our future. For example, the topic of cooperation between the centralized and decentralized energy systems is hardly ever debated. To give a better explanation, let me provide a broader picture. The transformation of the energy sector is driven by "4D" principles – decarbonization, digitalization, decentralization, and democratization. The Czech energy sector is still highly centralized – large power plants are dominant, and top-down power transmission and distribution are in place with electricity flowing from the power plant to consumers. Transition to decentralized, local sources – solar and wind farms, community energy systems, biogas and biomethane sources, heat pumps, geothermal energy, etc. – is supported both by the EU and the Czech government and yet encounters a number of obstacles in the Czech Republic. Foremost, resistance from major players who do not want to lose their influence and revenues impedes the development of decentralized energy, even though it significantly contributes to our energy security and increases our independence from fuel imports. The change must be supported by the government; we must continue to amend the relevant legislation and step by step remove the obstacles and barriers. Another taboo, perhaps even greater than the issue of interlinking centralised and decentralized energy systems, is the democratization of the energy sector.

What would, in your opinion, be the optimal and sustainable energy mix for the Czech Republic? What role would nuclear power, natural gas, renewable sources, or possibly even coal play therein?
This is a matter addressed by the updated State Energy Policy (SEP), which was submitted for approval this year.

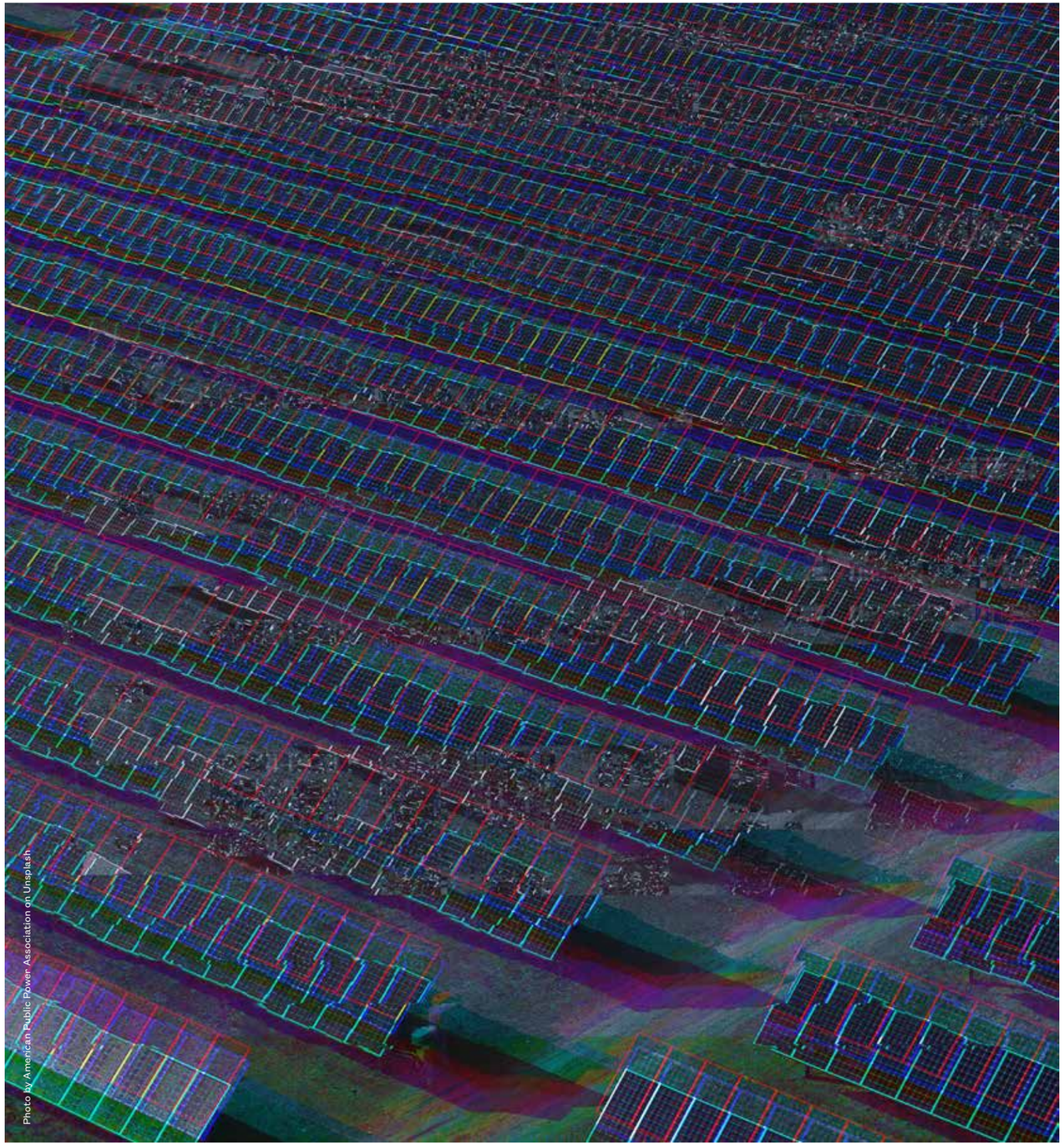

Photo by American Public Power Association on Unsplash

Although the Czech government has not yet adopted it officially, I can say that I appreciate the entire process of its drafting and consider the specified mix of sources for the future of the Czech Republic – a combination of nuclear energy and renewable energy sources (RES) with a transitional period relying on gas – to be adequate. The question remains, how will the development be affected by innovation and research in the energy sector? We must also keep in mind the future role of hydrogen as a gas, with great potential.

The State Energy Policy has faced criticism mainly due to the absence of sufficient impact studies on price developments for end users under various scenarios. For these reasons, a multi-year project, "*Socially and economically responsible pathways to decarbonization: modelling and evaluating energy transition scenarios in the Czech Republic,*" was developed and subsequently supported by TA CR under the SIGMA Programme. It aims to add comprehensive and detailed short- and medium-term implementation plans to the national long-term decarbonization strategies. The modelling will be based on the energy mix strategy and the possibilities and conditions for using the respective energy generation and energy-saving technologies. The results of the project will have an impact on the evaluation of the effectiveness and impact of policies, measures, and regulations, and will help the government decide which pathway to take in the energy sector transition.

The blackout in July raised questions about the quality of the power grid. As you see it, how important is the modernization of this critical infrastructure in the light of the ongoing green transition?
Modernisation of infrastructure is absolutely crucial. The existing grid was designed for a centralized power generation model – that is for a top-down approach. This model was put in place and worked well. Today, however, apart from the centralized network, there are thousands of small producers, community projects, battery energy storage systems, and growing electricity production from renewable energy sources, both in the Czech Republic and in other countries, which also has an effect on us. Flows from high voltage to low voltage can also move in the opposite direction. Without modernizing power substations and strengthening smart grids, which can balance energy flows, respond to changes in real time, and ensure cybersecurity, the entire energy transition could stall. It is not just about the transmission and distribution networks but also about the digitization of the entire system and the ability to manage it as a whole. Bearing in mind the worldwide situation with the threat of war and the need to defend our country, we must reckon with a future more complicated than the present, which is why we should be ready for situations more challenging than those we are facing today. ×

Megi Mejdrechová: With RoboTwin I want to bridge the gap between technological progress and industrial reality

Author: **Šárka Kováříková**
Photo: **Archive of RoboTwin, Michaela Szkanderová, e15, Unsplash**

The European industrial production is currently facing two challenges – a shortage of workers and the need to automate. Securing staff who will spray paint, grind, or assemble during the next shift is an everyday issue faced by small and medium-sized enterprises. And this is where the RoboTwin team saw an opportunity – to make it possible for those who understand production to become robot teachers and transfer their know-how for the sake of automation. How did they manage that, and how did the Technology Agency of the Czech Republic and the European EIC Accelerator help them on their path to success? Read the full interview with Megi Mejdrechová, the startup founder, and get inspired.

Photo by Michael Sergeev on Unsplash

Robotics or journalism? At one point, you had to decide. What ultimately made you choose the Faculty of Mechanical Engineering of the CTU in Prague? Have you ever regretted your choice?

At first, I started to study at the two universities because I didn't want to miss an opportunity to get an insight into these two different worlds. During the first semester, however, I realized that I wanted to fully engage in technology. I remember the intense feeling of learning something new every day, truly enjoying it, and acquiring one new skill after another. At that time, I didn't know exactly what professional career I would embark upon in the future, but I felt that technology was giving me useful tools, concepts, and knowledge I would then have at my disposal. The study programmes at the CTU are designed in such a way that the more time you devote to studying, the more you get out of it. Hence, I gave up journalism.

Moreover, I discovered that those two worlds aren't so different after all, and today I benefit from that insight. Building a startup isn't just about technology. As a founder, you have to know how to work with information, conduct interviews with customers, ask questions, verify facts, and understand the broader context. You also must be able to present your product as a story that people will believe.

The SprayGym project, a painting robot with automatic generation of robotic programs, shows that robots can learn in a completely unconventional way – from human movements. What was the key moment or idea that helped bring the entire project from laboratory to practice?

SprayGym is one of the milestones in our long-term efforts. It aims to expand the simple learning technology of industrial robots to international markets. We want automation to become efficient and easily accessible, even for operations with a broad product range and smaller series. The key factor for us in general is the demand for services of these businesses and, at the same time, their frustration often caused by the failure of traditional automation methods.

In the case of the SprayGym project, we identified an opportunity to collaborate with an industrial paint shop. Since they produce thousands of unique products, generating a conventional robot program for each of them was virtually impossible. Their production therefore relies on painters who do everything by hand, which is a difficult, annoying, and responsible job hardly anybody wants to do. We therefore decided to accelerate the development of our solution for automatic generation of painting programs and to test it in their plant in real-world deployment.

Do you intend to further develop the robotic solution for painting automation? What innovations of the technology can we expect?

Currently, there are two of our robot learning tools available on the market. RoboTwin is designed specifically for paint shops, for both wet paint and powder coating. RoboTeach is more versatile, does not require any specific technology, and can also be used in other operations, such as grinding or polishing. Both tools are based on the "demonstrate–generate–robotize" principle, which means that I demonstrate the movement for the first product in the series, and the robot can then do the rest of the series automatically.

The solution that was validated in the SprayGym project, and which is still being developed, is a bit more advanced. It makes it possible to design robotic programs solely through the analysis of the product's geometry. It uses the know-how gained from previous demonstrations of movements by painters but does not require another demonstration of movements for a new product. This makes the solution even more efficient.

Is there demand for your solutions among the businesses?

Yes, indeed. As of today, we have several customers in Europe, mainly in the Czech Republic and the DACH region, who use RoboTwin and RoboTeach for painting and grinding. Then there are production facilities whose production operations simply cannot be programmed in the conventional way. Either because they produce thousands of different products or because the required robot movement is so complex that it can only be demonstrated, not described. Such companies, sometimes coming from the other side of the world, often approach us themselves. This spring, for example, we installed some equipment in Mexico, and in the summer our product was delivered to Canada.

A more advanced version of the product, which builds on the results of the SprayGym project, is not yet available on the market but will be pilot tested at selected facilities throughout the next year.

Your project received support from TA CR and expert coaching under the SIGMA Programme. What specifically did this support facilitate – and how important was it on your path to receiving support from the European EIC Accelerator?

In the project supported under the SIGMA Programme, our new, more advanced product version was tested in practice in an industrial paint shop. Validation, both technological and ›

business-related, is key for steering further development in the right direction. It helped us refine the product definition and target market, and, most importantly, it confirmed the enormous potential of our solution. Nowadays, 30 million people work in production in the European Union alone, but the number of people interested in physically demanding manual labour jobs is naturally declining. This is countered by the trend of onshoring (the process of moving production or service operations, mostly from abroad, back to the company's home country). Consequently, European industrial production ceases to be competitive. We are fully aware of this huge issue, which is why we are developing a solution – a simple, effective, and sustainable method of robotization. It is an ambitious project with an enormous potential impact. Thanks to the plug-in mechanism of the TA CR SIGMA Programme, by real-world validation, we also passed the first step of the EIC Accelerator selection process, the short proposal. The EIC Accelerator is the most prestigious and competitive programme supporting deep-tech startups in Europe, offering funding many times higher than that offered by regular national schemes. From the short proposal to the full proposal, the interview in Brussels, and the final approval, a lot had to be done. But the plug-in mechanism that put us on the starting line gave us the push we needed to go for it.

