Zbornik 24. mednarodne multikonference

INFORMACIJSKA DRUŽBA

Zvezek E

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14. mednarodna konferenca o prenosu tehnologij

14th International Technology Transfer Conference

Urednika • Editors:

Špela Stres, Robert Blatnik

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PREDGOVOR MULTIKONFERENCI INFORMACIJSKA DRUŽBA 2021

Štiriindvajseta multikonferenca *Informacijska družba* je preživela probleme zaradi korone v 2020. Odziv se povečuje, v 2021 imamo enajst konferenc, a pravo upanje je za 2022, ko naj bi dovolj velika precepljenost končno omogočila normalno delovanje. Tudi v 2021 gre zahvala za skoraj normalno delovanje konference tistim predsednikom konferenc, ki so kljub prvi pandemiji modernega sveta pogumno obdržali visok strokovni nivo.

Stagnacija določenih aktivnosti v 2020 in 2021 pa skoraj v ničemer ni omejila neverjetne rasti IKTja, informacijske družbe, umetne inteligence in znanosti nasploh, ampak nasprotno – rast znanja, računalništva in umetne inteligence se nadaljuje z že kar običajno nesluteno hitrostjo. Po drugi strani se je pospešil razpad družbenih vrednot, zaupanje v znanost in razvoj. Se pa zavedanje večine ljudi, da je potrebno podpreti stroko, čedalje bolj krepi, kar je bistvena sprememba glede na 2020.

Letos smo v multikonferenco povezali enajst odličnih neodvisnih konferenc. Zajema okoli 170 večinoma spletnih predstavitev, povzetkov in referatov v okviru samostojnih konferenc in delavnic ter 400 obiskovalcev. Prireditev so spremljale okrogle mize in razprave ter posebni dogodki, kot je svečana podelitev nagrad – seveda večinoma preko spleta. Izbrani prispevki bodo izšli tudi v posebni številki revije Informatica (http://www.informatica.si/), ki se ponaša s 45-letno tradicijo odlične znanstvene revije.

Multikonferenco Informacijska družba 2021 sestavljajo naslednje samostojne konference:

- Slovenska konferenca o umetni inteligenci
- Odkrivanje znanja in podatkovna skladišča
- Kognitivna znanost
- Ljudje in okolje
- 50-letnica poučevanja računalništva v slovenskih srednjih šolah
- Delavnica projekta Batman
- Delavnica projekta Insieme Interreg
- Delavnica projekta Urbanite
- Študentska konferenca o računalniškem raziskovanju 2021
- Mednarodna konferenca o prenosu tehnologij
- Vzgoja in izobraževanje v informacijski družbi

Soorganizatorji in podporniki multikonference so različne raziskovalne institucije in združenja, med njimi ACM Slovenija, SLAIS, DKZ in druga slovenska nacionalna akademija, Inženirska akademija Slovenije (IAS). V imenu organizatorjev konference se zahvaljujemo združenjem in institucijam, še posebej pa udeležencem za njihove dragocene prispevke in priložnost, da z nami delijo svoje izkušnje o informacijski družbi. Zahvaljujemo se tudi recenzentom za njihovo pomoč pri recenziranju.

S podelitvijo nagrad, še posebej z nagrado Michie-Turing, se avtonomna stroka s področja opredeli do najbolj izstopajočih dosežkov. Nagrado Michie-Turing za izjemen življenjski prispevek k razvoju in promociji informacijske družbe je prejel prof. dr. Jernej Kozak. Priznanje za dosežek leta pripada ekipi Odseka za inteligentne sisteme Instituta "Jožef Stefan" za osvojeno drugo mesto na tekmovanju XPrize Pandemic Response Challenge za iskanje najboljših ukrepov proti koroni. »Informacijsko limono« za najmanj primerno informacijsko potezo je prejela trditev, da je aplikacija za sledenje stikom problematična za zasebnost, »informacijsko jagodo« kot najboljšo potezo pa COVID-19 Sledilnik, tj. sistem za zbiranje podatkov o koroni. Čestitke nagrajencem!

Mojca Ciglarič, predsednik programskega odbora
Matjaž Gams, predsednik organizacijskega odbora

FOREWORD - INFORMATION SOCIETY 2021

The 24th *Information Society Multiconference* survived the COVID-19 problems. In 2021, there are eleven conferences with a growing trend and real hopes that 2022 will be better due to successful vaccination. The multiconference survived due to the conference chairs who bravely decided to continue with their conferences despite the first pandemic in the modern era.

The COVID-19 pandemic did not decrease the growth of ICT, information society, artificial intelligence and science overall, quite on the contrary – the progress of computers, knowledge and artificial intelligence continued with the fascinating growth rate. However, COVID-19 did increase the downfall of societal norms, trust in science and progress. On the other hand, the awareness of the majority, that science and development are the only perspectives for a prosperous future, substantially grows.

The Multiconference is running parallel sessions with 170 presentations of scientific papers at eleven conferences, many round tables, workshops and award ceremonies, and 400 attendees. Selected papers will be published in the Informatica journal with its 45-years tradition of excellent research publishing.

The Information Society 2021 Multiconference consists of the following conferences:

- Slovenian Conference on Artificial Intelligence
- Data Mining and Data Warehouses
- Cognitive Science
- People and Environment
- 50-years of High-school Computer Education in Slovenia
- Batman Project Workshop
- Insieme Interreg Project Workshop
- URBANITE Project Workshop
- Student Computer Science Research Conference 2021
- International Conference of Transfer of Technologies
- Education in Information Society

The multiconference is co-organized and supported by several major research institutions and societies, among them ACM Slovenia, i.e. the Slovenian chapter of the ACM, SLAIS, DKZ and the second national academy, the Slovenian Engineering Academy. In the name of the conference organizers, we thank all the societies and institutions, and particularly all the participants for their valuable contribution and their interest in this event, and the reviewers for their thorough reviews.

The award for lifelong outstanding contributions is presented in memory of Donald Michie and Alan Turing. The Michie-Turing award was given to Prof. Dr. Jernej Kozak for his lifelong outstanding contribution to the development and promotion of the information society in our country. In addition, the yearly recognition for current achievements was awarded to the team from the Department of Intelligent systems, Jožef Stefan Institute for the second place at the XPrize Pandemic Response Challenge for proposing best counter-measures against COVID-19. The information lemon goes to the claim that the mobile application for tracking COVID-19 contacts will harm information privacy. The information strawberry as the best information service last year went to COVID-19 Sledilnik, a program to regularly report all data related to COVID-19 in Slovenia. Congratulations!

Mojca Ciglarič, Programme Committee Chair
Matjaž Gams, Organizing Committee Chair

KONFERENČNI ODBORI
CONFERENCE COMMITTEES

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Ljubljana, Slovenia

PREDGOVOR / FOREWORD

Spoštovani državni sekretar prof. dr. Mitja Slavinec, spoštovani državni sekretar gospod Simon Zajc, spoštovani najvišji predstavniki javnih raziskovanih organizacij, spoštovani udeleženci, lepo pozdravljeni in dobrodošli na 14. Mednarodni konferenci za prenos tehnologij.
Today we are gathered technology transfer experts, researchers, students and post-graduate students with entrepreneurial ambitions, established and future entrepreneurs, innovators and representatives from governmental institutions and policy-making organizations.
Najlepše se zahvaljujemo soorganizatorjem, spin-out partnerjem, programskim partnerjem, promocijskim partnerjem, ter partnerjem, ki so podprli dvostranske sestanke med podjetji in raziskovalci. Za podporo se zahvaljujemo tudi Ministrstvu za izobraževanje, znanost in šport in Slovenskemu podjetniškemu skladu.
Začetni del konference, pozdravni nagovori in okrogla miza bodo potekali v slovenščini, nadaljevali pa bomo v angleščini.
The event, except the pitching section, is being recorded and will be made public in the next days. The welcome addresses and the round table will be held in Slovenian, later sections will be in English.
Po pozdravnih nagovorih bomo začeli z okroglo mizo o prihodnosti prenosa tehnologij v Sloveniji in Evropi s častnimi gosti. Spremljali bomo tekmovanje raziskovalno-podjetniških ekip, ki se potegujejo za naziv najboljše inovacijo iz javnih raziskovanih organizacij, nato razglasitev nagrade Svetovne organizacije za intelektualno lastnino WIPO IP Enterprise Trophy. Vzporedno se bodo odvijali vnaprej dogovorjeni posamični sestanki med raziskovalci in podjetji. Osrednjo temo konference, premagovanje izzivov financiranja v t.i. dolini smrti, nam bosta predstavila spoštovana gosta: Matthias Keckl, managing partner sklada Fraunhofer Technologie-Transfer in Natalija Stošicki, direktorica Oddelka za naložbe in evropske programme, SID banka. Nato bodo uveljavljeni strokovnjaki iz Slovenije in tujine predstavili znanstvene prispevke o prenosu tehnologij in intelektualni lastnini ter izbrane raziskovalne projekte. Vzporedno bo izvedena še sekcija za šole, pred zaključkom konference pa bomo razglasili tudi prejemnika nagrade WIPO Medal for Inventors.
Program je, kot vidite, res bogat, saj se dotika množice aktivnosti, pri katerih smo v pisarnah za prenos tehnologij osrednjega pomena.

Organizacijski odbor 14.ITTC / Organizing Committee of the 14.ITTC

ORGANIZACIJSKI ODBOR, PARTNERJI IN SPONZORJI / ORGANIZING COMMITTE, PARTNERS AND FINANCERS

The main organizer of the 14th ITTC Conference is Jožef Stefan Institute.

Jožef Stefan Institute Ljubljana, Slovenia

center for technology transfer and innovation at the Jožef Stefan Institute

The organizing committee:

Dr. Špela Stres, MBA, LLM, Jožef Stefan Institute

Robert Blatnik, M. Sc., Jožef Stefan Institute

Marjeta Trobec, M. Sc., Jožef Stefan Institute

The scientiffic programme committee:

Niko Schlamberger, President of Slovenian Society INFORMATIKA

Doc. Dr. Tamara Besednjak Valič, Faculty of Information Studies in Novo Mesto

Prof. Alexandru Marin, University POLITEHNICA of Bucharest

The 14th ITTC Conference is organized in collaboration with the International multiconference Information Society (IS2021).