Generally speaking, our cooperation with TA CR was excellent. The whole support framework works well and is effective, and it is obvious that the Agency has many years of experience in project management. We could rely on the well-established processes, and the staff was very professional. They were ready to help us prepare for the EIC interview by providing constructive feedback.

Your company is one of 40 innovative startups (out of a total of 959 applicants) that made it into the aforementioned EIC Accelerator. What do you think was your greatest advantage that helped you stand out among the other applicants?

Our innovation project was selected by the committee among 4% of supported projects because it addresses an urgent issue with a major impact. We came up with a solution at the right time that meets market requirements as well as European standards and values. The competitiveness of the industrial production is an issue on the agenda of the European Union since it directly impacts the EU-wide economic performance. Credibility, reliability, and ethics in relation to artificial intelligence are required by the EU legislation for solutions implemented by European companies.

Our product has been designed to comply with these principles from the very beginning, which is why the EIC has placed its trust in us. Also, results are already under our belt. We have customers, industrial partners, actual sales, a pre-seed investment in place, a high-performing team availing of all the necessary skills and experience, and also a clear roadmap with a vision. Part of this plan is to expand the team, both technically (robotics, software, machine learning, data science) and commercially. In doing so, we create new jobs and strengthen Europe's innovation potential.

What would be your advice to other Czech applicants who would like to apply for support from any European instrument?

It is crucial to understand the evaluation criteria and to choose a scheme that suits you, not only in terms of focus but also in terms of the stage of development. In your proposal, it is essential to clearly demonstrate that your projects truly fit the selected scheme. You should provide as many specific proof points (i.e., evidence) as possible – numbers, photos, etc. It is also important to have a clear plan, leaving no room for doubt about your ability to fully use the granted funding. It is certainly useful to seek advice from someone with past experience with the scheme. We also took advantage of EIC coaching, and our consultant helped us review our proposal.

This issue's topic is "Forgotten Innovations: The World (Un)Known." Did you discover any old, overlooked technology or principle during the development of RoboTwin or SprayGym that had to be revived?

I would rather say that I keep rediscovering technologies and principles in the industry that I thought were long gone. That they were replaced with something more efficient. Right after my graduation from the technical university, I was naive and very optimistic about technology. The media often present the wildest innovations to the public. In the field of automation, for example, humanoid robots helping in warehouses or on assembly lines. In reality, however, most of the industrial production in Europe is represented mainly by small and medium-sized enterprises (SMEs), which very often rely on manual labour. The challenges inherent in robotization, such as complex programming and other issues, have not yet been resolved. RoboTwin's motto is that we are closing this very gap between the state-of-the-art technical progress and the everyday reality of industry. And that is what gives me personally a rewarding feeling. ×

Megi Mejdrechová

Megi Mejdrechová is actively involved in robotics, automation, and industrial AI. She has graduated from the Czech Technical University in Prague and gained experience in research, development, and business. In 2021, she founded the award-winning startup RoboTwin s.r.o., which focuses on motion-imitating robotics, and as the CTO, made it into the Forbes 30 Under 30 list in 2025. RoboTwin develops smart devices for production robotization that allow workers to teach robots without the need for programming – in a quick and flexible way. The no-code robotics solution helps automate what could not be automated before. RoboTwin's long-term goal is to implement innovation in production and thus to close the gap between state-of-the-art technology and industrial practice.

Internet-free future? Reality we are unprepared for

Author: **Leoš Kopecký**
Photo: **Unsplash**

The internet penetrates all crucial spheres of modern life. Our ability to survive its failure, however, lags behind the pace of digitization, and this network's failure would mean not only an economic collapse but also a crisis in security, transport, and healthcare. This article deals with the fragility of digital infrastructure and possible scenarios and directions of research that could boost the resilience of society as a whole.

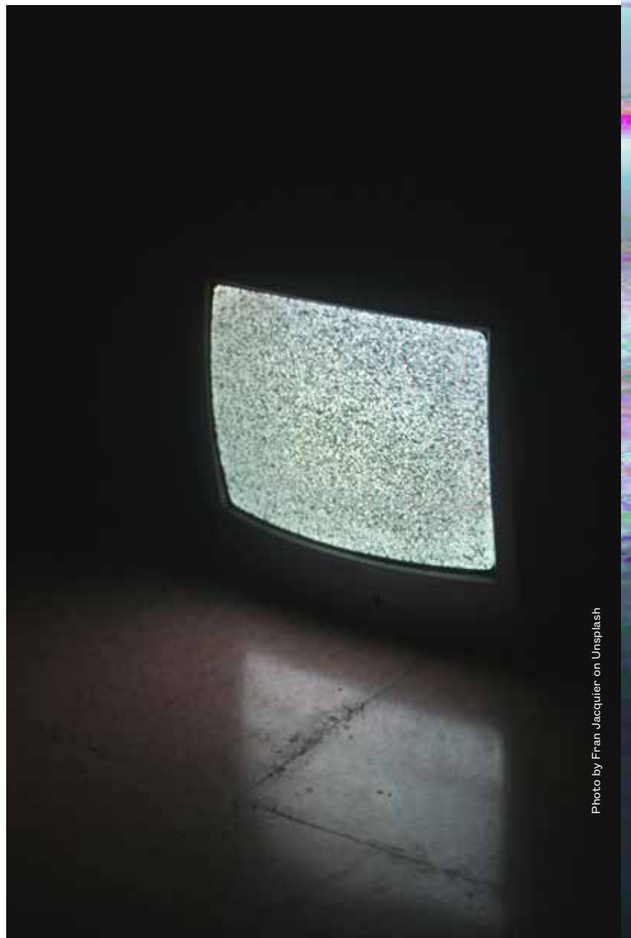

Photo by Fran Jacquier on Unsplash

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The greatest threat inherent in the Internet is not cybercrime or social media networks, but its possible absence: what if, all of a sudden, there is no Internet.

There are numerous scenarios that enhance the resilience of municipalities, cities, regions, countries, and entire civilization – from infrastructure modernization and development of renewable energy sources through efficient crisis planning and increasing public awareness to support for local self-sufficiency, smart technologies, and international cooperation.

We are prepared to deal with water, food, and medicine outages, and we are basically able to cope with a wide range of critical situations, better or worse, but we are not prepared for a long-lasting, global Internet outage, though almost every aspect of our lives depends on it.

The absence or long-lasting outage of the Internet is essentially unimaginable. Society would have to dramatically and rapidly return to the era before the digital revolution, which would cause enormous logistical, economic, and social problems affecting everyone.

What would happen in case of an extended Internet outage? What specific problems would arise?

First and foremost, the critical infrastructure and the financial systems would collapse. The systems controlling the power grid, water and gas supplies, and transport – air traffic control, rail transport, supply logistics, etc. – would fail. The global financial system would come to a halt – banks, stock exchanges, card payments, and ATMs would no longer work. This would immediately lead to a breakdown of basic services, massive panic, and cessation of economic activity. It is true that the internet is not the only network used by mankind, therefore, an emergency solution would be found, but it would not be fully functional. Apart from the Internet, there is, e.g., the conventional wired telephone network, which enables voice communication and connects landlines around the world. There are mobile networks such as GSM, 3G, 4G LTE, and 5G, and although the state-of-the-art mobile networks (especially 4G and 5G) are de facto gateways to the Internet, they still offer basic services independent of the Internet connection. These are, as a matter of fact, hybrid networks with their own infrastructure. Radio and television broadcasting would certainly also be useful, whether in the form of traditional terrestrial (ground-based) broadcasting or with the use of the satellite and cable networks. There is also the "Ham Radio" – a global network for radio amateurs that operates on the basis of allocated frequencies and enables global communication independent of the Internet infrastructure. Or the "CB" Radio (Citizen Band Radio) – freely available radio frequencies for two-way communication over shorter distances, often used, e.g., by truck drivers or tourists. There are also networks specifically designed for communication of ships and aircraft, which are only accessible to authorized entities but for critical communication operate independently of the Internet.

We must keep in mind that the boundaries between these networks and the Internet have becomed blurred, as many of them now use the Internet protocols (IP) as the underlying technology for data transmission or are somehow directly connected to the Internet. From the user's perspective and in terms of their purpose, however, these networks still operate as separate entities and would certainly be useful in the event of any complications. Nevertheless, protecting the Internet and improving its reliability is becoming increasingly important, as its use will continue to expand virtually endlessly into more and more areas and fields. That is clearly confirmed by the applied research projects supported by TA CR.

Examples of projects supported by TA CR

The use of Internet principles is unlimited and truly affects all human production activities – from production lines in industry to the needs of local farmers. The project whose results have been available to Czech winemakers since 2019 can serve as an example. ***"The sophisticated wireless network with elements of IoT for plant protection and water management,"*** developed with the support of TA CR, uses special sensors enabling prompt and professional response to unexpected or rapid spread of plant diseases, an overview of the current state of irrigation, and ensuring timely delivery of critical status reports to the user. The combination of a low-power LPWAN wireless network designed for the IoT with subsequent cloud server monitoring and big data analytics will make it possible to achieve an attractive price level and great flexibility in optimizing the installation of components in the specific terrain.

The applications of artificial intelligence have brought an entirely new dimension to the possible uses of the Internet – if only because they significantly increase our ability to process big data and the flexibility of system responses. The recently completed research and development project **"A cloud-based monitoring and analysis tool for structures"** uses these capabilities to create tools for ensuring the safety and longevity of aging buildings in the Czech Republic and Europe. Under the name CloudMATE, it offers a cloud-based platform that includes various innovative technologies such as digital twins, LiDAR-based scanning, the Internet of Things (IoT), and image-based solutions using cameras and drones to capture and process images of structures. CloudMATE encompasses the design of a smart sensor network, big data storage and management, and the development of cloud software for the integration and processing of data from multiple sources. It uses artificial intelligence (AI) and machine learning (ML) to analyze large amounts of data to identify potential problems, automate tasks, improve accuracy, and provide more insights into the condition of structures. By integrating images and data from IoT sensors, CloudMATE can provide comprehensive 2D and 3D visualization tools that make it easier to understand the behaviour, performance, and condition of a structure throughout its lifetime.

Clearly, measures must be systematically and proactively prepared to prevent unforeseen incidents that threaten the stability of the Internet and to increase the ability to restore systems if such incidents occur. Securing the Internet against outages will always be an ongoing struggle, requiring continuous investments and innovations. Full invulnerability of the Internet is most likely unachievable, but its resilience and ability to recover quickly can be significantly increased. This is a comprehensive task that requires a multi-level approach involving architectural and infrastructural changes for the sake of network decentralization and redundancy, or installing a resilient cable infrastructure. Operational and administrative measures such as regular maintenance and monitoring, data backup, and, first and foremost, cyber defense are also important. This is closely linked to technological development aimed at developing more resilient protocols, new forms of connectivity, and quantum cryptography. Another important category of measures is regulatory and political measures, such as international cooperation, introducing standards and certification, as well as increasing information literacy and awareness. ×

Jan Kleindienst: AI is not a solution to everything but has huge potential

Author: **Šárka Kováříková**
Photo: **Archive of Jan Kleindienst, Unsplash**

Artificial intelligence is penetrating various areas of human activity, such as industry, science, and creative professions. Its use is not about speed or efficiency, but about a brand-new way of cooperation between humans and machines. What is AI already capable of, where are its limits, and why is it not a threat but a new opportunity for the future? Those and many others were the questions we asked Jan Kleindienst, a leading Czech expert on artificial intelligence and co-founder of the Mama AI company.

Photo by Google Deepmind and D koi on Unsplash

Does society, in your opinion, need artificial intelligence? What would the world look like today without AI?
In recent years, artificial intelligence has become an integral part of our everyday lives – often without us even realizing it. We use it to search for information or translate texts, in map applications, or when recommending content on streaming platforms. AI handles routine tasks while expanding our capabilities – helping us focus on more complex or creative activities.

Without artificial intelligence, our world would be much slower, less efficient, and less connected. The pace of innovations in medicine, science, industry, and climate modelling would be significantly slower. Today, AI enables us to efficiently store and exploit knowledge, assists in decision-making in crisis situations, and even helps in overcoming language barriers.

However, the question is not whether we need AI – the mankind has survived without AI for most of its history. Rather, it is a tool that can significantly help us – if used responsibly. It is a technology that can improve the quality of life, expand the access to information, and at the same time make us reflect on what it means to be a human being in a world where some tasks can be performed by machines.

Does AI represent a turning point in human history, like the introduction of the Internet, or is its importance being overestimated?
Artificial intelligence certainly represents a major technological breakthrough – perhaps even more significant than the Internet. While the Internet changed the way of communication and information sharing, AI affects a much broader spectrum of activities: from healthcare through industry and education to art and everyday life.

AI is a general-purpose technology, such as electricity or steam. The changes caused by the AI in the society are all-encompassing. The main difference lies in the speed and scope of its spread – it affects not only manual labour, but also cognitive and creative activities. This is unprecedented.

At present, you would use AI mostly in the form of language models. What other tools can be used, and how can they assist people in their work?
It is true that most people associate language models with text generation – from drafting emails to summarizing documents. But that is just the tip of the iceberg. The true power of AI is demonstrated when it is used for specific types of tasks in specific fields. An example would be automated data extraction from documents, such as tender documents, contracts, or legal texts. This is not about "writing texts," but about searching for relevant data, its structuring, and comparing it across different documents. What used to take a person hours (reading, searching, sorting) can now be done by AI in seconds and with high accuracy.

Photo by Evgeny Ozerov on Unsplash

An interesting example is a tool that can automatically extract key data from large tender documents in the PDF format – e.g., suppliers, price, type of contract, or scope of contract. It allows companies and institutions to analyze the market more quickly, to check compliance with the rules, or to search for opportunities without having to read through hundreds of pages of text. The result is not only time savings but also greater transparency and better decision-making.

These tools are not "artificial general intelligence" but rather targeted specialized systems that build on a combination of language understanding, domain knowledge, and approaches such as entity extraction (a language processing technique that helps automatically recognize and highlight important information in texts), classification, or context-aware search.

And many other similar applications rapidly emerge – whether in healthcare, finance, compliance, or even public administration. AI is used here not to replace people but to help them cope with the ever-increasing quantity of information and focus on decisions that really require human judgment.

The true potential of artificial intelligence becomes fully apparent only when it is linked to a specific process in a particular field and transforms it from scratch.

Kooperativa's recent project, presented on LinkedIn, can serve as a great and groundbreaking example: a fully automated end-to-end process for handling life insurance claims using AI – according to available information, the first of its kind in the Czech Republic. It is not just about automatic document reading. The AI system handles the entire process, which normally takes an employee a considerable amount of time and requires a combination of expertise, reading, decision-making, and access to internal systems. To be specific, AI registers the insurance claim, reads the medical documentation, searches for and correctly evaluates the applicable insurance terms and conditions and actuarial compensation tables, verifies the client's specific contract in the system (e.g., exclusions, limits, sums insured), and finally makes a decision: either to automatically pay out the insurance benefit or to consciously hand the case over to a human if "it knows that it does not know".

All this is done in a matter of seconds, and the AI's decision is always being reviewed by a human – not out of mistrust, but out of respect for the client and the importance of the situation. And that is crucial: it is not about replacing people, but about smart collaboration – AI does the heavy analytical work, but humans have the final say.

This example of an "AI agent" shows that AI is not just a tool to speed up the process – it is a smart infrastructure that can comprehend complex documents, think in the context of rules and contracts, and, most importantly, know when to defer to humans. This is the future of AI at work – not just "writing texts" but deep integration into processes that require intelligence, responsibility, and context. ›

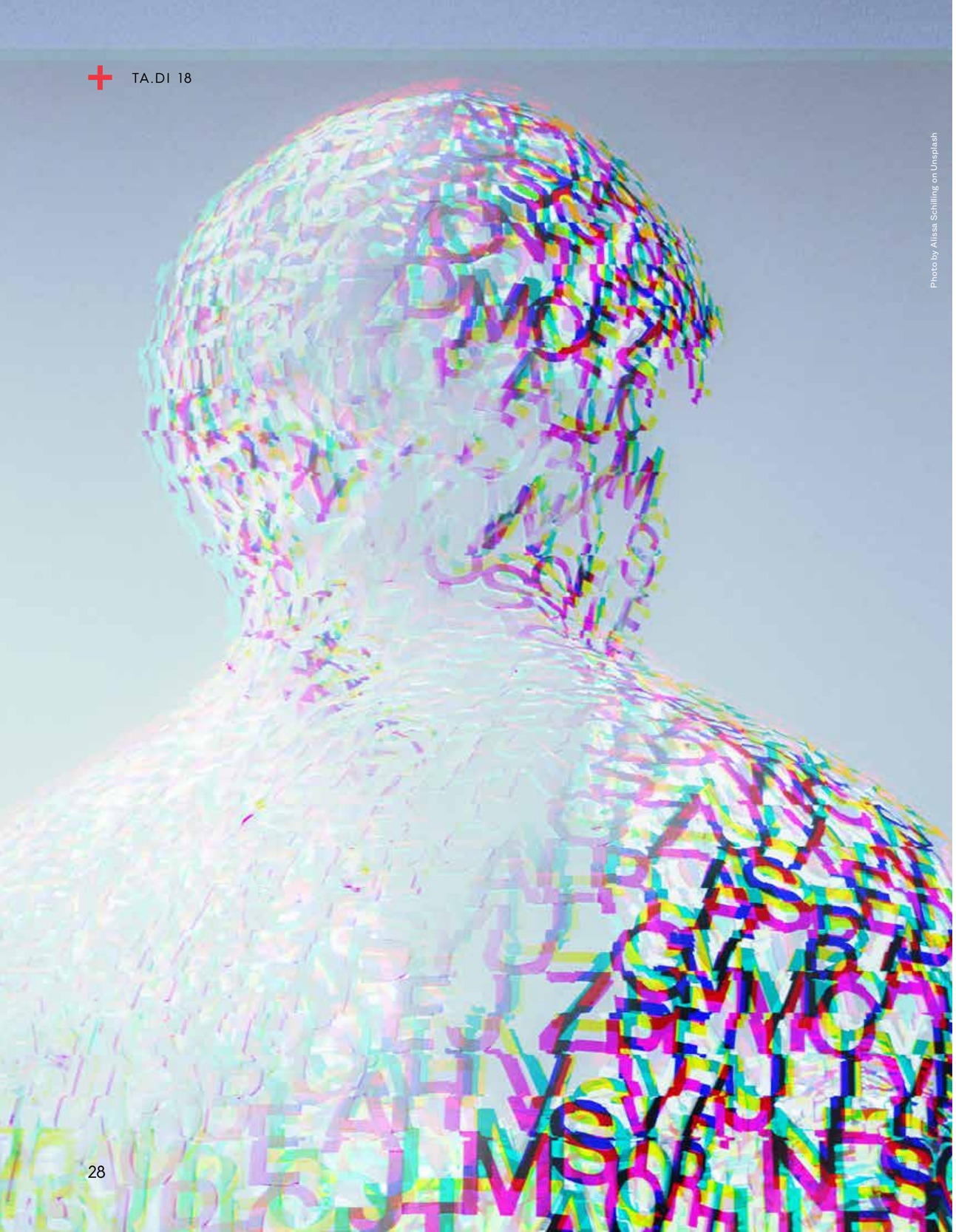


Photo by Alissa Schilling on Unsplash

Does AI pose any risk to society? Is there anything during its use we should be wary of? Are any of the concerns arising from the rapid development of AI justified?
Artificial intelligence is a powerful technological tool. And as such, it entails certain risks. These risks often do not lie in the technology itself, but rather in the way we use it, who owns it, and what goals are pursued. Today, the greatest risks associated with AI do not concern some superintelligence taking over the world, but rather real issues that already exist.

One of them is, e.g., spreading misinformation and manipulating public opinion. The point is that artificial intelligence can generate very realistic texts, images, and videos, which can be misused to create fake news or deepfake content (i.e., fake digital content, largely in the form of videos). Another issue is the imbalance and concentration of power. The development of the most advanced models is in the hands of a few deep-pocketed companies, which can further deepen economic and power inequalities unless the access to AI is transparent and fair.

There is also a risk of losing human autonomy and responsibility if too many decisions are left to AI. Whether in healthcare, finance, or justice. AI should be a helper, not the sole decision-maker. There are also ethical issues related to the world of work – AI can streamline multiple processes, but it can also threaten jobs, especially in administration or customer service. The way the society will respond to this change is therefore not only a technological matter, but first and foremost a social and political issue.

Another substantial risk is an excessive trust in AI systems. They are hardly infallible, and can be very convincing even when they make mistakes. That is why it is critical today to preserve critical thinking skills.

This brings us to the conclusion that AI itself is neither good nor bad. However, the pace of its spread and its impact on society are unprecedented, which is why having an open debate about the risks with experts from various fields is crucial. We should ensure that AI always remains at the service of men, not the other way around. It is not about slowing down the technological progress but about managing it with consideration and vision, because right now, the decision is being made about the future direction to be taken by the society with regard to AI.

What is awaiting AI in the long run? Can we predict any further impact it will have on our lives?
Further developments in AI can be anticipated to some degree only, as it is a highly dynamic field where new discoveries and innovations come quickly and often unexpectedly. We can be sure, however, that it will become ever more integrated into our daily activities. We are already witnessing how it helps in communication, healthcare, industry, and education – and this trend will continue. In the future, we can look forward to even more intelligent assistants that will be able to better understand human needs, emotions, and context, thereby offering us much more personalized and effective support.

On the other hand, AI evolution also entails challenges that will have to be addressed: ethical, privacy and security issues, and social impacts, particularly in the labour market. The direction AI takes will depend largely on the decisions made today – on the ways of its evolution, regulation, and implementation.

In a long-term perspective, AI will no longer be just a tool or service – it will become an integral part of our society, shaping the way we live, work, and think. It is up to us to actively engage in its evolution so that artificial intelligence truly serves people and contributes to a better and fairer world. ×

Ing. Jan Kleindienst, Ph.D.
Jan Kleindienst graduated with a degree in computer science from the Faculty of Electrical Engineering, Czech Technical University in Prague, and earned his Ph.D. in the field of distributed systems and theoretical computer science from the Faculty of Mathematics and Physics, Charles University in Prague. For a few years, he worked at the Institute of Computer Science of the Czech Academy of Sciences. In 1993, he joined IBM, where he spent several years working in the laboratories of IBM's T. J. Watson Research Center in New York. At IBM, he led a number of international projects in the field of artificial intelligence, acted as the director of the Watson AI group. He is the author of many publications and holds 50 international patents. In 2021, he co-founded the European company MAMA AI, which develops AI solutions for the global market. Since 2018 he has been a member of the TA CR Research Board, and in 2025 he was appointed its chairman.

Google is not a physician, and TikTok is not telemedicine

Author: **Leoš Kopecký**
Photo: **Unsplash**

Telemedicine, or remote medical care, is not just a vision for the future but it is becoming part of a systematic approach to healthcare digitization. In the Czech Republic, this discipline has been developing dynamically thanks to interdisciplinary research projects focusing not only on artificial intelligence, but also on legislation, economics, and ethics. The Technology Agency of the Czech Republic plays an important role in this process, and its support was instrumental in developing numerous applications and models with a major impact on clinical practice.