IS Information Society

The 14th ITTC Co-organizers are:

Slovenian Intellectual Property Office (SIPO)

World Intellectual Property Organization (WIPO)

Faculty of Information Studies Novo mesto

The 14th ITTC Programme partners are:

Fraunhofer Technologie-Transfer Fonds

Slovenian association of technology transfer professionals (SI-TT)

The 14th ITTC Spin-out partners are:

Slovene Enterprise Fund

SID Bank (SID – Slovenska izvozna in razvojna banka)

The 14th ITTC Research-to-Business meetings partners are:

SRIP - Smart Cities and Communities partnership

The Research-to-business meetings at the 14th ITTC Conference were co-organized in collaboration with the Enterprise Europe Network partners:

Innovation Center of the Faculty of Mechanical Engineering in Belgrade

Fundació Universitat-Empresa de les Illes Balears (FUEIB)

MIR Foundation

Development agency of the Republic of Srpska

Area Science Park

Business Incubator Novi Sad

The Netherlands Chamber of Commerce KVK

KOSGEB Ankara Ostim (Small and Medium Enterprises Development Organization EU and Foreign Relations Department)

The 14th ITTC Associated partners are:

University of Ljubljana

National Institute of Biology

National Institute of Chemistry

University of Maribor

Agricultural Institute of Slovenia

University of Primorska

The 14th ITTC Promotion partners:

University of Belgrade

GIS – Transfer Center Foundation

Scientific Research Centre Bistra Ptuj

Centre of Excellence for Integrated Approaches in Chemistry and Biology of Proteins (CIPKeBiP)

Development Centre Novo mesto

SAŠA inkubator

SIS EGIZ

SRIP Health – Medicine

SRIP hrana

Podjetniški inkubator Vrelec

RDA Koroška - Regional Development Agency for Koroška

University Industry Collaboration Centers Platforms of Turkey

Razvojno informacijski center Bela krajina

The Conference is co-financed by:

Consortium for Technology Transfer

Investment is co-financed by the Republic of Slovenia and the European Union under the European Regional Development Fund.

Enterprise Europe Network

Co-financing Enterprise Europe Network's part of R2B international brokerage event of Sector groups BioChemTech and ICT Industry&Services that are formed and co-financed entirely by the Enterprise Europe Network.

R2B meetings are organized and co-financed in the frame of the Enterprise Europe Network (contract number 880148).

Slovene Enterprise Fund

The event is co-financed by the Slovenian Enterprise Fund and the European Union, namely from the European Regional Development Fund. It is implemented on the basis of the program "Substantive support of recipients of funds (SMEs) in the period from 2018 to 2023", within the Operational Program for the Implementation of European Cohesion Policy in the period 2014-2020.

ACKNOWLEDGEMENTS

The editors and organizing committee of the Conference would like to express cordial thanks to all who helped make the 14th International Technology Transfer Conference a success.

We would like to acknowledge the valuable contributions to the members of the **SCIENTIFIC PROGRAMME COMMITTEE:**

Niko Schlamberger, President of Slovenian Society INFORMATIKA

Doc. Dr. Tamara Besednjak Valič, Faculty of Information Studies in Novo Mesto

Prof. Alexandru Marin, University POLITEHNICA of Bucharest

for their contribution to the scientific programme and review of the scientific contributions and selection for publication in this Conference proceedings.

Our special thanks go to the **EVALUATION COMMISSION MEMBERS**:

Dr. Jon Wulff Petersen from Plougmann Vingtoft

Matthias Keckl from Fraunhofer Technologie-Transfer Fonds (FTTF)

Nina Urbanič from Slovene Enterprise Fund

Gregor Klemenčič from Deep Innovations

for their evaluation of written technology commercialization proposals and selection of winning teams, authors of inventive technologies with the best potential for commercialization of the technologies, developed at Public Research Organizations.

We are particularly grateful to the members of the **EVALUATION COMMISSION**:

Alojz Barlič from Slovenian Intellectual Property Office (SIPO)

Matthias Keckl from Fraunhofer Technologie-Transfer Fonds (FTTF)

Nina Urbanič from Slovene Enterprise Fund,

for their evaluation and selection of the awardees of the WIPO IP ENTERPRISE TROPHY and WIPO MEDAL FOR INVENTORS

Technology Transfer Fund - Central Eastern European Technology Transfer (CEETT) platform

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ABSTRACT

This article describes the importance of technology transfer funds in financing the transition of discoveries from the laboratory to the market, which is called bridging the commercialization gap or the "valley of death". Presented is the newly established Central Eastern European Technology Transfer (CEETT) platform, the first multinational technology transfer investment platform ever introduced in the European Union, as well as its importance and expectations in the protection of intellectual property and technology transfer from public research organizations (PROs) to industry in Slovenia and Croatia.

KEYWORDS

Technology transfer, venture capital, proof of concept, technology transfer fund, commercialization gap, valley of death, Central Eastern European Technology Transfer platform, CEETT

1 INTRODUCTION

Much of what is used today was born in a laboratory — but how did it develop from research to a product that can be bought? Technology Transfer (TT) funds commercialise promising research, allowing it make that crucial step from the prototype world into the commercial space. Technology transfer (TT) can be broadly defined as the process of converting scientific findings from research organisations into useful products by the commercial sector [1]. TT is also known as "knowledge transfer or knowledge sharing" [1], the process whereby an enterprise converts scientific findings from research laboratories and universities into products and services in the marketplace [1]. This understanding is adopted for the purposes of the present article. The transformation of scientific findings into products can take place through a number of means, in particular through the collaboration between research organisations and industry, the licensing of intellectual property rights, the creation of start-up businesses or university spin-out companies.

Although Technology Transfer seed investments in Europe are in the radar of some investors, academic research is often considered to be 'too new' or 'too high-risk' to be transferred out of the research laboratory and financed by the traditional investors [2]. New discoveries and technologies may not realize their potential unless they become attractive to industry or downstream investors, so the aim of the European Investment Fund (EIF) [3] is to play an important role.

Venture Capital (VC) is usually available to start-ups or other young companies that show potential for long-term growth.

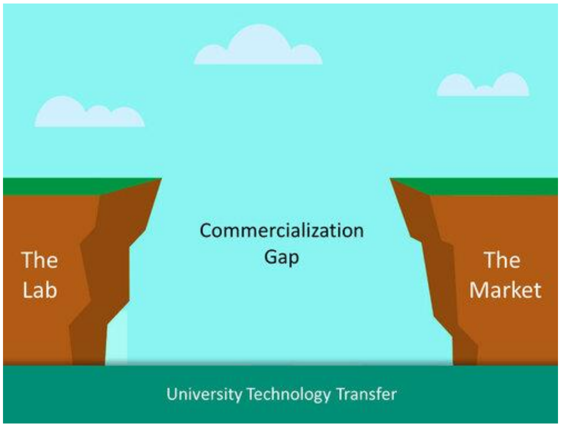


Figure 1: Commercialization gap [4].

On the other hand, there is a lack of funding to develop laboratory discoveries to prototypes suitable for the market because this step is risky for investors. Between the laboratory and the market is a commercialization gap (Figure 1) that has to be bridged to successfully put the discovery on the market as a product or service.

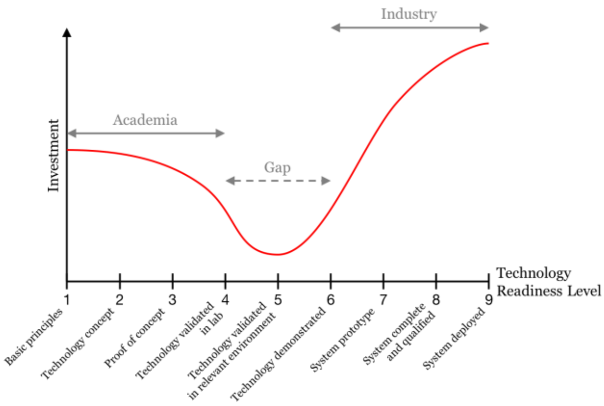


Figure 2: Technology readiness levels and the "valley of death" [5].

The journey of new technology from research to commercialization goes through a number of technology readiness levels (TRLs). The latest version of the scale from

NASA includes nine TRLs and has gained widespread acceptance across governments, academia, and industry. The European Commission adopted this scale in its Horizon 2020 program.

Academia tends to focus on TRLs 1–4, whereas industry prefers to work with TRLs 7–9, rarely 6. Therefore, TRLs 4–6 represent a gap between academic research and industrial commercialization. This gap, show in Figure 1 as the commercialization gap, is colloquially referred to as the technological “valley of death” (Figure 2) to emphasize that many new technologies reach TRLs 4–6 and die there.

2 TECHNOLOGY TRANSFER FUNDS

Venture capital (VC) funds are pooled investment funds that manage the money of investors who seek private equity stakes in startups and small- to medium-sized enterprises with strong growth potential. These investments are generally characterized as very high-risk/high-return opportunities. Although investments of VC funds in start-ups are risky, investments in development of technology between TRL4 and TRL 6 are even more risky. As a result, VC funds with private equity participation do not typically invest in bridging the “valley of death”. So, special technology transfer funds are needed to financially support the development of discoveries from TRL 4 to TRL6.

Technology transfer still remains a rather political investment field, but one that offers economic opportunities with a growing potential for commercialization. Even though private investors become more and more interested in this field, the European Investment Fund (EIF) [3] remains a crucial player, often taking the role as lead investor. The EIF is a specialist provider of risk finance to benefit small and medium-sized enterprises (SME) across Europe. It is part of the EIB Group. EIF’s shareholders are the European Investment Bank (EIB), the European Union, represented by the European Commission, and a wide range of public and private banks and financial institutions. EIF carries out its activities using either its own resources or those provided by the European Investment Bank, the European Commission, by EU Member States or other third parties. By developing and offering targeted financial products to EIF’s intermediaries, such as banks, guarantee and leasing companies, micro-credit providers and private equity funds, EIF enhances SMEs access to finance.

EIF also seeks to support financially sustainable **Technology Transfer structures** or **funds**. These intermediaries typically invest into projects or start-up companies, at proof of concept (PoC), pre-seed, seed, post-seed to A & B rounds, where the companies can be financed further by the normal Venture capital / Private equity investor. The EIF have become one of the main European investors providing guidance and cornerstone funding to players in this emerging market segment. Between 2006 and 2018 the EIF alone invested an amount of about EUR 1.7 billion in 38 TT funds throughout Europe [6]. While the market is more advanced in the Nordic countries and Western Europe, two TT funds have recently been established in Germany in cooperation with the Fraunhofer Society and the Max Planck Foundation, respectively. The number of TT funds funded by the EIF [3] between 2006 and 2020 is shown in Table 1. There are very few other TT funds in Europe not funded by the EIF (if any).