Photo by Joshua Chehov on Unsplash


Photo by Etactics Inc on Unsplash

Is the internet helpful in solving health problems? Of course it is, but everything has its pros and cons. It reminds me of a joke from a local GP's waiting room: "We ask patients who have already self-diagnosed using Google to also check Yahoo and other search engines..." Besides, self-diagnosing using the Internet isn't the worst thing. It might just upset the physician because the patient believes he or she already knows what medication the physician should prescribe. Much more dangerous is the advice given and treatment methods recommended by social networks that encourage treating yourself without a physician. Currently, this is mainly the case with TikTok, which is full of guaranteed cures for many health problems. Some advice may be harmless, but others may not. We shall realize that the network's algorithm favours the number of views, not professional quality. This is the main reason why myths and unverified treatments such as "liver detox with lemon," "homeopathic cancer treatment," etc., are spreading.

This is nothing new, though. Lots of tips (surprisingly useful, but also somewhat strange) can be found even in ancient books, such as the medieval manuscript Cotton MS Vitellius C III, which oscillates between medical practice and magic. Vulture eyes wrapped in fox fur will most likely not relieve your eye pain, just as the childbirth will not go more smoothly and quickly if you tie bird feathers to the left leg of a woman in labour. Some other treatments also balance between valid and absurd. A tip for healthier hair from another 9th-century manuscript starts quite reasonably – covering the hair with herbal salt and vinegar will help disinfect the scalp and remove parasites. But to really make your hair shine, it is recommended to apply an oil ointment with ashes from a burned green lizard. What else to add, the Middle Ages certainly did not lack creativity.

This was just to remind us that in our world full of social media, it is worth remembering what telemedicine certainly is not. But what is it actually?

Telemedicine is the remote provision of healthcare, namely using telecommunications and information technology. It allows physicians and patients to communicate and share health data without requiring their physical presence. It is used for consultations, health monitoring, and other healthcare services. In recent years, the development of telemedicine tools in the Czech Republic has accelerated dramatically. One of the drivers was undoubtedly the COVID-19 pandemic, together with major state aid for research and development. Through TA CR alone, dozens of projects dedicated to telemedicine have been supported, bringing solutions in the areas of eHealth, digital healthcare, artificial intelligence in healthcare, and others.

The development of this field in the Czech Republic is not only about technology but also about the ability to combine medicine, computer science, and healthcare management into a single functional whole. We will now take a closer look at three projects that deserve special attention – not only for their technological sophistication but also for their potential for a genuine systemic change, which started in our country at the end of the last century. In the period from 1995 to 1998, eHealth and remote data transmission were first mentioned in cardiology in the ORCA project. Subsequently, in 1997, the pilot projects of teleradiology between smaller hospitals were launched, and two years later, between 1999 and 2000, the first version of the healthcare data standardization of the Czech Republic was developed under the leadership of Jana Zvárová and Vladimír Přibík. By coincidence, preparation of multiple projects and programmes resulted in their implementation at the time far from being optimal in many ways, which, however, proved to be extremely favourable for telemedicine – the period of the COVID-19 pandemic. During this time, a dramatic increase in the use of telemedicine occurred globally. In some countries, such as Canada, Norway, and the US, telemedicine temporarily accounted for up to 80% of outpatient care. In 2023, the Czech National eHealth Center of the Olomouc University Hospital was established, which now plays the key role in the systematization of legislation, financing, and standardization in the field of medicine.

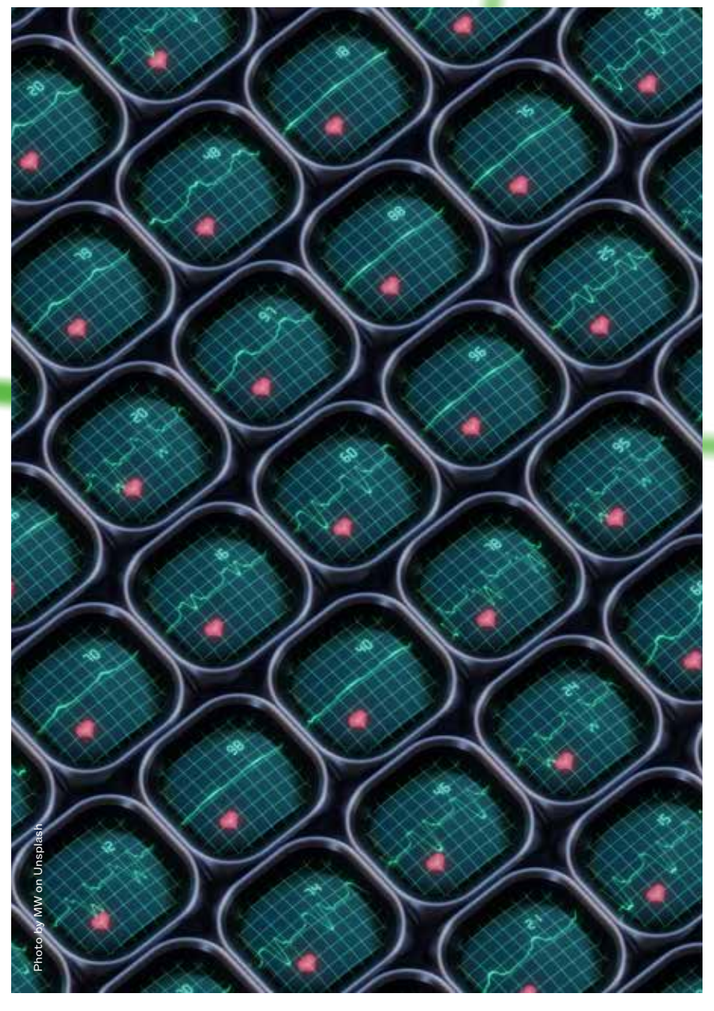


Photo by MW on Unsplash

The implementation of telemedicine and the ability to respond swiftly to the unexpected COVID-19 pandemic were crucial developments. They highlighted the need for new technologies and our capability to quickly develop and apply these innovations in practice. One notable example is the project titled "Development of Selected Technologies in the Conditions of the COVID-19 Crisis and After It." This project was conducted by the Technology Center Prague in collaboration with the Faculty of Business Economics at the Czech University of Life Sciences in Prague. The primary objective of the project was to capture the impulses triggered by the COVID-19 crisis and evaluate their impact on the drivers of rural development. The goal was to create opportunities for reducing regional disparities and enhancing the resilience of rural areas. Among its sub-objectives, the project examined the scope and various applications of selected technologies, including digitalization, cloud services, additive manufacturing, telemedicine, and distance learning. Additionally, the project analyzed the impacts of these technologies, the fulfillment of needs by involved stakeholders, and the methods of cooperation based on the operational areas of these technologies.

JOSEPH – an AI-based heart rate monitor – is the result of a project carried out under the TREND Programme and investigated by Medical Data Transfer s.r.o. and the Institute of Scientific Instruments of the Czech Academy of Sciences. It is a technologically advanced solution that combines remote ECG monitoring with analytical tools of artificial intelligence. ›

The project aimed to enable physicians to timely diagnose cardiac arrhythmias through an online platform that collects and evaluates data in real time. It was developed with account taken of its usability in everyday clinical practice and the safety standards of medical devices. JOSEPH is an example of how AI can be used not as a replacement for a physician, but as their smart assistant.

While the previous two projects focused on the methodological and technological framework, the project "Research of the operational and economic model of telemedicine care," investigated by the Olomouc University Hospital and implemented under the National Recovery Plan, focused on comprehensive systemic preparation for the introduction of telemedicine into everyday activities within the Czech healthcare system. A team of experts was engaged in drafting legal provisions and operating rules, proposing data architecture design, and developing communication platforms. Pilot tests carried out in specific clinical branches, such as diabetology, cardiology, and home palliative care, were also an important part of the project. The result was not only the product itself but an overall functional framework that allows safe, reimbursable, and clinically useful provision of telemedicine care in real-world practice.

These three examples illustrate a hypothetical axis of Czech telemedicine – a strategic model, a technological tool, and an implementation framework. They represent a link between research and clinical reality, between technology and the patient. Creating such a framework is essential since it is about systemic coordination of disparate disciplines and areas, which will encompass a wide portfolio of specific activities – from data processing and information transfer through analytical diagnostics and prevention to robotization of medical departments. ×

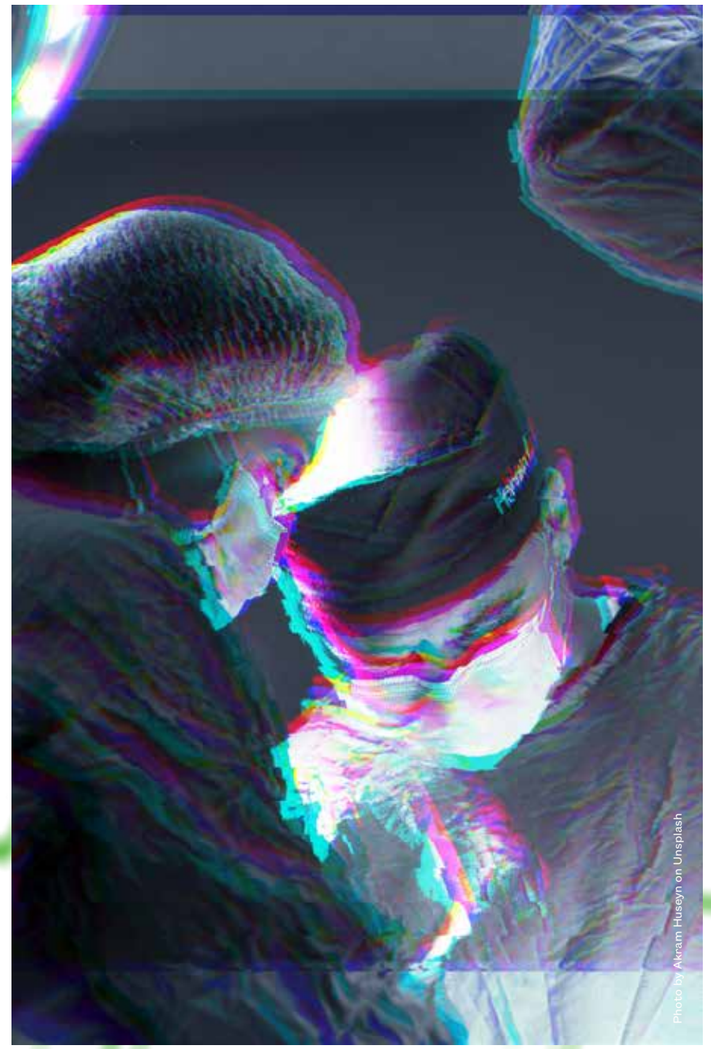


Photo by Akram Huseyn on Unsplash

Business – Research – Innovation, all under one roof

Author: **MSIC**
Photo: **Pavla Gajdová**

What is the InnoVerse conference?
Firstly, InnoVerse is not just a conference. It is a story, the second chapter of which will be told in November. A story full of successful startups, inspiring personalities, planned as well as unexpected encounters, and also colossal fuckups. To cut a long story short, there's something for everyone. You do not have the slightest idea how to *"hack your business"*? You might find the answer right there.

Who is InnoVerse intended for?
- C-level and innovation managers of companies
- Entrepreneurs, including wannabes
- Investors
- Researchers with ambitions to commercialize the results of their work
- Representatives of the public sector pulling for change and progress

What can you look forward to?
Workshops, keynote speeches, panel discussions, networking, and, of course, something good to eat. But primarily for the souped-up Startup Expo stage offering an all-day interactive program, the *"selection of grapes"* of our startups, lots of inspiring projects and ideas, and perhaps even a special guest from abroad.

Registration and more info: **www.innoverse.cz**

Who will be there to inspire you?
- **Jan Berger (Themis Foresight):**
  „An innovation is only good if you earn money with it."
- **Pavlína Louženská (#HolkyzMarketingu):**
  "People do not want to pay for sustainability."
- **Jan Rafaj (BR Group, Confederation of Industry of the Czech Republic):**
  "We need to move from a low-cost economy to an economy with higher added value."
- **Bobby Bahov (Tietoevry):**
  „AI systems must adhere to strict ethical, safety, and regulatory standards to address these challenges effectively."