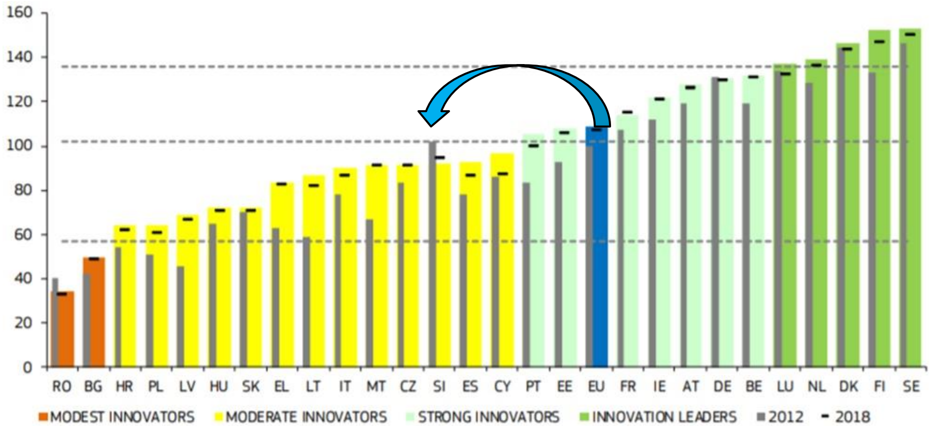
Table 1: Technology Transfer (TT) Funds funded by the EIF by country and year of start of funding.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	**sum**
France					1	1	3	3	1			2	1			**12**
United Kingdom	1		1				1	2			1					**7**
Italy												1	2	1	2	**6**
Belgium		1			1	1				1	1					**5**
Netherlands									1	1		1				**3**
Turkey										2						**3**
Germany														2		**3**
Sweden			1		1											**2**
Norway									1				1			**2**
Portugal									1							**1**
Spain											1					**1**
Ireland											1					**1**
Finland														1		**1**
Switzerland															1	**1**

In terms of best practices, the most relevant somehow are IP Venture [7] in UK and CD3 [8] in Belgium. Another very interesting is Innovation Industries [9] in Netherlands. Of the Italian ones that the EIF funded through ITAtech [10], each is quite interesting, especially because they have been funded through a similar initiative (and the only one such initiative at the moment). Particularly interesting would be Sofinnova Telethon [11] (Sofinnova is one of the most important VC firm in Europe, and the strategy is focused on rare and genetic diseases), or Progress Tech Transfer [12] and Eureka [13] (both first time team/first time funds, and both good examples of how a fund should collaborate with the research institutes).

3 CENTRAL EASTERN EUROPEAN TECHNOLOGY TRANSFER (CEETT) PLATFORM

In July 2021, the European Investment Fund (EIF), part of the European Investment Bank Group, the Slovenia’s national promoter bank, SID Banka, and the Croatian Bank for Reconstruction and Development (HBOR) signed an agreement



Coloured columns show countries' performance in 2019, using the most recent data for 27 indicators, relative to that of the EU in 2012. The horizontal hyphens show performance in 2018, using the next most recent data, relative to that of the EU in 2012. Grey columns show countries' performance relative to that of the EU 2012. For all years, the same measurement methodology has been used. The dashed lines show the threshold values between the performance groups.

Figure 3: Slovenia's innovation performance fell in 2012/18 (source EIS [17]).

on establishing a regional technology transfer platform, Central Eastern European Technology Transfer - CEETT platform [14], from research institutions to the economy, amounting to at least 40 million euros. The scope of the EIF's SEGIP (Slovene Equity Growth Investment Programme) and CROGIP (Croatian Growth Investment Programme) mandates has been expanded to include the support for business applications of Slovene and Croatian academic research via a commitment to a technology transfer fund operating in the two countries. The resulting joint initiative is the first investment programme under the Central and Eastern European Technology Transfer (CEETT) initiative, to which SID Banka contributed an additional EUR 10 million to SEGIP, HBOR contributed additional EUR 10m to CROGIP and the EIF made further EUR 20 million available for investment. Thus, the total available funding amount indicatively represents EUR 40 million.

The CEETT will invest in venture capital funds and finance innovative technological research projects and the protection of the intellectual property of universities and research institutes in Slovenia and Croatia. It will also fund the commercialisation of scientific achievements and research projects.

This is the first multinational investment platform for technology transfer ever launched in the European Union. The EIF estimates that the universities and research institutes in Slovenia and Croatia targeted by the platform will generate more than 350 patent applications and 100 spin-off companies in the next five years [15].

Investment in innovation and technology transfer will be key to the long-term sustainable green economy, job creation and global competitiveness of the European Union.

3.1 Benefits of the platform from the point of view of the research organization

The Center for Technology Transfer and Innovation (CTT) at the Jožef Stefan [16] is the largest and the most experienced technology transfer office (TTO) in Slovenia at public research organizations (PRO or JRO in Slovene). In January 2015, Dr Špela Stres, the head of the CTT, was invited to an "ad-hoc meeting on the design of the EC's pilot Technology Transfer Financial Facility (TTFF)". As the only representative from the EU13 countries, together with 14 colleagues from more innovative and open environments in Western Europe, she participated in the final stages of creating the Technology Transfer Financial Facility pilot, from which Invest EU later grew and the participation of the European Investment Fund with various actors in Europe in the creation of the Proof of concept (PoC) funds. They all shared the opinion that the European Commission's initiative to finance the technology transfer of research results from universities and other public research organizations to the economy and society is crucial for the development of processes linking excellent and prioritized science and knowledge transfer to the economy and society.

3.1.1 Why is such a Proof of Concept (PoC) Fund measure urgently needed?

The strong European, Slovenian and Croatian research success is currently not translated into innovation due to the lack of breakthrough innovations that create new markets. Two financial gaps (2 "valleys of death") prevent innovations:

1) The transition from laboratory to enterprise and
2) Scale-up (growth) for high-risk innovative start-ups.

In addition, many national and local ecosystems have been established, but they are fragmented and unconnected. In addition, not all PROs (JROs in Slovene) and all talents (especially not women and young people) are systematically involved in innovation processes. It is at least partly due to such a situation that e.g. Slovenia's innovation performance decreased in the period 2012–2018 (Figure 3). Slovenia fell 6 places (for an extra place in 2019) and went from strong innovators to moderate followers. The trend shows an even more worrying picture, as Slovenia is only slightly below average in terms of results, but with the most negative trend of all EU28 countries (Figure 4).

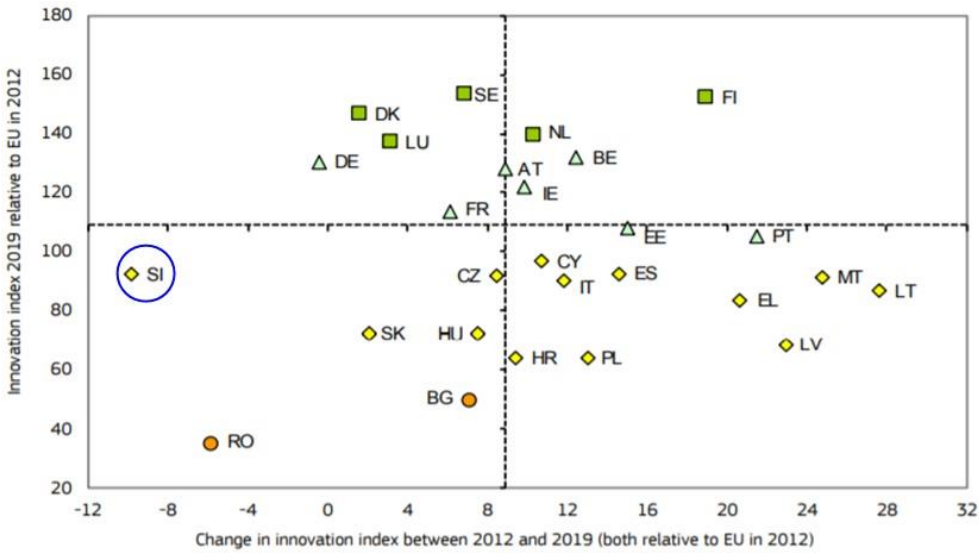


Figure 4: Performance and trend of EU members in the field of innovation – Slovenia is slightly below average with the most negative trend (source EIS [17]).

Meanwhile, Croatia is positioned slightly worse than Slovenia, but its development innovation trend is average compared to the EU28.

In the case of Slovenia, therefore, it is not so much a matter of deteriorating the absolute situation as of not improving it. The main issue of Slovenia lies in its diminishing innovation capacity from 2021-2019, where Slovenia's position has dropped from Strong innovators to Moderate innovators (source: European Innovation Scoreboard [17]). Even though the public R&D expenditure remains at the EU average, the Slovenian scientists overproduce with 155 % in number and 105% in highly cited the EU average. On the other hand, the product/process innovation and the number of SMEs innovating in house is at 80% of the EU average, IPR, in particular patenting issues place Slovenia at 93 % of the EU average, which all results in the sales of new market and firm products at 84% of the EU average. The main solution for this issue is to push for scientific knowledge, created and collected at the Public Research Organizations (PROs), to be used in the national economy and increase its competitiveness. It is expected that the CEETT platform will play a very important role in reversing the negative innovation trend into a positive one.

However, the funding gap for scaling up highly innovative startups and SMEs in significant, as US venture capital investments in the period from 2016-2020 were 4-5 times higher than in the EU (source: Invest EU, Pitchbook) and the number and market value of "unicorn" companies (those valued at over 1 EUR billion) in Europe (according to CB Insights [18] in January 2021) is 3-4 times smaller than in North America and Asia. And Slovenia lags behind Europe. There are not as many spin-outs in Europe and in Slovenia as there are in the USA or Asia, neither per capita nor per researcher, because there is no career path that would enable a return to the PRO, because there is no PoC fund and because in Slovenia failure is punished with ridicule and do not reward with a smile [19]. Therefore, the establishment of interconnected, integrated instruments that enable the growth of technology and researchers with it, in fast-growing companies, European, Slovenian, Croatian gazelles, is absolutely necessary.

3.1.2 What are the benefits of the Proof of concept (PoC) fund for a research organization?

The easiest way to answer is the Jožef Stefan Institute's (JSI) example. Today, there are over forty companies operating directly based on JSI technology and knowledge. As early as 2010, the JSI adopted detailed procedures that prevent conflicts of interest and encourage researchers on their entrepreneurial path. JSI has had an internal PoC fund for more than 20 years, and the fund is not financed from the budget, but exclusively from royalties. However, there are certainly many more examples that could / should be supported on their way to the market than can be financially supported by public research organizations themselves. At JSI alone, around 30 technology offers have been identified that are currently waiting for a clear interest from the economy, or to be internally developed with the help of the PoC fund to the extent that they can be marketed independently. There are even more such offers of research results at all four universities and public faculties, as well as 17 public research institutes in Slovenia and all public research institutions in Croatia. Therefore, following the example of 48 similar European funds established in previous years, intended specifically for cases from public research organizations, a multi-million PoC fund, which will be established by SID Bank together with HBOR and the European Investment Fund (EIF), is urgently needed.

It is crucial that a significant share of funding will also go to the pre-incorporated phase, ie projects that are still within the PROs and are preparing to spin off into new start-ups. And it is this risk, the investment in the pre-incorporated phase of bridging the valley of death, that is key to the successful transfer of knowledge from public research organizations into practice and separates it from other instruments available.

3.1.3 What are the direct benefits of the new fund for research organizations?

The new platform will also offer funding in the early stages of TRL development, which will enable a smooth transition of projects from the research environment to the market. Funding will be open to all innovators in any priority area. The platform will act as a path finder for advanced research into new technologies and enable the growth of TRL, which is essential for the transition from the laboratory to the commercial environment. The platform will also provide access to business promotion services (coaches, mentors, companies, investors and knowledge partners). It will further enable the development of a vision for breakthrough, portfolio management and integration with ecosystems, and crowd-sourcing of other investors. The PoC fund will give teams from public research organizations enough time to come up with technology according to market needs, to decide on their further research and business path, to regulate intellectual property relationships, to establish relationships that will reward both those who will remain researchers at the parent organization and those who will also operate within new start-ups.

3.1.4 Could public research organizations cope without the Proof of Concept (PoC) fund?

In 2015 it was and still is the opinion that there is enough money. That there is certainly no shortage of money to move from research to the economy. This is partly true. It really isn't just money that is lacking and really the most proactive and skillful can find money in any country, in any situation, despite all obstacles, as long as they are persistent enough. This is called entrepreneurship. As Professor Howard Stevenson, the godfather of the study of entrepreneurship at Harward Business School, put it, entrepreneurship is the pursuit of opportunity beyond resources controlled. Entrepreneurs need to show significant progress in raising funds, and time alone is consuming available funding.

But the goal of society that funds research and development through gross domestic product is not just to fund excellent inventions and then place them at the start of a mountain trail that gets lost between rocks and impassable overhangs leading to the market. The aim of society is by no means to place as high an obstacle as possible to the transfer to the economy and entrepreneurship, obstacles that can only be overcome by the naturally most talented and most stupidly persistent. The goal of the society is sensible and proactive management of innovations arising from the research system in such a way that as many useful inventions find their way to the market (instead of just in the drawers of public research organizations). The goal is for as many innovations as possible to find their niche in the market, the goal is to establish a clear, transparent path, a motorway that is easily followed by those who want it, and others who would like to remain in the safe haven of publicly funded research can stay there. continue to contribute constructively. Smooth paths to the market are necessary for the renewal and progress of society in a double transition and as a basis for a decisive breakthrough of Slovenia and Croatia between competitive and research-based society with sustainable development, which will catch up with the most productive and competitive countries in the world. life in the conditions of a rapidly aging society based on digitalisation and in the conditions of aggravated climate change. At the same time, development will raise the quality of life in the conditions of a rapidly aging society based on digitalisation and in the face of intensified climate change.

4 CONCLUSIONS

Establishment of a regional technology transfer platform, Central Eastern European Technology Transfer - CEETT platform, the first multinational investment platform for technology transfer ever launched in the European Union, intended for Slovenia and Croatia, is a great opportunity for technology transfer from public research organization to industry in both countries. The established technology transfer fund will enable the public research organizations to bridge the commercialization gap or the "valley of death" and to improve the successful rate of technology transfer from the academia to industry.

The successful operation of CEETT will require an appropriate manager with experience in the field of venture capital investments and cooperation between research organizations and companies. In addition, he will have to be aware of the specifics of Central Europe region, especially Slovenia and Croatia, as well as the specifics of public research organizations in both countries.

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Software Protection and Licensing Challenges in Europe: An Overview

Izzivi na področju zaščite in licenciranja programske opreme v Evropi: pregled stanja

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ABSTRACT

With the transition of innovation to the digital sphere, software has become an important part of contemporary inventions and creations and it is also an extremely important part of intellectual property – in Slovenia and in Europe. The software protection in the European Union – that is, in Europe – not considered fully arranged. Computer scientists face a number of challenges when it comes to exploiting intellectual property rights in software. The field therefore offers many opportunities for further work. In this paper, we discuss software and focus mainly on the challenges computer scientists face in protecting and licensing software in the European innovation arena.

KEYWORDS

Software, patents, protection and exploitation of intellectual property rights, challenges, Europe.

POVZETEK

S prehodom inovacij na digitalno področje je programska oprema postala pomemben del sodobnih izumov in stvaritev, hkrati pa predstavlja izjemno pomemben del intelektualne lastnine – tako v slovenskem kot evropskem prostoru. Stanja na področju zaščite programske opreme v Evropski uniji oz. v Evropi s pravnega vidika še vedno ne moremo obravnavati kot povsem dorečenega, prav tako pa se znanstveniki na področju računalništva soočajo s številnimi izzivi, ko gre za izkoriščanje pravic intelektualne lastine iz programske opreme. Področje zato narekuje številne priložnosti za nadaljnje delo. V prispevku obravnavamo programsko opremo, pretežno pa se posvečamo izzivom, s katerimi se znanstveniki na področju računalništva soočajo pri zaščiti in licenciranju programske opreme v evropskem inovacijskem prostoru.

*Article Title Footnote needs to be captured as Title Note
†Author Footnote to be captured as Author Note

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KLJUČNE BESEDE

Programska oprema, patenti, zaščita in izkoriščanje pravic intelektualne lastnine, izzivi, Evropa.

1 INTRODUCTION

Computers are part of almost every area of contemporary life and they are becoming more advanced every day, with increasingly small gadgets performing increasingly complicated tasks. Consequently, the number of new inventions seeking patent status in the field has been rising steadily. In fact, patent applications for computer-based inventions display one the highest growth rates across all patent categories arriving at the European Patent Office (EPO). A thorough examination process awaits all new applications in this field. The crucial aim is to distinguish between legitimate technological innovations which contribute to the overall technological progress and straightforwardness and inventiveness of computer-implemented inventions. [1]

Over the last decade there has been an intense debate over the extent to which software should be the subject to patent protection as opposed to copyright protection for a program. Different understanding applies to the US, Europe and the rest of the world. Many companies in the software industry are apprehensive of the perceived difficulty of defining the scope for software patent. Inappropriate scope definitions can result in legal proceedings involving large fees where plaintiffs have the advantage of patent ambiguity. Others feel equally strongly that the software industry needs strong software patents. [2]

Currently, software that does not demonstrate a technical contribution can only be protected by copyright, which does not protect ideas. The appearance of a command line or graphical interface can be protected as a registered design, whereas a patent for computer or mobile application can be granted if a technical contribution is demonstrated. Under EPO rules, if this criterium is fulfilled software must be connected to the hardware. [3] Part of the reason for the lack of appropriate legal instrument is that such inventions are very specific and proving their technical contribution and industrial applicability can be challenging. [3] In order for computer scientists to successfully market software, the Public Research Organization (PRO) system needs to provide

the motivation and reward computer scientists for it. The present state of European innovation arena contains nothing to motivate computer scientists in this respect.
The current situation calls for a study to identify the most critical points in order to update some of the legal bases, to address this area more clearly and to resolve the issue of rewarding computer scientists (described in this document with the focus on software), also in terms of Technology Transfer Office (TTOs) role.

2 SOFTWARE IN THEORY AND PRACTICE

The European Patent Convention stipulates in Article 52(2) (c) that programs for computers are not regarded as inventions [4]. European Patent Convention in this Article excludes computer programs from patentability. It is important to emphasize the distinction between "software patents", which are excluded according to the aforementioned Article, and "computer-implemented inventions", which are accepted by EPO [5].

Software that does not demonstrate a technical contribution can only be protected by copyright which does not protect ideas. The appearance of a command line or a graphical interface can be protected as a registered design, whereas a patent for computer or mobile application can be granted if a technical contribution is demonstrated. Under EPO rules, if technical contribution is successfully demonstrated the software must be connected to the hardware. [3]

Although the European Patent Convention excludes "computer programs" from patentability to the extent that a patent application relates to a computer program "as such", this is interpreted to mean that any invention that makes a non-obvious "technical contribution" or "solves" a "technical problem" in a non-obvious way is patentable, even if the technical problem can be solved by running a computer program. [6]

The problem of strictly classifying software similar to a literary work arises when one considers that computer programs have other elements that are usually not protected by copyright. Software is not just a literary expression – lines of code have a function that does not depend on their grammatical construction. Issues related to protection of additional elements of computer programs have created a perceived need for software patentability. Today, the three largest patent offices in the world – in the EU, US and Japan – allow patenting of certain software, although there are differences in the criteria they use when accepting applications. In the US, all new and non-obvious software that produces a useful material and tangible result is eligible for patent protection, whereas in Europe the technical contribution of the invention must be defined as described above (also applies to Slovenia). These discussions led to the widely accepted principle that computer programs should be protected by copyright, while apparatus using computer software or software-related inventions should be protected by patent. [6]

Protecting and obtaining intellectual property rights in fast-growing areas such as artificial intelligence is a particular challenge. Artificial intelligence provides entirely new approaches to creation of intellectual property. Questions arise as to the eligibility of patent protection, authorship and rights ownership of a newly developed technical solution or creation that is autonomously created, enabled or co-created by a program. Methods of resolving the question without stifling innovation potential are subjects of intense debate and accelerated activity at the EPO [7].

3 SOFTWARE AND EXPLOITATION OF INTELLECTUAL PROPERTY RIGHTS

3.1 Software Licensing Process

Intellectual property is an essential tool for protecting the value created by software. As a general rule, almost all software is protected, including the smallest libraries and subroutines. Intellectual property rights are divided into economic and moral rights. [8]

Economic rights give the holder the right to exploit the work and prevent others from using it without consent, and are aimed at economic gain. The right to use can be granted by license. Exclusive license allows the holder to exclude others from using the intellectual property in question and, if it is transferable, it allows the holder to grant third parties the rights to use it. A license is a permission granted by the licensor to the licensee to use an identified asset under certain conditions. In doing so, the licensor may determine at their discretion the extent of the exclusive intellectual property rights granted in respect to the asset (and, conversely, the rights it reserves for itself). Moral rights include the right to authorship, the right to publish the work anonymously or under a pseudonym, and the right to integrity of the work. In most countries (including all EU countries), copyright protection lasts throughout the author's lifetime and extends 70 years after their death. [6]

As we have seen above, software is very specific as far as intellectual property is concerned – it can be protected by several types of intellectual property rights ranging from pure creations of the mind to technical inventions. But a whole new level of complexity arises from intangible nature of software, variety of uses and different means of creating value from software. As a consequence, the means of creating value from software can vary considerably depending on the exploitation scheme chosen and associated ecosystem to which the use of software in question is directed. Nevertheless, licensing plays an essential role in creating value through management of intellectual property associated with software development. Business models are formalized in a contract, usually in the form of licensing agreements which impose specific rules of use on third parties who intend to exploit the software. Figure 1 shows some typical software licensing models. [6]

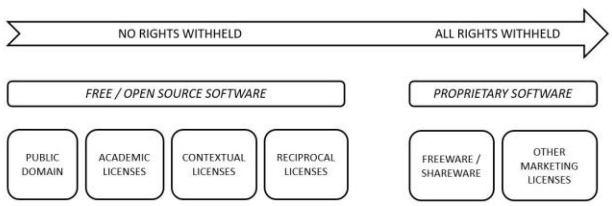

Figure 1: Classification of typical software licenses

Free and open-source software rights include use, inspection and modification, and distribution of modified and unmodified copies. They typically allow it to be used for any purpose without restriction. When the code is reviewed and modified, it requires that the modified code is made available again under the same conditions. The rights also allow distributing modified and unmodified copies of the software. When free and open-source software is modified, derivative works are created, and when various components of the software are assembled, composite parts of the underlying components are created. When Component A and Component B are assembled and Component A is also modified, Component C is created, which is both a derivative work of Component A and a composite work of Component B. Different economic rights may arise from the use of open-source and free software. Free software derives from licenses granted by the Free Software Foundation, while open-source software is defined by the Open Source Initiative, which has a more business-oriented approach. We consider the following types of such licenses [6, 9, 10, 11]:

1. Academic licenses are extremely open, permissive licenses which allow licensees to perform, modify, and distribute derivative works without restrictions, although licenses for derivative works may lead to new licensing terms, including proprietary ones. Such licenses are generally accepted in academia.
2. Contextual licenses allow licensees to use, modify, and distribute derivative works, provided that the derivative or composite works are distributed under the same license. Specific form of such license is called a "Copyleft license" which is the practice of granting the right to freely distribute and modify intellectual property with the requirement to preserve the same rights in derivative works created from that property. The main advantage of such license is to ensure joint investment, as no derivative or major works can be licensed under another license. They allow the original licensor to be granted the same rights in the derivatives as those originally acquired by the original code licensees.
3. Reciprocal licenses are very complex as licenses of major works using an unmodified version of the original component under a contextual license are not limited by the original license and derivative product containing a modified component must be released under the same license.