Lukáš Polák: Hydrogen-powered trains demonstrate their strength over battery-powered trains, especially in hilly landscape

Authors: **Šárka Kováříková, Leoš Kopecký**
Photo: **Marika Veselá, Lukáš Polák**

Regional railways often face decline if their electrification is not cost-effective. Hydrogen-powered trains can bring cleaner transport, lower noise levels, and a new appeal for both residents and tourists. Where does this technology have the best odds for success, what are its limitations, and when could it become a reality in the Czech Republic? We asked these questions to Lukáš Polák, an expert on hydrogen-powered technologies.

Photo by D koi on Unsplash

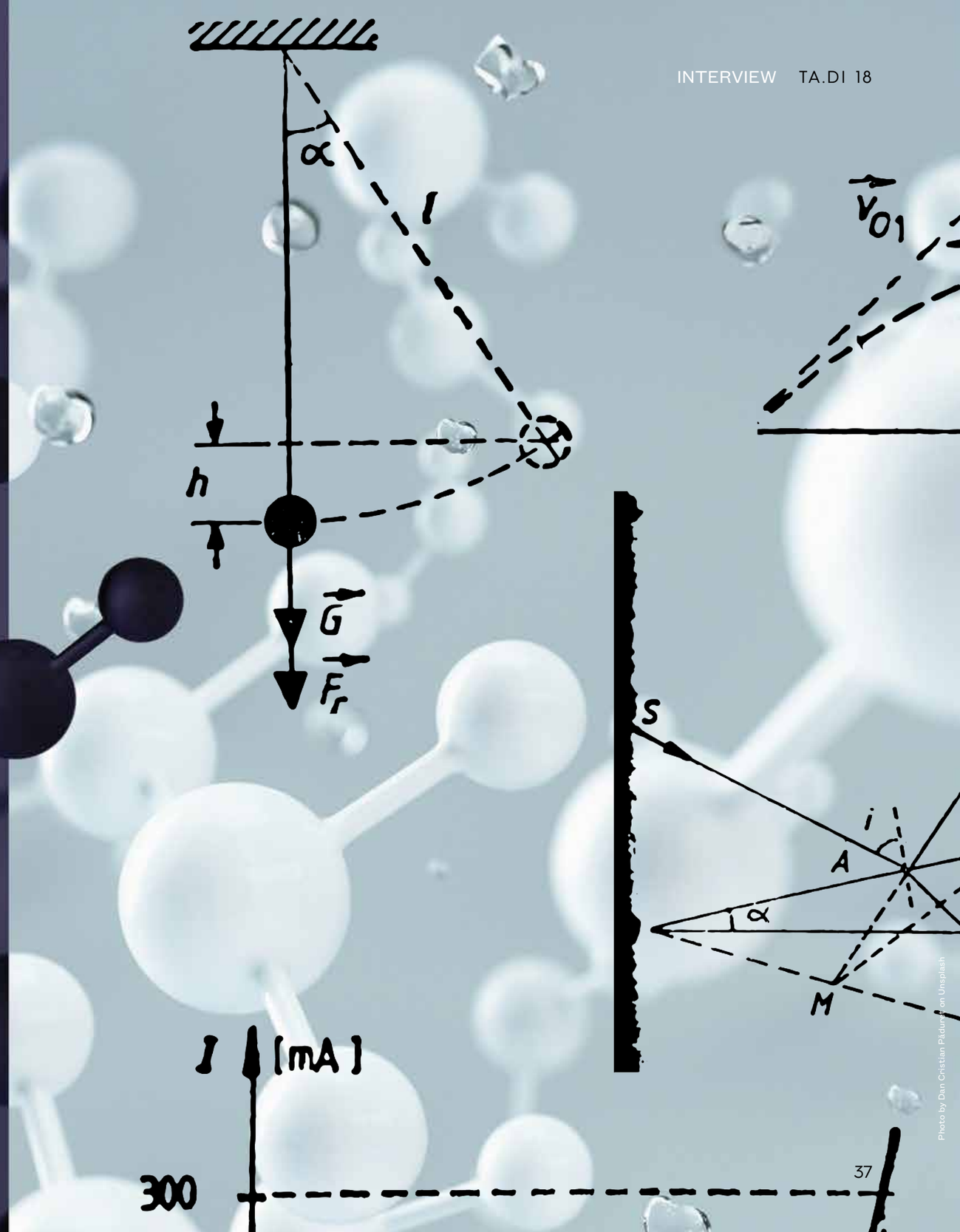


Photo by Dan Cristian Pădureț on Unsplash

Hydrogen on rails sounds like an innovation of the future, but isn't it in fact just an old idea that is now becoming relevant? Why did hydrogen-powered trains disappear in the past?
In more than 200 years of the history of rail transport, the use of hydrogen fuel cells is a relatively new concept. The first experiments with hydrogen-powered trains were carried out several decades ago, but only now, thanks to advances in technology and pressure for transport decarbonization, has this type of propulsion seenpractical application. One of the reasons behind it is the need to build infrastructure for hydrogen production and refuelling. Last but not least, trust and willingness to develop this type of propulsion are also important.

When you conducted the analysis of railway lines for the deployment of hydrogen-powered trains, were you surprised by the number of underutilized though technically suitable lines in the Czech Republic? What impact could, in your opinion, the deployment of hydrogen-powered trains have on regional development? Could they help maintain transport in areas where it would otherwise be at risk of decline?
Yes, the analyses reveal that there are numerous regional railway lines in the Czech Republic where electrification is neither economically viable nor feasible timewise. If we want to keep rail transport on these lines and at the same time achieve its decarbonization, hydrogen-powered or battery-powered trains can offer a clean alternative to diesel units. Moreover, these railway lines often serve residents of small municipalities as the only alternative to personal car transport and provide the necessary connection to the district or regional town.

The use of zero-emission trains, whether hydrogen- or battery-powered, can have a positive impact on regional development, both in terms of reducing emissions and noise levels and enhancing the attractiveness of the given regions for residents and tourists. From a broader perspective, the use of hydrogen-powered trains can also support the development of new technologies and job creation, for example, via local hydrogen production from renewable energy sources (RES).

Is the Czech railway infrastructure currently ready for hydrogen-powered trains? Not only when it comes to technology but system as well, as perceived by the general or professional public.
In terms of technology, it is not ready yet. The aforementioned infrastructure for hydrogen production, storage, and refuelling is missing. Nevertheless, the first pilot projects from abroad and the interest expressed by regions and transport companies indicate that readiness is gradually improving.

Public opinion is still circumspect, but the awareness of hydrogen as an alternative and interest in various zero-emission propulsion systems is on the increase. The professional community considers hydrogen-powered trains to be a relevant alternative, which is also supported by the results of our study conducted within the project funded under the KAPPA Programme of the Technology Agency of the Czech Republic. However, I do see certain shortcomings on the part of the state, which lacks a clear strategy for decarbonising regional railway lines.

What role do geography and topography play in the selection of suitable railway lines? Are hilly lines rather a challenge or, on the very contrary, an advantage offering hydrogen an opportunity to show its strength?
Topography plays an important role. Each railway line has its own energy profile, which is primarily determined by its gradient profile but also by speed requirements, number of stops, timetable, etc. Non-traction energy consumption, i.e., consumption for heating the cars, air conditioning, lighting, etc., also plays an important role. Compared to battery-powered trains, the hydrogen-powered trains have a significantly higher energy storage capacity, which provides them with a range almost ten times higher. Hilly terrain generally does not pose an obstacle for alternative propulsion in rail. Compared to conventional diesel units, they also show better dynamics when moving uphill and the possibility of recovering traction energy when braking. Availability of fuel (electricity or hydrogen) and its local production, for example, from renewable or low-emission energy sources, also must be factored in. In remote locations, this solution can also help manage the distribution network by using surplus renewable energy for hydrogen production.

The green nature of hydrogen is often a subject of public debate because its environmental benefits depend on the way it is produced. How does the project deal with the carbon footprint of hydrogen-powered trains? And how is it doing compared to battery-powered trains that are charged directly from the grid?
Hydrogen can be completely emission-free if produced via electrolysis using renewable energy sources. Simply put, the operation of hydrogen-powered trains is just as emission-free as is the production and distribution of the hydrogen used. The project calculates the carbon footprint of hydrogen production for both existing sources and potential new refuelling stations with local production.

In battery-powered trains, the carbon footprint depends on the primary source of electricity, i.e., the energy mix of the Czech Republic. In view of the fact that electricity generation from fossil fuels still prevails, hydrogen from renewable energy sources represents a cleaner alternative. An interesting comparison can also be made between refuelling speeds, i.e., charging battery-powered trains and refuelling hydrogen-powered trains. It depends on the specific technology, availability of the relevant power input ›

in a given location, or (im)possibility of dynamic charging of battery-powered trains while the train is in motion, which is significantly faster than stationary charging, e.g., at a final station.

The hydrogen-powered train project was supported by the Technology Agency of the Czech Republic. How important was this support for the implementation of the entire project? How did you benefit from the support?
As I mentioned earlier, the project was supported under the KAPPA Programme, which enabled direct involvement of a foreign partner – the Norwegian company SINTEF – and four other Czech institutions led by ÚJV Řež. The support of TA CR was vital for the project because it enabled the cooperation of a team with diverse expertise, connecting academia and industry. Thanks to public funds, it was possible to carry out detailed analyses of individual regional railway lines and to conduct a unique study assessing the technical and economic feasibility of various types of zero-emission propulsion systems. Without this support, the project could not have been carried out on such a scale.

According to the second update of the National Action Plan for Clean Mobility (NAP CM, 10/2024), building hydrogen infrastructure is planned, and support will be granted primarily to projects on hydrogen refuelling stations where road vehicles can also be refuelled. That sounds reasonable. What do you think?
The priority is given to refuelling stations for road vehicles along the European motorway network and urban agglomerations, where it can boost the development of not only personal car transport but also public and cargo transport. At the same time, the NAP CM does not rule out the possibility of building hydrogen refuelling station infrastructure as multifunctional or multimodal, i.e., infrastructure that could also serve to refuel rail vehicles. This could increase the efficiency of investments and support the integrated approach to clean mobility.

How many hydrogen storage tanks and how many refuelling stations would need to be installed, and how quickly?
Examples from all over the world show that hydrogen refuelling stations can be built with different capacities, both in terms of daily throughput and hydrogen storage. The actual number of stations depends not only on their size but also on the number of trains operated, their daily performance, and any links to other modes of transport. From the perspective of operational reliability, it is always more convenient to have more smaller stations than a single large one. However, this approach requires higher investment costs, so a balance must be struck between these two factors. For the first pilot project, one or two refuelling stations in appropriately chosen key hubs with connections to local hydrogen production and operation of 6 to 20 train units would suffice. The speed of construction depends firstly on the legislative and technical readiness of the project and secondly on securing funds and on delivery dates of key technologies. The realistic estimate would be 2 to 3 years from project approval.

At the same time, though, the plan states that there are, as a matter of fact, no railway lines in the Czech Republic that cannot be electrified. And it seems that investment and support will be channelled thereto – i.e., to the electrification of the railway lines. Will the results of your project bring about a change in this plan?
As for the Electric Traction Development Policy, preference is clearly given to electrification, which has already been launched, approved, or is in the feasibility study phase on a number of lines. Electrification, however, is economically justifiable only on lines with sufficient performance of both passenger and, particularly, freight transport, or where there is potential for their expansion thanks to electrification. Another factor is the actual speed of electrification and the time frame within which regional railway lines will also have to be decarbonized. Our calculations show that not all lines are fit for electrification economically. The resulting study thus provides new arguments for a diversified approach – i.e., a combination of electrification and the deployment of battery- or hydrogen-powered trains depending on local conditions.