Many different types of contractual relationships or contractual sets of rules can be derived from proprietary licenses, all of which typically require a financial contribution from the end user. Exceptions are:

1. Freeware, where the software is available free of charge but any modification of the code is prohibited.
2. Shareware, where the user is free to use the software for a limited period of time or with limited functionality, but in order to gain access to the full unrestricted version an additional license must be obtained.

All proprietary licenses prohibit modification of the software, impose strict conditions of use and usually do not allow access to the source code. Typical models for proprietary licenses are:

1. End-user licensing where the license can be used by a specific user while sharing with other users is not allowed. However, the license can be used by the same user on different devices.
2. Node licensing, where the license can be used by multiple users, but on the same device rather than at the same time.
3. Site licensing (licensing for use on a dedicated website), where the software may be used by multiple users on multiple devices in a specific area or company, but the number of users may be limited.
4. Network licensing (floating licensing), where the same software may be used by multiple users at the same time, but a central server authorizes access to the application. [6, 9, 10, 11]

3.2 Management of Intellectual Property Rights for Software

Managing intellectual property in software requires the strategic and complementary use of different types of intellectual property. Exploitation and licensing strategies need to be carefully considered, taking into account all associated costs and market opportunities. Two basic issues should be addressed in the assessment and planning process [6, 12, 13]:

1. *Why was the software created: was it intended to generate income through licensing to end users or was it developed as part of a scientific project without an exploitation strategy in mind*? Even if we focus only on the technical challenges of R&D, we should not neglect the long-term benefits of protecting intellectual property not only from a revenue perspective but also in light of reusing the developed software in future applications.
2. *How was the software developed: which are our own components, what have we obtained from elsewhere, and, if obtained from elsewhere, under which licenses?* Developing from third-party components can result in legal challenges as the individual licenses of different third-party software may not be compatible.

Derivative works based on academic license software components may be re-licensed under the same type of license or upgraded to contextual or reciprocal licenses which are compatible. If necessary, contextual licensing code can be re-licensed by reusing the same license, upgrading the license to a newer version that remains in the same contextual field, or switching to reciprocal licenses. It is not allowed to embed free and open-source software in proprietary software. However, it is possible to combine copyleft-licensed software without copyright and some contextual rights (e.g., LGPL). [6]

However, if the software is protected exclusively by copyright it is possible to easily circumvent all prior rights as long as we have access to the source code: the same idea can simply be implemented in another source code. As previously explained: copyright does not protect the idea, only its expression. A new implementation of the code is the only legal way to convert academic or reciprocal software code into proprietary code and sell and license it under the rights granted by copyright law.

4 CONCLUSION

The situation of software in the European innovation arena can still be considered as neither resolved nor uncertain in legal terms, thus raising a number of open questions and opportunities for further work.

TTOs are deeply involved in the work of organizations where inventions and creations take place. Their expertise primarily helps computer scientists who create software evaluate which problem they are solving and based on that make an informed decision on how to protect intellectual property using copyright or patent. In view of the above, TTOs can contribute to a constructive decision-making process regarding the future of software protection and rewards for computer scientists by participating in (open) public debates and presenting real-life examples of scientists developing software in PRO.

In order to ensure successful marketing of software, the PRO system needs to provide the motivation and a rewarding mechanism for scientists for their enterprise.

It is good to remember that any invention that implements a non-obvious "technical contribution" or "solves a technical problem" in a non-obvious way may be patentable, even if the same technical problem can be solved by running a computer program. Consequently, program code in which technical effect (even if in a non-obvious way) constitutes a technical improvement is patentable by its very nature. The trade secret segment is also important, since disclosure of program code without a suitable proprietary license or any license at all may result in commercial damage. By combining the technical effect of the software code with the trade secret effect, it is possible to register the software code example as an invention and, consequently, ensure a reward for computer scientists.

We therefore propose that regular reflection among computer scientists within PRO is facilitated on new, marketable software code, that verification is introduced to any technical contribution, and that invention based on software code is registered accordingly. TTOs play a key role in this respect, as their specific expertise contributes to the proper assessment and registration of service inventions as well as to the wider popularization of software commercialization (also protected and registered in this way). At the same time, the proposed method allows computer scientists working in the field of software code development to be rewarded for their work.

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European Guiding principles for knowledge valorisation: An assessment of essential topics to be addressed

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ABSTRACT

Knowledge transfer is a complex mechanism of providing the society with benefits arising from all segments of publicly financed research. Knowledge transfer is also an important mechanism to advance and improve technology transfer as its part (as technology is only one of several research outputs [1], [8]), and a reason to analyse the current situation in the field.

This paper has three different parts. In the first part, models of knowledge and technology transfer will be discussed, including the Defense Advanced Research Projects Agency (DARPA) model of operation, as it was the basis for the development of the European Innovation Council (EIC) of Horizon Europe internal management operation in which the author of this paper was involved. The model is essential also for the future development of EU Knowledge Transfer Offices (KTOs). Given its high budget and added operational and substantive value related to Program Managers, the EIC in a way represents the largest - a kind of umbrella - KTO in Europe, which should integrate many small, different and unique European KTOs into one whole. Therefore, it is recommended in this paper that each European KTO reviews and understand the previous DARPA / ARPA-E models and/or the European EIC model. They should use it as a framework for adaptation of operations based on its legislation and the specificities of the industrial and public sector so that each KTO becomes a comparable element of the whole at the European landscape.

In the second part, a brief review of the **knowledge transfer (KT)** literature of the past 15 years will be done, given the KT profession's prevailing state of mind. A lot has been done during this time in KT development and attempts to evaluate the operation of KTOs. It turns out that there are different national environments, so the way KTOs operate may differ slightly from KTO to KTO. Nevertheless, there are common points in the pipeline of all KTOs, namely the KPIs represented in this paper (Table 1), which are not limited to KTO results only (e.g. patents filed, license and R&D agreements), but rather act as indicators of the quality of the KTO activities. The represented nomenclature of KPIs should help set up a uniform path that European KTOs are supposed to follow to achieve the results.

In the third part, specific segments of the *Commission Recommendation on intellectual property management in knowledge transfer activities and Code of Practice for universities and other public research organisations* [1] will be touched upon. These documents are still relevant in their present form. However, some new aspects have arisen and are further addressed in this paper - for example, state-aid issues connected to the intellectual property right (IPR) issues.

To conclude, the idea of further networking between innovation support stakeholders needs to be put forward, particularly regarding Enterprise Europe Network (EEN). In the coming years, EEN plans to pay more attention to the field of KT, as KT is essential for raising the competitiveness of the European economy. In this context, the presented proposal of topics that need to be addressed within new European Commission recommendations will be mutually beneficial in developing new strategies of EEN and KTOs as well. It would be of utmost importance to establish a fruitful collaboration between KTOs and national EEN offices to assure full in-depth support to researchers and SMEs alike in this TRL challenging exercise in between the worlds of academia and industry, in particular given the EEN's core values (Fig.6).

KEYWORDS

Knowledge valorization, knowledge and technology transfer, knowledge transfer office, innovation, public research organization, industry, key performance indicator, licensing, collaborative research, funding, spin-out, spin-off, intellectual property, models, technology readiness level, networking.

1 MODELS OF KT: DARPA AND THE EU KTO WAY

The formal organizational models of KTOs in the EU are ranging from internal KTOs, through institutionally owned enterprises to national, either network-based or private regional entities. This contribution will focus on an internal model of operation of a KTO.

The goal of any innovation intermediary should be to increase the deal flow, increase the number of deals, and increase the impact of those deals. The Defense Advanced Research Projects Agency (DARPA) and the Advanced Research Projects Agency-Energy (ARPA-E) in the US became hands-on innovation agencies to achieve such a goal. This required innovative internal procedures, a new risk-taking mindset and tailor-made management. Its operating concept is to be hands-on, thus involving the activities of a group of people in many segments, very similar to a proactive KTO. This concept is embedded in a set of questions known as the "Heilmeier Catechism", attributed to George H. Heilmeier, a former DARPA director (1975-1977), who crafted them to help Agency officials think through [2], evaluate and manage proposed research programs for maximum impact. By being proactive in managing the innovation side of the financed projects, DARPA and ARPA-E could successfully operate their model for breakthrough innovation.

The DARPA proactive model of operation is also present in the work processes of the European Innovation Council (EIC), with its important new feature, the Programme Managers. As Europe's flagship innovation programme to identify, develop and scale up breakthrough technologies and game-changing innovations, EIC has a budget of €10.1 billion to support game-changing innovations throughout the lifecycle from early-stage research to Proof of concept, technology transfer, and the financing and scale-up of start-ups and small to medium-sized enterprises (SMEs). With its Programme managers and support staff, it can be considered the largest KTO in Europe. The synergies and similarities of KTOs with EIC should be looked into. The EIC builds (and so should the EU KTOs) on active pipeline management (see Fig.1), combined with Proof of concept funding related to a well-defined pipeline of case management. The management is done by highly skilled professionals, combining technical and commercial acumen through a well-defined interface, expanding far beyond the current average public relations activities of the European KTOs [3].

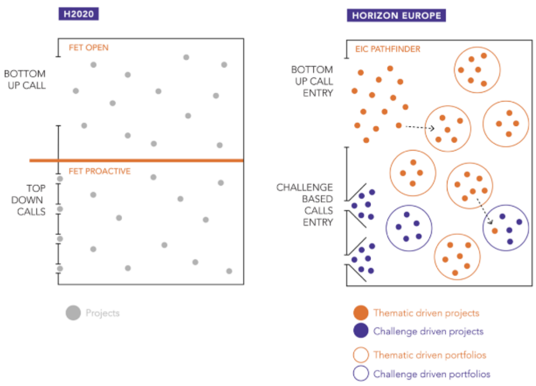

Figure 1: From Horizon 2020 to Horizon Europe: Active Portfolio Management of funded projects [3] A comparison between Future Emerging Technologies (FET) calls in Horizon 2020 as a predecessor of European Innovation Council (EIC) calls in Horizon Europe

The goal of any KTO in Europe should not be to copy the DARPA/ARPA-E or the EIC model. However, it should instead be to translate a known useful model into their context considering the Horizon Europe rules, the national legislation and the current national/regional/local research, development and innovation culture. Only in this way can the innovation intermediaries, the KTOs, create their own unique identity in the European landscape for supporting breakthrough innovations – create the EU KTO way.

Developing the unique EU KTO way is challenging and necessary. It will comprise novel practices supporting the development of breakthrough technologies and actively bringing them to the market. To support breakthrough innovations, the EU KTOs must themselves be an organizational breakthrough in Europe. The main components for achieving this endeavour are centred on the creation of challenge- and thematic-driven pipelines in each of the KTOs, high rejection rate in the acceptance of the cases to the portfolio, active portfolio management of cases, transition activities that bring new solutions to the market and KTO personnel who binds all of this together into complementary practices (see Fig.2). It is crucial to understand that DARPAs results show that this is the right way, and it should be investigated how such a proactive system could be set up in an environment like ours.

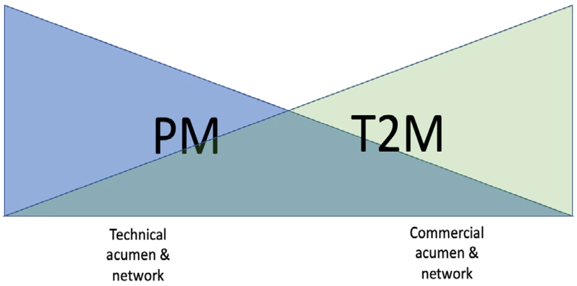

Figure 2: The need for highly skilled personnel in the KTO to active pipeline management, combined with Proof of concept funding related to the pipeline [4]

2 STATE OF THE ART IN KT IN THE EU

2.1 A literature review

For almost 15 years now, the Knowledge transfer flow has been discussed: on the operational and top policy levels. In this section, a discussion about the essential works in this field is given: »Communication (2007)« [5], »Recommendations (2008)« [1], »A composite indicator (2011)« [6], »Knowledge economy (2020)« [6], »Performance indicator system (2021)« [8]. The KT topic was brought into the open by the »Communication« [5], co-signed by the Slovenian commissioner for research Janez Potočnik) in 2007, just before when Kevin Cullen from Glasgow University designed his KT flow in 2008 (Fig.3). Moreover, Kevin's KT flow has been used ever since: in the »Recommendations« in 2008, later shown in the 2011 EC Report »A Composite Indicator« and also in the new 2020 »Knowledge« report.

The view on the KTO role in connecting research to the economy (and its vehicles) has not changed since 2007. To observe this, a comparison between Fig.3 [6] and Fig.4 [7]) can be made. The flow is divided into Research Outputs, KT Channels/Activities, Users/Economic Activity and Impact. The segments are not surprising because the division represents the flow-through of knowledge in the KT system, as described already in 2008. However, the perception of the KT community has changed for the better in the meantime. It has at least changed in terms of the involvement of a KTO in different KT vehicles. In 2013 the Board members and Vice Presidents of the European Association of Technology Transfer Professionals (ASTP) even at this premier knowledge transfer organization's top-level, we could barely discuss the inclusion of Key Performance Indicators

(KPIs) on software and contract or collaborative research endeavours to the KT pipeline in the yearly Metrics report of European KTOs. Most of the time, negative comments regarding the importance of indicators other than licensing deals came from people working in biotech or medical technologies focused public research organization (PRO) environments connected to university hospitals in Western Europe. As these had a prevailing licensing deal flow at the time, primarily with the pharmaceutical industry, their interest in widening the scope of the KT vehicles was limited.

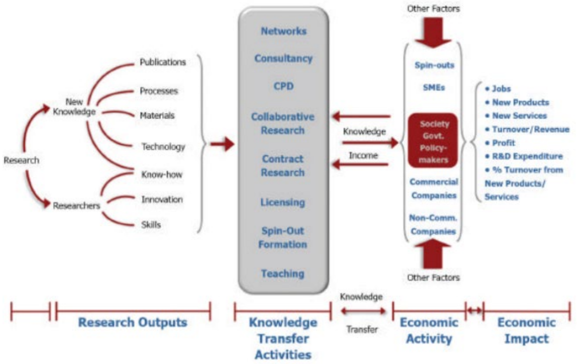

Figure 3: Model of knowledge transfer within the innovation ecosystem [8]

However, gradually through the years, an understanding has arisen that as there are many different national environments, there are many different economic situations, with diverse technological absorption capacity from the industry, requesting and even demanding different vehicles to achieve actual KT. Thus, we recognized that there are indeed many different vehicles, and as KTOs are the primary activity-focused linkage between the Public Research Organizations (PROs) and the industry, they should be appropriately put into the KTO practice. Many KTOs, in particular in the Eastern and Southern parts of Europe, but also such prominent ones as Cambridge Enterprise, started to empower any one of the KT vehicles (including contract and collaborative research and services), which bring results for the global/national/regional/local economy, society and the PRO itself. In this way, the perception of the role of a KTO in the innovation flow system remained the same throughout the last 15 years (if we compare the figures presented in 2011 [6] and in 2020 [7], they are essentially the same), but the understanding and the focus of KTOs rightly shifted from patenting and licensing to other vehicles of KT as well. However, even though progress has been made, the KT community is still struggling to define the KPIs of the KT operations completely [8]. This shortcoming is an echo of the under-developed research activity in the field of KT.

The level of research activity in and on KT is still relatively low in the EU. Primary sources as Joint Research Centre (JRC), TTO Circle and ASTP mainly focus on producing success stories and incomparable status reports, which lack the in-depth definition of KPIs to allow for fair and holistic assessment of the KT system in the EU. As important as success stories, networking and workshops in the field of the KT profession are, these are not enough to professionalize the activities and create a full-pledged and recognized profession. Scientific research, critically analyzing the processes within KTOs, their success and fail factors, and a rigorous scientific approach to monitoring trial and error knowledge transfer practices within the KTOs is needed to improve the EU KTOs.

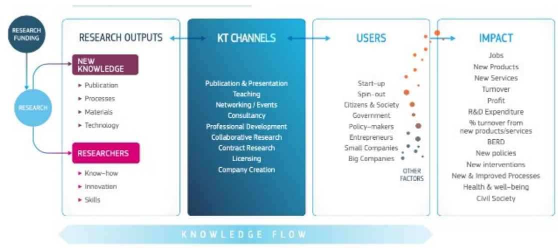

Figure 4: Knowledge Transfer: from research to impact [7]

2.2 The role of the missing KT KPIs

The goal of any innovation intermediary is to increase the deal flow, increase the number of deals, and increase the impact of those deals. To achieve such a goal, DARPA and ARPA-E in the US became proactive, hands-on innovation agencies. In Europe, given the Knowledge Transfer Metrics [7], in 2020, the authors focus on defining the KT indicators in four quadrants, including Internal Context, Environment, Activity, Impact – trying to assess the inputs and the outputs of the KT system (Fig.5). In effect, apart from the Activity indicators, the proposed metrics observes the enabling factors - the success factors of the KTO's pipeline from the outside of the KTOs (which they have little influence over). On the other hand, it observes the final impacts of KTO's operations on society (which are very distant from today's perspective). However, it does not focus into great detail on the internal procedures and pipelines directly under the KTO's influence. Thus, such enabling indicators have a role in evaluating the level of the KTOs possible maximum results, not the quality of its operations.

The KT profession is clearly labelled as inefficient throughout Europe, which is also confirmed by the fact that the Recommendations of 2008 are now being urgently reviewed by the European Commission, but seeking remedies outside the community, not taking responsibility for its actions. In order to improve the operation's quality, it is not enough to assess what is outside of the KTO's reach (internal PRO's context, environment). Moreover, it is not enough to claim that [7] the KTO impact is long term, we cannot measure it right now, we shall see what happens long-term—neglecting evaluations of the internal KTO procedures and their efficiency results in the fact that the profession is not advancing as fast as it should.

The results are indeed dependent on the enabling factors, but are essentially determined by the actions taken by the KTOs [9]. Thus, to improve the quality of the KTO operation in Europe, it is necessary to set up process KPIs to monitor KTO processes and evaluate their quality. The focus should be paid to measuring the efficiency of the KT process, using Detailed Activity or Process KPIs, organized as a funnel, and, on this basis, address the shortcomings in the effectiveness of KTOs. The focus should be given to KTO's internal operation, evaluating the KTO activity in detail: analyzing the deal pipelines, making them professional, flow-through, and improving KTOs' performance by understanding the interdependence of the processes KTOs carry out.

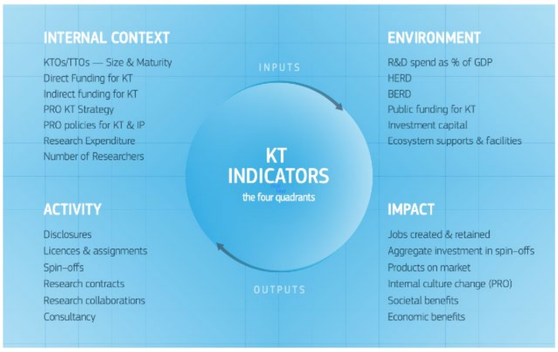

Figure 5: Input and Output KT Indicators: the four quadrants [7]

To monitor the activity within a KTO's pipeline is the only way to observe the points where the activity goes awry. In the »Knowledge economy« report, the valuable parts of the indicators are shown under the Activity part in the quadrant, focusing on the final KTO results only. However, it is not analyzed how the results were obtained. The KTOs are stuck with the KT indicators – they indicate the temperature in the KT system. However, they do not analyze what is going on and how the impactful factors are connected. The problem is similar to the difference between measuring water temperature in a glass and understanding the physical processes behind heating the water. From the measured water temperature, it might be concluded that the fact that we are based in tropical climate influences its heating on the stove, but not how. Likewise, from observing the lower than desired KT results, it might be concluded that the only reason for the unsatisfactory performance of the KT in Europe is the too low percentage of the GDP spent for the KTO or the R&D. To support breakthrough innovations, the EU KTOs must themselves be an organizational breakthrough in Europe.

Moreover, to achieve that, we should focus on the KT process and understand it. We must focus on internal KTO operation, evaluate the KTO activity in detail and set up KPIs to monitor it. We must analyze the deal pipelines, make them professional, flow-through, and improve our performance by understanding our processes.

How can we establish process focused KPIs to evaluate the efficiency of KTO operation? The efficiency of the innovation management system in a country can be evaluated through the share of successful commercialization of patents and secret know-how originating from PROs. The commercialization involving KTOs occurs through new company creation, IPR licensing and sales, and direct R&D collaboration. These are the results of the KT process (but not the impact). Nevertheless, there are many other processes KPIs, which enable us to monitor the efficiency of the KTO process: for example, the number of Market assessments/analyses, Identified topics at meetings with companies for potential collaboration with PRO research teams, Number of Individual Advisory Supports delivered to companies, Number of Individual Advisory Supports delivered to researchers, Active marketing: number of offers prepared for selected companies, Number of received expressions of interest-based on active marketing, Spinout Business Plans prepared, Internal Proof of Concept projects approved, financed and managed and others ...