Right now, green hydrogen is significantly more expensive than grey hydrogen, produced, e.g., from natural gas. When, in your opinion, will this change in the Czech Republic, which has only limited renewable energy sources? And will it change at all?
The introduction of this change necessitates, first of all, the creation of a market, i.e., demand for green hydrogen. Apart from the price of technology (electrolyzers, refuelling stations), also the degree of utilization of these facilities and the price of electricity from renewable sources are key to minimizing the production costs. The change in the price gap between zero-emission and fossil hydrogen may also be affected by the introduction of a tax burden on grey hydrogen. In the Czech Republic, where the use of renewable energy sources is very limited, low-emission hydrogen produced, for example, using the electricity from nuclear sources may also play a key role.

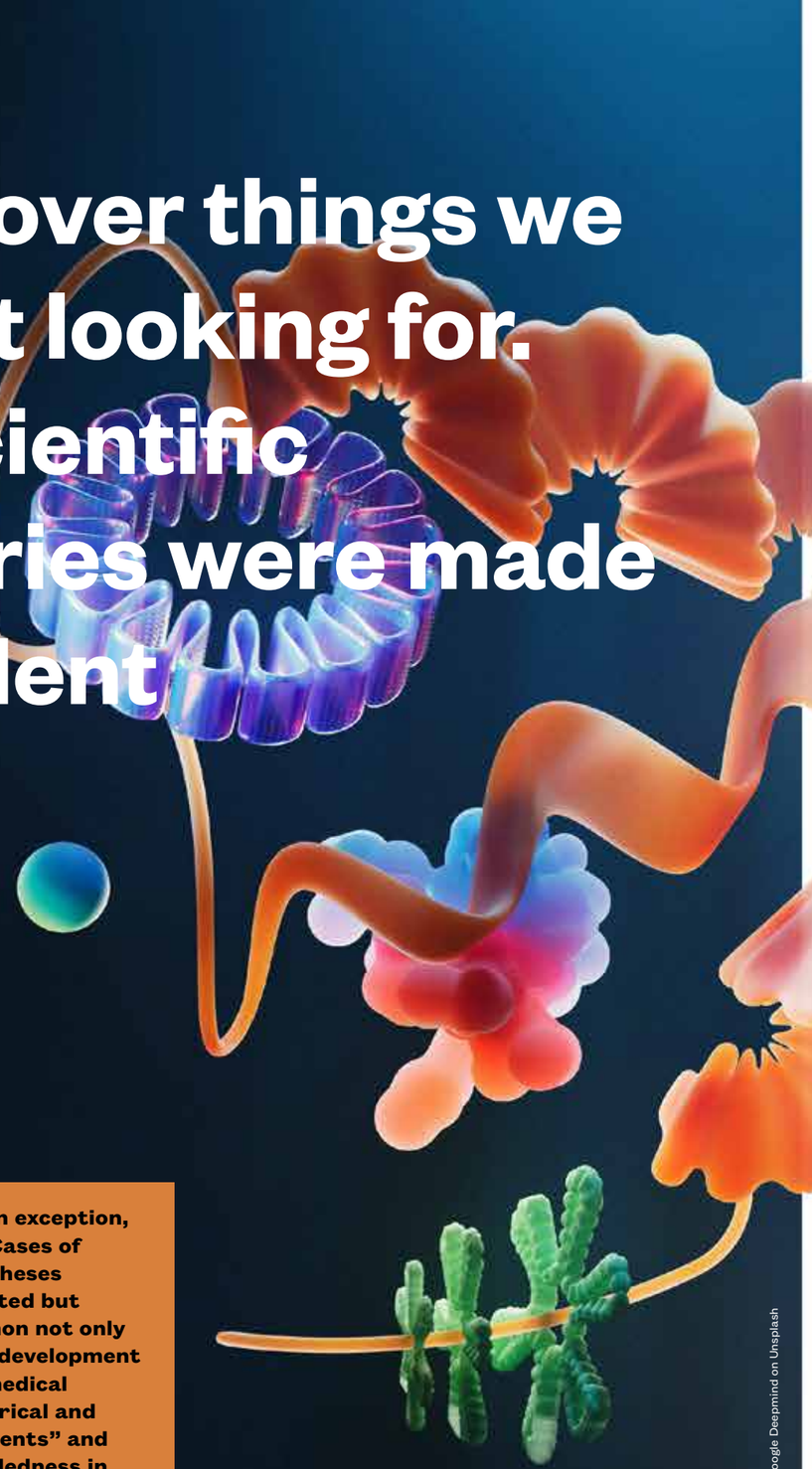
Iceland Liechtenstein Norway grants
Norway grants

What is your optimistic vision regarding the development of regional hydrogen-powered trains?
Hydrogen-powered trains can replace diesel units on regional railway lines where electrification is economically pointless, and battery-powered trains cannot be used for technical reasons. Their deployment can not only reduce emissions but also noise pollution, and on top of that, increase the attractiveness of rail transport. Based on a technical and economic assessment, lines have been identified where hydrogen propulsion may bring more benefits than other alternatives. Compared to costly electrification, the deployment of hydrogen-powered trains on these railway lines can be much quicker and cheaper thanks to lower infrastructure costs. Any optimistic vision, however, can become reality once the technical readiness of hydrogen technology and its economic and environmental viability are verified in practice. This cannot be achieved without the first pilot project, whether fully Czech or implemented as a cross-border project, i.e., using one of the train services operated between the Czech Republic and a neighbouring country. ×

Ing. Lukáš Polák, Ph.D.
Lukáš Polák graduated in the field of Chemical and Energy Processing of Fuels from the University of Chemistry and Technology. Since 2011, he has been working at ÚJV Řež, a. s., namely at the Department of Hydrogen Technologies and Energy Innovation. As the principal investigator, he has coordinated numerous research projects focused on the use of hydrogen not only in transport but also as a tool for energy storage. Under his leadership, a prototype hydrogen Tatra truck and a hydrogen-powered municipal vehicle were developed. He has also been actively involved in international cooperation, particularly with the Norwegian research institute SINTEF. An example of this cooperation is the project Regional Hydrogen Trains on Czech Railways, supported under the KAPPA Programme. He regularly presents the results of projects at technical conferences and workshops, drawing attention to challenges related to hydrogen safety, economic aspects, and the need to build a comprehensive infrastructure for its sustainable production and distribution.
His activities have significantly contributed to the development of sustainable transport in the Czech Republic and to strengthening the role of hydrogen in the decarbonization of transport and energy sectors.

We discover things we were not looking for. Many scientific discoveries were made by accident

Author: **Leoš Kopecký**
Photo: **Unsplash**



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In research, accidents are not an exception, but rather a part of the game. Cases of serendipity, when original hypotheses were abandoned due to unexpected but beneficial discoveries, are common not only in pharmacology but also in the development of new materials, implants, or medical devices. This text sums up historical and current examples of such "accidents" and underlines the role of open-mindedness in the innovation process.

Discovering things that we were not looking for aptly describes the phenomenon called serendipity – a happy coincidence that leads to an unforeseen but valuable discovery, often made when a person is looking for something completely different. This phenomenon is strongly present in research. However, coincidence is not the only important part of serendipity – the key is that it is noticed by someone who understands its potential and is able to make good use of it at the right time.

An open mind is a natural and necessary condition for the creation of something brand new and meaningful through human activity. Another common circumstance is the influence of non-standard conditions, when the experimental environment is somehow exceptional – these are the circumstances under which revolutionary and unexpected discoveries are made. It comes as no surprise that children with an open mind or adults with a childlike and playful spirit of a discoverer are behind some of them. Major breakthroughs often happen in hostile environments, extreme conditions, or outer space. Many revolutionary inventions originated in a situation that might be perceived as a coincidence – even if only at first glance. Upon a closer look into individual cases, one would often realize that it was not a coincidence at all. I believe that the philosophy that denies the existence of coincidence is not far from the truth and that the feeling of accidentality is just a demonstration of our inability to fully understand the entire context of an event in time and predict its consequences. But whether coincidence exists or not is a question of philosophy. The fact remains that the so-called accidental discoveries are indisputable, their value is undeniable, and in no way diminishing the value of targeted human research. Not by any means.

One of the most important spheres of research is certainly medicine, which has been impacted enormously by practical discoveries over the last decade. As for the potential and scope of these discoveries, only the fields of electronics and IT have been able to compete with medicine in recent decades. However, compared to other fields, the speed of application of medical discoveries is significantly hindered because the actual development and translation of a discovery into practice usually entail a long period of testing, conducting studies, and, naturally, also large investments. In electronics, the situation is much easier since it is usually the market that decides whether a discovery will be applied or not. And how fast it is, we can see every day. No one can keep up with all the new developments.

This makes more interesting the discoveries in medicine where, while something was investigated, something else was discovered – with surprising results that improve the quality of our lives. The most famous and essential for all mankind will probably always be Alexander Fleming's accidental discovery of penicillin. Nevertheless, you will probably be surprised by the number and variety of other accidents thanks to which physicians today can improve our lives and restore our health. For example, the discovery of insulin was also accompanied by a number of happy coincidences. At first, Frederick Banting (a Canadian physician) and Charles Best (a Canadian scientist) believed they were isolating something else in the laboratory. Their first extracts were extremely impure. Thus, the key serendipity happened when James Collip (a Canadian biochemist) managed to significantly improve the purification process, making insulin safe and effective for use in clinical practice.

The poison became a widely used medicine

Warfarin, which was originally a rat poison and is now a medicine commonly prescribed by physicians to prevent blood clotting, came into being in a much more dramatic way.

In 1920, a mysterious bleeding syndrome was observed in cattle in the U.S. and in Canada. The animals would die of internal bleeding. It turned out that it was caused by the consumption of spoiled sweet clover, which contained a blood-thinning substance. In 1940, Karl Paul Link (an American biochemist) and his team at the University of Wisconsin isolated and identified the active anticoagulant substance present in spoiled clover, which they named dicumarol. From this substance, Warfarin – a more effective and stable compound – was later synthesized. It was originally developed and patented in 1948 as an effective rodenticide (rat and mouse poison) that causes internal bleeding in rodents. The pivotal moment that changed the perception of Warfarin was an event in 1951 (sometimes reported as 1952). Back then, a U.S. Navy soldier who attempted suicide by ingesting a large dose of this rat poison was taken to the hospital. According to the physicians, the chances of his survival were minimal, but to their surprise, the treatment with vitamin K and blood transfusions was successful. Thanks to this case, the mechanism of action of warfarin was discovered.

In terms of drama, a completely opposite development occurred in Minoxidil, a drug intended to treat high blood pressure. Its side effect was excessive hair growth in patients, which gave rise to a new drug treating certain types of alopecia (hair loss). There are many other similar cases of pharmaceuticals – even Viagra which was originally developed as a drug for angina pectoris and other cardiovascular conditions.

It was thanks to a mistake that the pacemaker was invented

Happy accidents have resulted, however, not only in inventing medicines and in their use. The pacemaker, for example, was also invented by mistake. Wilson Greatbatch, an engineer working at the Cornell Aeronautical Laboratory in Buffalo, was tasked with designing an oscillator to measure heart ›

Photo by Maxim Berg and Nigel Hoare on Unsplash

rate to record heartbeats in animals. During his experiments, Greatbatch, by mistake, used the wrong electrical resistance in the circuit, and instead of a 10,000-ohm resistor, he connected a resistor two orders of magnitude higher. To his surprise, the circuit did not work as he had expected. Instead of measuring heart rate, the circuit began to generate regular electrical pulses that perfectly simulated the human heartbeat. Greatbatch realized that these pulses could be used to regulate the heartbeat in cases where it was too slow or irregular. This led to the development of the first implantable pacemaker. The first successful implantation of a pacemaker based on his design in a human took place in 1960, only four years after this discovery.