Table 1: The proposed nomenclature of KT Key Performance Indicators

Description of KPI/Result (all counted in Number of, unless where specified)	
Cases accepted for processing in KT Office	*Number of patent applications filed with full examination*
First meetings with researchers - inventors	*Opinions on continuation of IP protection*
Assessments of the state of the art	*Passive Marketing: Preparation and publication of Technology Offers*
Market assessments/analysis	*Submitted expressions of interest*
First meetings with companies (company visits)	*Active marketing: number of offers prepared for selected companies*
Participations of licensing team member in 1st meetings with companies	*Active marketing: number of offers sent to selected companies*
Second meetings with companies	*Active marketing: no. of received expressions of interest*
Participations of licensing team member at 2nd meetings with companies	*Signing of Non-disclosure agreements*
Third meetings with companies	*Negotiations conducted*
Participations of licensing team member at 3rd meetings with companies	*Cooperation agreements (R&D contracts) signed*
Identified topics at meetings with companies for potential collaboration with PRO research teams	*Licensing agreements (licensing Contracts) signed*
Collaboration topics from meetings with companies identified by licensing team members	*Amount covered by R&D Contracts (EUR)*
Meeting minutes from the 1st, 2nd and/or 3rd meeting with the company	*Amount covered by licensing Contracts (EUR)*
Supplementations by licensing team member, of minutes from the 1st, 2nd and / or 3rd meeting with the company	*New Companies in collaboration with the PRO (via R&D and licensing agreements)*
Collaboration topics disseminated to internal technology transfer coordinators and published in the suitable PR publications (counting by company visit)	*Consultings on Access to financial sources (Tenders, VCs, Commercial Loans)*
Collaboration topics disseminated by licensing team member to PRO Researchers (counting by company visit)	*Spinout First meetings on spinout creation*
Individual Advisory Supports delivered to companies	*Spinout Business Plans prepared*
Individual Advisory Supports delivered to researchers	*Spinout documentations for the establishment of the spinout prepared for consideration by PRO*
Invention disclosures at PRO / decision to acquire the invention by PRO	*Signed contracts for the establishment of spinout companies*

Author: Š. Stres in collaboration with selected members of Center of Technology Transfer and Innovation, 2020 (M. Trobec, F. Podobnik, L. Pal)

Setting up and active monitoring of the entire funnel of KTO KPIs may turn out especially advantageous for young KTOs that have been just established. The "case-by-case" process from preparation to protection and marketing and hopefully conclusion of license and R&D agreement can take a very long time (on average at least 12 - 30 months), and much work has to be done before the final results are earned. During this time, well-established and internationally recognized KPIs might become extremely useful - justifying the existence of such young KTOs to the management authorities and tracking/evaluating their operations. Verified and standardized international KPIs, therefore, illustrate whether the KTOs are on the right path to their goals or not.

With the process KPIs of KTO operations, we can set complete metrics for the Key KT Activities of KTOs. Such metrics are presented in Table 1, *The nomenclature of KT*. These metrics allow for the intertwining of contract and collaborative research in countries where this is necessary, with actual licensing and sales of industrial property (nationally or internationally) and spinout creation. Every country has a specific *distribution* of particular KT Activities and results (final contribution measured much later on by Economic Impact). The efficiency of these efforts measured by KPIs may differ throughout the countries, but the KPIs themselves, the nomenclature, and the results remain the same everywhere: Number of disclosures, Number of licensing, contract, collaborative and service deals, Spinouts established.

3 AN ASSESSMENT OF TOPICS THAT NEED TO BE ADDRESSED WITHIN THE NEW RECOMMENDATIONS

In light of the above analysis of the field and the existing Recommendations, **we suggest topics of concern to be addressed in the amending of the text of the 2008 Recommendations – because these are topics of concern in the current KT endeavors in Europe and they are not covered within the existing Recommendations**. The suggestions areas are listed below.

Operational Issues: Every KTO should have a set of operational principles, an honour code and a code of conduct as a basis of its operation. It could be based on the Code of Conduct of the Enterprise Europe Network (EEN) or built anew.

Accounting issues: Emphasize the importance of registering the intangible assets – in principle, one cannot sell something that has not been registered according to the European accounting principles for intangible assets (including its initial accounting value).

State Aid and Evaluation methods with competition law: Evaluation of IPR is also essential in state aid in collaborative projects (IPR transfer in the context of state aid). Even though not in Horizon Europe, operating under the State-Aid Exemptions, but in all cohesion related funding and national funding for higher TRLs (which are not part of the State-Aid Exemptions). To assess the value, different valuation methods (not valutation) should be understood to set the first value in the accounting books. For this purpose, intangible asset evaluation methods should be analyzed and valuation principles accepted for the KTO usage. **Competition law** – Technology Offers should continuously be published before setting a contract with a specific entity to distort the market's competition. Need to publish the TOs to assure state aid and fairness in terms of competition laws.

Synergies: Look into possible synergies with European Innovation Council (EIC), Enterprise Europe Network ... from operational, not political or networking point of view. KTOs should capitalize on the existing financing available and the existing support networks available.

Broader view on IPR: Registration of models, trademarks, printed circuits, new plant sorts, software should be encouraged. Copyright implications should be addressed, as software is part of the Copyright legislation. Recommendations should be given on how to award researchers for software commercialization and define incentives in different countries (as the legislation in some countries excludes copyright from the rules on awarding researchers in case of commercialization of copyright).

Diversification of KT Activities: Wherever only licensing is mentioned as a vehicle; this should be remedied with other available KT vehicles. The difference between spinouts and spinoffs should be introduced. The specific knowledge and capacity on capital share management by the KTOs should be addressed. The positive impact of spinoffs vs spinouts and vice versa? The need to develop internal PoCs which increase the efficiency of the KTO, the InvestEU with EIF policy introduction. Publishing the technology offers (TOs) and sending them around - active and passive marketing, requiring different knowledge and yielding different success rates, depending on the "name" of the institution.

The use of EEN and its Thematic/Sector Groups for technology marketing is also essential. There is a mutual need to increase KTOs' awareness about EEN and its Sector Groups (mainly "technology-based") and Thematic Groups as a channel for technology marketing, access to SMEs and obtaining the latest expert information in the field of work, respectively. EEN should continue its efforts to emphasize actively seeking Technology Requests at SMEs and linking them to Technology Offers of PROs. Moreover, KTOs should actively harvest commercial databases for technology requests. Several services offered by EEN serve as a prelude to the required (but not always available) expert services of the KTO consultants. Providing a vibrant innovation ecosystem, in which the EEN and KTOs would work in view of signposting and the hub and spoke model, EEN serving as a liaison (account manager), but KTO as a final expert service provider, could work effectively.

A wider approach to science disciplines: Collaboration with social sciences and humanities (for example, the connection with heritage science and alike should be investigated) should be encouraged. In this regard, the »Outputs« as defined in the Research Excellence Framework (REF) of the UK research evaluation system should be studied and possibly all 22 categories, which also include patents) should be analyzed for further usage. Citizen science and science with and for society issues should become more prominent within the work of KTOs.

A systematic research approach to KT content and increasing the quality: Policymaking and lobbying for research projects in the KT – political impact of the EC and JRC is required for this. The explicit notion of the need to upgrade the KTO services from PR activities, and the importance of KT activities to actual execution of such activities, measured by unique KPIs, results should be normalized to research FTE headcount. KPIs are the same in all KTOs regardless of the enabling factors (these only define the maximum KTO output and maximum impact in the economy). Build on the impact factors from the pathway to impact of the EC (commercial, research, societal).

Systemization on the Horizon Europe level: In the same way as »Gender equality plans« need to be published as a prerequisite to a Horizon Europe project approval, also »IP and commercialization policy, including Open Science« should become such a required action for HE projects. The DARPA model and EIC model (with PMs and the support team) are development directions.

Beneficiaries of the KT Activities: It should be emphasized in the Recommendations that students as private persons are not the target of the Recommendations nor the focus of KT activities of the KTO, at least not under the legislation for IP ownership; remedies to assist student-based inventions should be devised under different measures than KTOs (e.g. university, incubators).

Organizational issues in different specific situations: Recommendations on how to organize the system for smaller institutions that do not have the capacity nor the need to retain a full-pledged KTO are needed. Such recommendations are required due to the diversity of personnel needed. Several employees are needed to have a successfully operating KTO. Several models have been tried out: SATT (centralized), Knowledge Transfer Ireland & Slovenia (consortium distributed), Cambridge (University-owned), Leuven R&D (independent internal office) ... It is true that everyone needs to find their way, but there are specifics and criteria which can help find the suitable model. The emphasis on trust-building with the research and economic community is of the utmost importance.

Pooling and open science: Requirements for pooling among institutions on IPR offer should be upgraded in pooling of Open science access. The possible tension between IP protection and Open science, particularly secret know-how, should be addressed in straightforward operational funnels.

Career progression in KT: The career progression of KTO professionals should be addressed, agencies and ministries should be invited to discuss this issue.

Managing the financial return: Recommendation on how the PRO uses the income from commercial activities - should it be used for a PoC fund managed by the KTO for TRL increase of commercialization cases? Or for further IPR cost financing? Why?

Last but not least, an idea of further networking between innovation support stakeholders needs to be put forward, particularly in regards to Enterprise Europe Network (EEN) being active in more than 60 countries worldwide providing support to SMEs with international ambitions. Co-funded by the European Union's COSME and Horizon 2020 programmes, the Network aims to help businesses innovate and grow internationally.

CHAPTER 1 - Core values

PARTNERS
Professionalism
Adding European Value
Responsiveness
Trust
Network
Encouragement
Relationships
SME focus

Figure 6: Enterprise Europe Network Code of Conduct, Annex 2 to the Grant Agreement, 2014

In the coming years, EEN plans to pay more attention to the field of KT, as KT is essential for raising the competitiveness of the European economy. In this context, we believe that the presented proposal of topics that need to be addressed within new recommendations will be mutually beneficial in developing new strategies of EEN and KTOs and strengthening their relations.

4 CONCLUSIONS

- European KTOs should review and fully understand the current European EIC model connected to the successful DARPA / ARPA-E models. They should consider the model as the main framework while adapting its operations to national legislation and the specificities of the industrial and public sector – all with the aim that each KTO becomes a comparable element of the whole community of KTOs at the European landscape.

- There are some common critical points in the pipelines of all KTOs irrespective of different national environments and specifics, namely the KPIs represented in Table 1. Such KPIs are indicators of the KTO activities rather than only general and final KTO results (e.g. patents filed, license and R&D agreements) or remote indicators of KTOs' maximum possible results (limited by the environment). The represented nomenclature of KPIs should help set up a uniform path that European KTOs are supposed to follow to achieve the results.

- It would be of utmost importance to establish a fruitful collaboration between KTOs and national EEN offices to assure full in-depth support to researchers and SMEs alike in this TRL challenging exercise in between the worlds of academia and industry, in particular given the EEN's core values (Fig.6), focusing on the signposting and the hub and spoke model of operation.

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Digital Innovation Hubs and Regional Development: Empirical Evidence from the Western Balkan countries

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ABSTRACT

The Digital Innovation Hubs (DIHs) in Europe are created to support the digital transformation of small and medium enterprises (SMEs). The network of DIHs is in the process of establishing throughout Europe. However, the work of DIHs is not sufficiently investigated neither in developed nor developing countries. In the Western Balkan region (the WB-5), there are 24 registered DIHs, but only five of them are fully operational. Throughout the survey, the authors investigated the WB-5 DIHs and compared their performance with their EU-28 counterparts. The survey results and interviews with the WB-5 DIHs indicate a lower level of their specialization and suggest that they failed to support the digital transformations of local businesses. They also have a great potential to improve cooperation among industry, academia, and governments in the WB-5 countries and between the countries.