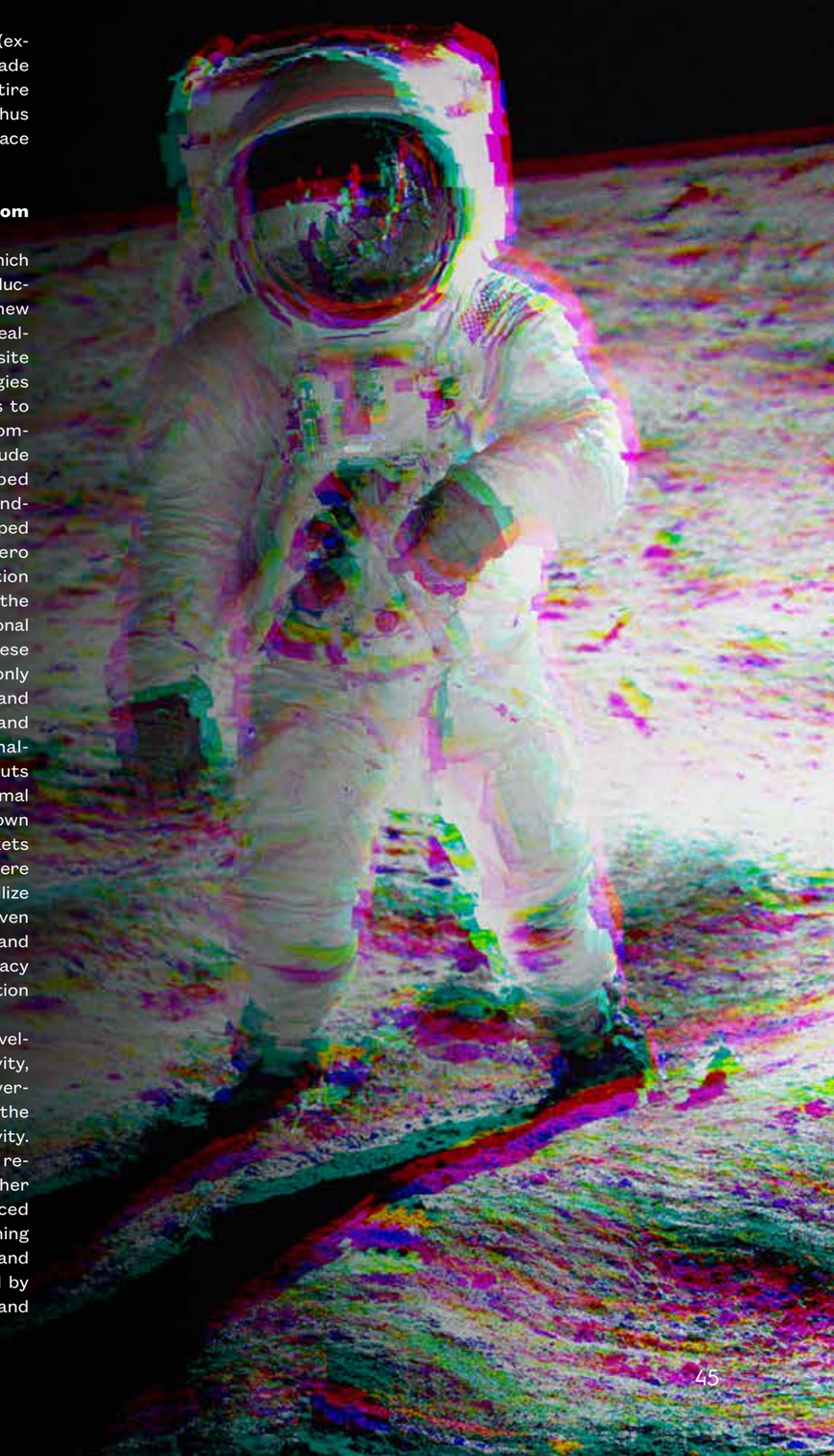
Teflon was originally intended for cooling, but it surprised everyone.
The champion in this category is probably Teflon, which was discovered by accident and outside the medical field. The discovery of Teflon (PTFE – polytetrafluoroethylene) in 1938 by chemist Roy J. Plunkett at the DuPont company was pure serendipity. Plunkett was originally developing a new refrigerant, but instead of gas, he found a white, waxy powder in the test tube, which proved to be an extremely slippery and chemically inert material. Many years later, in 1969, Robert W. Gore (an American researcher) accidentally discovered Gore-Tex (ePTFE – expanded PTFE) while trying to produce a cheaper version of PTFE cable insulation and experimenting with rapid stretching of PTFE rods. One day, he unexpectedly gave a hard yank to the rod, which expanded massively and created a porous structure. Gore-Tex was born, and so two materials with a wide range of applications and uses, not only in medicine but also in everyday life, came into being quite by accident. After all, who does not have a Teflon pan or Gore-Tex clothing or shoes at home?

Vulcanization triggered the development in many industries
Materials engineering is today, also thanks to the developments in nanotechnology and other fields, in the spotlight of many developers and designers. We could certainly identify lots of new materials, the creation of which was largely accidental. After all, a happy accident also played a role at the end of the first industrial revolution in 1839, when Charles Goodyear (an American chemist and inventor) sought to improve natural rubber and turn it into a useful material that would not be affected by changes in temperature and would not smell so bad. During one of his many experiments, Goodyear accidentally dropped a mixture of rubber and sulphur onto a hot stove. Instead of melting and deteriorating, the mixture carbonized like leather, but the edges that touched the hot surface remained flexible and non-sticky. This unexpected result – the fact that heat and sulphur could transform rubber without melting it – led to the discovery of vulcanization. This ushered in the massive development of the rubber industry, producing a range of products from seals, hoses, and belts in machines up to tires, the invention of which brought about the revolution in transportation. It was one of the most significant discoveries in the history of materials science and engineering. In 1969, 130 years later, Goodyear became a partner of NASA and supplied important components for the Apollo 11 spacecraft, helping to facilitate the first manned mission to the moon. For the Apollo 14 mission in 1971, Goodyear and NASA launched a project to develop lunar tires and

created two non-pneumatic XLTs (experimental lunar tires), which made history by being the first to leave tire tracks on the surface of the Moon, thus paving the way for the future of space exploration and mobility.

Inspiration and motivation from space
Due to the extreme conditions in which it takes place, space research introduces into our everyday lives more new and useful things than we often realize. The official NASA Spinoff website gives examples of many technologies that have been developed thanks to space research and are now a common part of our lives. These include memory foam, originally developed to protect astronauts during landing, battery-powered tools developed for the work of astronauts in zero gravity, and water and air filtration technologies perfected through the experience gained at the International Space Station (ISS). At present, these filtration technologies are commonly used in disaster-stricken areas and by the armed forces. Polarized and UV protection sunglasses originally protected the eyes of astronauts from strong radiation, while thermal foils and insulating materials known as gold or silver emergency blankets for rescue services and athletes were developed to reflect heat and stabilize temperatures in space shuttles. Even the GPS navigation, its satellites, and algorithms for positioning accuracy were also developed in collaboration with space research.

The driving force behind the development is primarily human creativity, desire for knowledge, effort to overcome difficulties, and to improve the conditions of the respective activity. It is irrelevant what the subject of research and development is, whether it concerns our health or advanced production processes; the main thing is the progress itself. Its impact and significance will only be assessed by the future and next generations and centuries. ×



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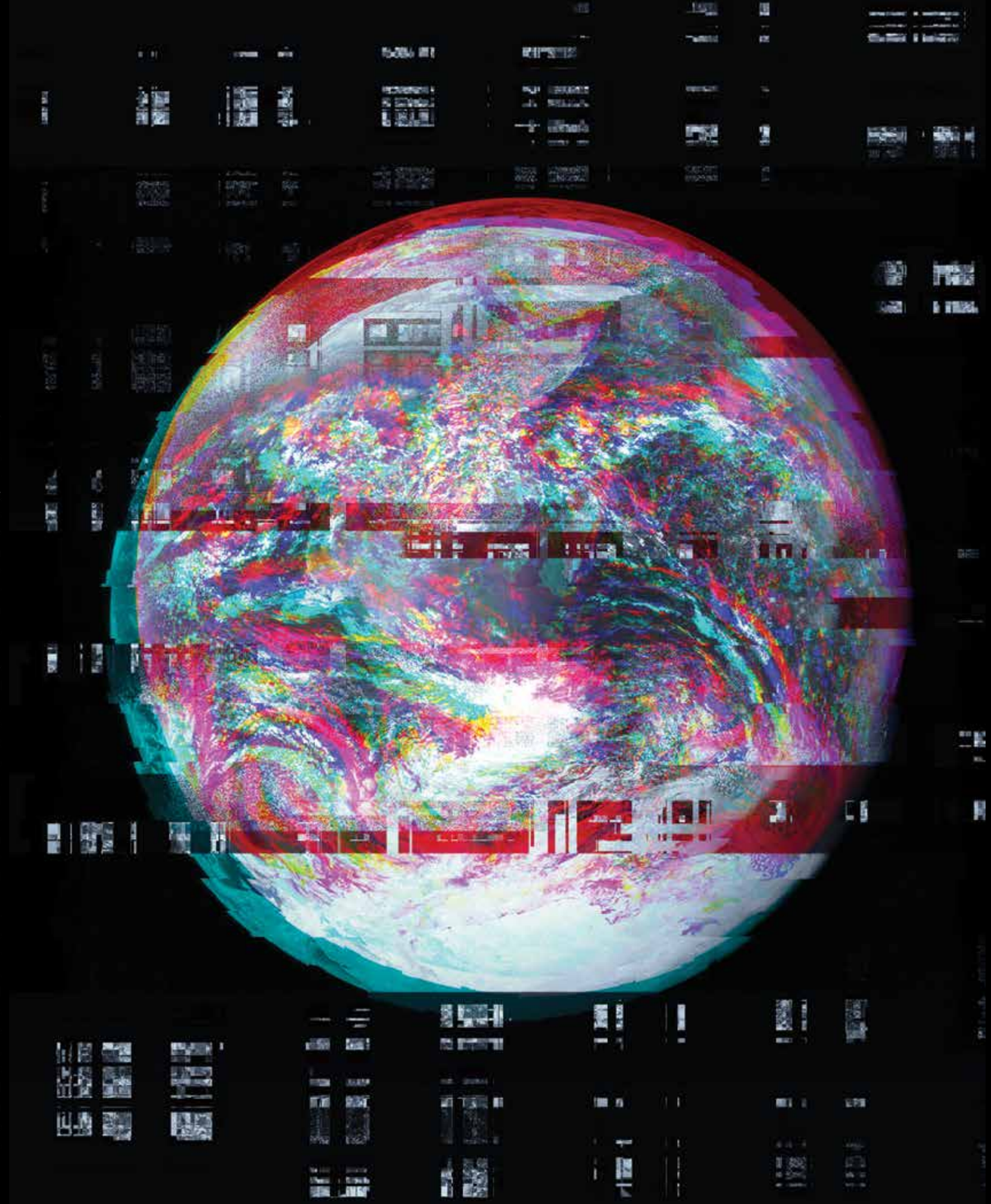
TA CR Awards 2025

Author: **Veronika Dostálová**
Photo: **Unsplash, Archive of VZLU**

Since 2013, when spring turns to summer, we have had a very pleasant yet difficult task – to nominate the best applied research projects of the past year that will receive a glass statuette by Lukáš Jabůrek during the TA CR Awards ceremony held in the autumn. Even though we have been doing this for more than a decade, selecting the best projects is becoming ever more difficult. Not because there are few applied research projects or because they are not of high quality. On the very contrary. Every year, we receive plenty of top-notch projects that are not only highly beneficial for our society and economy but have much more in common – unique partnerships, interdisciplinarity, perseverance, courage, and faith in oneself and the entire team.

The purpose of the TA CR Awards is not only to pay tribute to outstanding researchers, but also to motivate exceptional talents, highlight their tireless work, and last but not least, strengthen the positive perception of research among the general public. The TA CR Day, during which the TA CR Awards are granted, can already be considered one of the most significant traditional events in the field of research. The candidates for prize-winning projects are nominated by our colleagues, who, throughout the year, monitor projects with excellent results, unique collaboration, and high benefits for our country. The winners are then selected by an independent committee composed of both internal and external research experts.

This year's topic of the TA CR Day: **Forgotten Innovations: The World (Un)Known**, will focus on how we take the established innovations for granted and show how our lives would change if we had to live without them. At the TA CR Awards ceremony, which will take place at the National Museum on November 13, we will, as always, present glass statuettes to the investigators of the best projects of the past year in four categories: Business, Governance, Society, and Partnership. Our colleagues had a difficult task – to select truly innovative projects that will improve the lives of us all and boost the competitiveness of the Czech Republic. You may be surprised by the final selection. However, I believe that the description of the projects will turn this surprise into pride that such great ideas emerge in our country.



Business Category

A Lighter, More Durable Airframe for the L-39NG in Modern Defense

Investigators:
- AERO Vodochody AEROSPACE a.s.
- Aeronautical Research and Test Institute

Programme:
TREND

The Czech Republic has a long-standing tradition in the development and production of training and light military aircraft. The proof thereof is the state-of-the-art L-39NG aircraft, which is attracting worldwide attention. The investigators of the prize-winning project in the Business Category focused on improving the utility features compared to the older L-39C model. Their efforts resulted in a completely redesigned airframe (principal structural unit), which has been adapted to modern loading standards and simulations, e.g., in line with the NATO standards.

The new airframe design offers major advantages – it is lighter, three times more durable than the previous model, safer for pilots, and has lower operating costs. Thanks to these parameters, the L-39NG is not only a perfect training aircraft for new generations of pilots but also a full-fledged part of modern defense.

The new design of the L-39NG meets the strict requirements of modern military aviation, and the demand for it in the foreign markets has been on the increase. Apart from the Czech Republic, orders have been placed by countries such as Vietnam, Hungary, and LOM Praha s.p. Negotiations are underway within NATO and beyond.

Society Category

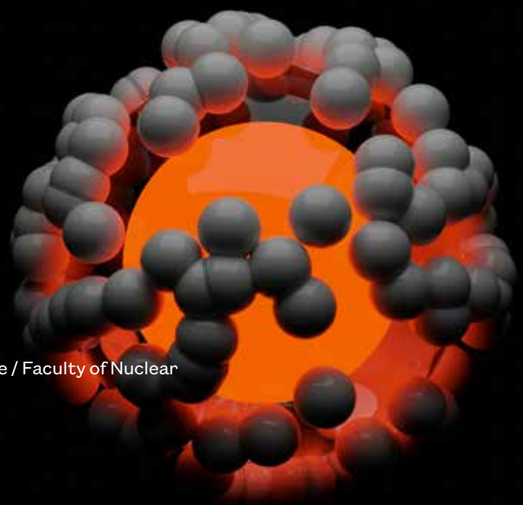


Photo by Shubham Dhage on Unsplash

Safer and More Efficient Fuel for Nuclear Energy

Investigators:
- UJP PRAHA a.s.
- Czech Technical University in Prague / Faculty of Nuclear Sciences and Physical Engineering

Programme:
THETA

The TA CR Award in the Society Category went to a project that contributes to a safer and more efficient nuclear energy sector. It aimed to develop a new type of nuclear fuel that can better withstand crisis situations. The researchers developed and tested a fuel of high density and with a special protective nickel-chromium coating. This material increases the fuel's resistance to overheating, oxidation, and corrosion – the main risks faced during nuclear power plant operation and in emergency situations.

The new fuel has a longer lifespan, which reduces the replacement costs and the overall operating costs of nuclear power plants. Another advantage is its more stable behaviour in the event of changes in power output, which occur commonly during the operation. This makes it easier to plan power plant operations and to respond to various situations. Within the project, software was also developed that can more accurately model fuel behaviour in real conditions. This is important not only for fuel producers but also for power plant operators and regulatory authorities overseeing the safety.

Although similar types of nuclear fuels are being developed abroad, the available data is often limited. Hence, the Czech project represents an important and open step forward. Its results can be used by local and foreign partners, which makes the project beneficial not only for the Czech energy sector but also for the international nuclear community.

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Governance Category

Managed Replenishment of Groundwater from Rain and Snow to Combat Drought

Investigators:
- T.G. Masaryk Water Research Institute, a public research institution
- Czech Geological Survey

Programme:
Environment for Life

In recent years, the Czech Republic has been struggling with severe drought impacts, which also affect groundwater levels. The winning project in the Governance Category presents an innovative solution to this issue. It proposes to collect rainwater or snowmelt and store it safely underground in the so-called hydrogeological collectors. This will prevent evaporation losses and keep water in the landscape for periods when it is most needed.

The project has two pillars: investigating the methods of targeted replenishment of groundwater and identifying suitable areas for their implementation, drawing the first national map of groundwater vulnerability to drought. Another important part of the project was the research of changes in the amount of groundwater during drought, in the form of so-called base flow maps.

The results will enable the targeted implementation of the proposed measures in areas most threatened by drought. This will secure sufficient drinking water resources for the population well into the future and will also supplement the Catalogue of Nature-Based Solutions for Water Retention in the Landscape. The project represents a crucial step towards better and more sustainable water management amidst ongoing climate change.

Partnership Category

Innovative Footwear to Support Toddlers‘ First Steps with Ankle Issues

Investigators:
- Masaryk University / Faculty of Sports Studies
- Boty J HANÁK R, s.r.o.

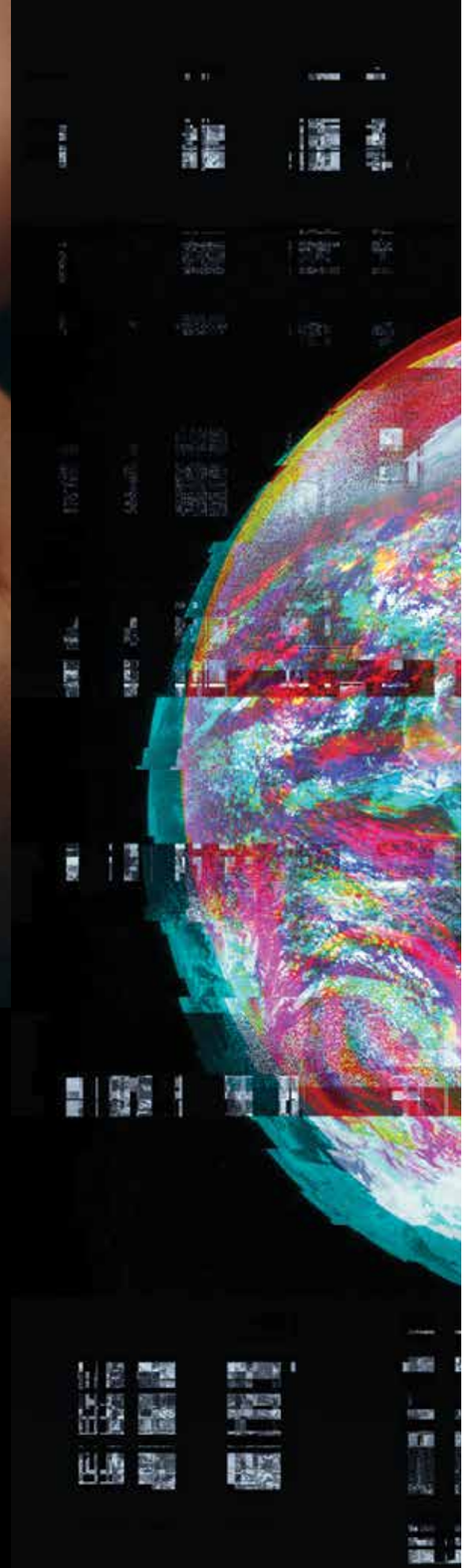
Program:
ZETA

The first steps are the key milestone for every child. In toddlers with ankle valgus – heels angled outward, learning to walk can be more difficult. This defect affects 5 to 10% of toddlers, and these children often prefer sedentary activities and insist much more on being carried than their healthy peers. That is why the research team of the winning project in the Partnership Category developed and tested special footwear to help these children in their development.

The study compared three groups of toddlers – healthy children, children receiving standard treatment, and children with valgus ankles who wore the tested footwear. The results showed that the new footwear improved key gait parameters in children – their stride length increased, and ankle range of motion and heel contact with the ground improved.

This biomechanical footwear is designed to minimize the limitations of children‘s feet, which boosts confidence when taking their first steps. Although it is primarily intended for toddlers with valgus ankles, it may also be used in the future for healthy children or those whose parents are concerned about their gait development.

Photo by Ana Curcan on Unsplash



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3D printing is no longer an innovation. The innovation is the digital ecosystem

Photo: **Archive 3Dees**

Today, 3D printing is no longer an innovative technology but a standard part of manufacturing. Or is it? Although additive manufacturing has enormous potential, it often faces mistrust and a lack of knowledge in companies. In an interview, Ondřej Štefek from 3Dees Industries explains why the industry needs "Renaissance people" and how the approach differs in the Czech Republic, Poland, or Ukraine.

Is 3D printing still an innovative technology?
No, it is not. 3D printers have become an integral part of companies' manufacturing processes – from research and development to final products. Thus, it is not the technology itself that is innovative, but the digital processes involved: input data optimization, AI-powered STL model file generation, automated quality control, smart production planning, and integration of data from 3D scanning and simulations. Which means we do not refer to the 3D printer as such, but to the entire ecosystem, with all stages of the production cycle included in a single digital loop.

If 3D printing is no longer innovative, does that mean it is now a standard technology commonly used in companies?
Unfortunately, that is not the case either. The biggest limitation is not the technology but the human being – employees or managers who distrust change or reject it outright. Therefore, a major part of our work lies in education: explaining that 3D printing is not a competitor to traditional technologies such as machining or injection moulding, but a powerful complement thereto. Additive manufacturing has enormous application potential, but it is impeded by the unwillingness or lack of imagination of those who could use it. In many companies, the perception still prevails that 3D printing equals prototyping, and when you refer to "3D printer," most people visualize a small desktop device working with plastic filament. And yet, current industrial platforms are capable of one-piece or batch production of end-use parts with properties that often surpass those of traditional manufacturing methods – e.g., in healthcare.

How could this be changed?
Sometimes it is a Sisyphean task – and you also need a little bit of luck to come across someone with an open mind. But it all starts at universities. If a technical degree graduate shows up for an interview and mentions that he has a desktop 3D printer at home, it's comparable to him bragging that he can use a desktop drill. That's fine, but it's not enough to understand the true potential of additive manufacturing. We want to get completely different information: what 3D modelling and design tools they are familiar with, what AI skills they master, and how they think about process optimization and finding new solutions. Basically, we are looking for modern "Renaissance personalities" – people who not only combine engineering with computer science but are also capable of creative thinking. Because only then does the 3D printing become a game-changer and not a mere hobby tool.

What is your approach thereto in 3Dees?
We have a team of application engineers who are not narrowly specialized but rather versatile. The customer's requirements cover multiple fields. Before installing an industrial 3D printer or metrology 3D scanner, you and your client plunge into cost analyses, modifying the components for printing, seeking suitable materials for production, or setting up the manufacturing process for their product. Our colleagues must be creative, share experiences with each other, and be culturally sensitive. Our company operates in Central and Eastern Europe and communicates with suppliers from all over the world.

What are, from your perspective, the differences between the individual markets you operate in?
Apart from the Czech Republic and Slovakia, we opened a subsidiary in Ukraine six months before the Russian invasion. We have a team there with broad expertise and a number of interesting applications installed in various industries. In the autumn, we are entering the Polish market, which is incredibly dynamic. Local companies are aggressive, and Polish society as a whole recognizes the need for rapid development and increased defense capability against the threats from the east. The situation in the Czech Republic is entirely different. Many companies still have close ties to the automotive industry and are now treading water, somewhat wearily. However, I believe that this will change too and that the boom we are witnessing in the arms industry will gradually pour energy into other sectors. ×

Ondřej Štefek
Ondřej Štefek is the managing director of 3Dees Industries and Paarts Additive, companies focused on industrial applications of 3D printing and 3D scanning in Central Europe and Ukraine. He studied political science at Central European University and began his professional career in public consulting, where he gained experience in project management and finding innovative solutions in both the public and private sectors. For more than ten years, his professional path has been focused on new technologies in digital manufacturing. Ondřej specializes in connecting 3D printing with the real needs of industry, healthcare, and the defense sector, and is behind a number of projects that have helped move additive manufacturing from prototyping to full-fledged serial production.