KEYWORDS

Digital Innovation Hubs, Business Support Organizations, Small and Medium Enterprises, Quadruple Helix Model of cooperation, developing countries.

Technology Transfer as a Unifying Element in EU Projects of the Center for Technology Transfer and Innovation

Prenos tehnologij kot povezujoči element EU projektov na Centru za prenos tehnologij in inovacij

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ABSTRACT

Technology transfer supports the transfer of knowledge from research institutions to industry through various mechanisms, including those enabled by international project schemes. We analysed how projects, carried out within our unit, the Center for technology transfer and innovation (CTT), based on the outputs and processes developed, align to a technology transfer pipeline on an SME's path to innovation. We also investigated how different projects complement each other in creating a comprehensive innovation support system for SMEs. Projects involving voucher-based financial support of innovative collaboration and highest involvement of researchers emerge as most engaging for future funding applications, with other types of project nevertheless being recognized as important in focusing on individual stages of innovation. Regardless of project, dedicated efforts are important for establishing strong research-industry connections and enabling their continuous collaboration after the project's end.

KEYWORDS

Technology transfer, innovation, EU projects, H2020, Interreg

1 INTRODUCTION

Technology transfer supports the transfer of knowledge from research institutions to industry, enabling laboratory research to progress to an industrial level, and in turn, enabling small-to-medium-sized enterprises (SMEs) to innovate through collaboration with researchers. An SME can use various forms of support offered by a technology transfer office, and the forms of support are frequently part of a national or an international project scheme, such as European Commission's Horizon 2020 and EU's Interreg programs. CTT at the Jožef Stefan Institute has been a partner in several such projects. In this work, we analyzed how our projects align to a technology transfer pipeline on an SME's path to innovation, and how different projects complement each other in creating a comprehensive innovation support system for SMEs. Finally, we identify the type of project most suited for bringing into practice collaborative research that drives technology transfer's ultimate goal, innovation.

2 METHODOLOGY

Ten EU projects analyzed in this work (out of a total of 24) have been selected with the criterion of being geared towards supporting SMEs in gaining new knowledge and/or finding research and/or industrial business partners with the goal of innovation. CTT projects not included were those related to popularizing science and introducing scientific courses into high school programs. National projects were not surveyed due to their different selection process. Projects that ended before December 2014, and more recent projects that didn't entail sufficient involvement and therefore familiarity by one of the authors (D.O.) to enable analysis, were not included. The surveyed projects are listed in Table 1.

To identify projects' alignment to individual stages of innovation and evaluate the extent to which they incorporate elements of technology transfer, we reviewed project deliverables, outputs, and processes developed most relevant to innovation.

To illustrate the range of support types that the projects have offered, and to identify the type of projects most in line with technology transfer goals, we created a simplified project landscape wherein we distributed the projects along two dimensions: (1) level of involvement of research institutions, and (2) innovation stage reached by the project's outcome, from basic raising of awareness to concrete advanced innovative collaboration. The analysis aims to identify type(s) of project towards which most efforts should be directed in future funding applications.

3 RESULTS

Selected project deliverables, outputs, and processes relevant to innovation, are listed in Table 2. All projects lead to raised

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Table 1: EU projects surveyed.

Acronym	Brief description	Duration	Program
KET4CP	Supporting manufacturing SMEs with key enabling technologies provided by research institutions, with the emphasis on environmentally–friendly manufacturing	2018-2021	H2020
Central Community	Supporting life-science-oriented SMEs and research institutions in finding business partners through a platform	2012-2014	Central Europe
Co-Create	Supporting SMEs in involving creative sectors to define new products and services according to social trends	2016-2020	Interreg Mediterranean
EU-GIVE	Connecting SMEs to collaborative, circular and sharing economy actors for increased efficiency of innovation	2017-2019	COSME
finMED	Supporting financing of innovation in green growth sectors through improved delivery of policies and strategies	2018-2022	Interreg Mediterranean
IP4SMEs	Supporting SMEs in defining the role of intellectual property (IP) in creating regional value through interregional IP exchange	2012-2014	Slovenia – Italy Cross Border
KETGATE	Supporting SMEs with access to key enabling technologies through research equipment and services provided by research institutions	2017-2020	Interreg Central Europe
Open I SME	Supporting SMEs in solving technical issues with the aid of researchers via an online tool matching technology requests with research competencies	2014-2016	CIP
Scale (up) Alps	Supporting SMEs by setting up a hub enabling a single entry point to assistance in access to finance, access to talent, and access to market opportunities in the EU	2016-2019	Interreg Alpine Space
SYNERGY	Supporting SMEs in finding potential innovation partners through platforms for submitting technology challenges and enabling crowdfunding schemes	2017-2020	Interreg Central Europe

awareness and new knowledge gained by SMEs, as well as new processes developed at CTT to effectively support SMEs. However, individual projects lead to innovative collaboration to varying degrees.

Based on data from Table 2, we aligned the projects with a hypothetical innovation process in an SME. The relevance of selected projects at different stages of innovation (from problem to innovative solution) is shown in Figure 1. While individual projects are relevant to different stages and support technology transfer to different extents, most have the goal of connecting SMEs to relevant stakeholders and lead to innovative collaboration.

Since technology transfer from research to industry ideally entails participation of researchers, we analyzed the projects not only according to the stage of innovation but also according to researcher involvement. Distribution of projects in relation to involvement of researchers – from none to full - and to role in innovation based on project results and outputs – from indirect to direct – is shown in Figure 2. Both dimensions are descriptive rather than quantitative, and the landscape has been created for illustrative purposes.

The results show that projects such as KET4CP and KETGATE, which include operational support steps from the beginning till the end of the innovation pipeline (Table 2), and have important roles in innovation as well as a high level of researcher involvement, emerge as having the highest potential for technology transfer.

Projects with lower relevance that enter the innovation pipeline in the beginning of the innovation process but do not include mechanisms to sustain active collaboration, such as Open I SME and Central Community, are those that enable matchmaking through platforms but in absence of further innovation support actions they do so with lower impact. In effect, they start the process by introducing potential partners but leave them to carry out setting up the collaboration by themselves.

Projects having the most impact in raising awareness rather than in producing actual collaborative development, such as IP4SMEs, EU-GIVE, Co-Create, and Scale(up) Alps, enter the pipeline at the middle of the process (scouting and innovation potential discovery) and are least relevant, as their impact on technology transfer is most indirect. They make the potential partners aware of the fact that there is an opportunity for collaboration to be seized, but do least about creating an actual collaboration among potential partners.

Lastly, projects that only deal with a singular aspect of the process can be influential in terms of that particular aspect (for example, finMED for financial support setup, IP4SMEs in IP issues), but act out of context in terms of the innovation pipeline.

From the analyses conducted, the KET4CP and KETGATE projects emerge as a type of project most closely in line with the complete collaborative innovation pipeline, involving strong research participation, creating concrete connections and following them through to realization of the opportunity, thus most effective in increasing SME-research collaboration and most attractive in subsequent funding opportunities.

Table 2: Project deliverables, outputs, and developed processes most relevant to innovation, distributed based on the benefit to SMEs participating in the project.

Project	knowledge gained by SME	Instruments / processes developed	registration on platforms, submission of challenges, matchmaking	successful joint research and development projects
KET4CP	map of European technology centers	Cascade funding with evaluation and support process	KET4SME platform	yes (voucher-supported)
Central Community	list of Life Science companies	Process of scouting, matching, and encouraging SMEs towards open innovation	LifeScience Room	
Co-Create	design thinking, co-creation	Design thinking process for inclusion of different stakeholders in traditional SME innovation process	Co-Create platform	
EU-GIVE	map of collaborative economy initiatives	Process of engaging researchers in creating innovative collaborative economy approaches		
finMED	list of financial instruments and mechanisms	Process of including intangibles into financial intermediaries' (as banks) loan capability criteria evaluation		
IP4SMEs	importance of IP	Process of auditing SMEs towards discovery of innovation potential		
KETGATE	available research equipment at JSI	Process of scouting, matching and financially supporting research and SME partners with cascade funding	KETGATE platform	yes (voucher-supported)
Open I SME		Process of scouting, motivating research experts to become available to SMEs for industrial counseling	OpeniSME platform	yes
Scale (up) Alps	list of Slovenian startup ecosystem actors	Process of scouting for expertise, supporting creation of SME (spinout), matching its needs to the support system and allocating relevant support – it being a part of a group of companies with similar needs	Scale(up) Alps support ecosystem	
SYNERGY	list of crowd innovation initiatives	Process of determining entities suitable for crowd sourcing, based on relevant criteria, and of matching them with suitable crowd innovation initiatives	SYNERGY platform	

4 DISCUSSION

In this work, we analyzed selected projects in terms of their contribution to technology transfer. It should be noted that there is a distinction in terms of relevance to individual stages (Figures 1, 2), however, the KET4CP and KETGATE projects emerge as a type of project most closely in line with the complete collaborative innovation pipeline. On the other hand it should be emphasized that each project has its place in the overall innovation process. Consider a hypothetical Company that agrees to participate in all listed projects. The Company benefits from all aspects of innovation (Table 2), and ends up having a complete set of services that are in fact part of technology transfer. It starts by attaining basic knowledge about intellectual property and innovation management (IP4SMEs), its position among other SMEs in a given sector (for example, life sciences; Central Community) and familiarizes itself with the landscape of collaborative economy (EU-GIVE), available technology centers (KET4CP) and research equipment (KETGATE), startup support

(Scale(up) Alps) and crowd innovation initiatives (SYNERGY). The Company then proceeds to learn about the design thinking approach in innovation and the possibilities to connections with the creative sector (Co-Create), and gets an opportunity to explore a host of national and international research and/or business partners via various online platforms (KET4CP, Central Community, Co-Create, KETGATE, Open I SME, SYNERGY) or through attending matchmaking events (KETGATE). The Company receives a comprehensive informative guideline on the possibilities of financing (finMED), and may enter into research and development collaborations (Open I SME), with the possibility of additional financial support by vouchers (KETGATE, KET4CP). Thus, any given project, even if filling

Figure 1: Relevance of selected projects at different stages of innovation (from problem to innovative solution) in an SME.

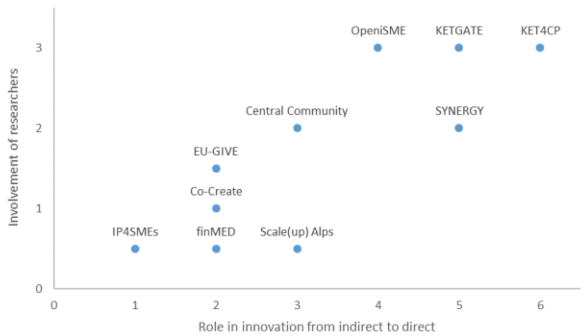

Figure 2: Distribution of projects in relation to involvement of researchers, and to role in innovation based on project results and outputs. Note that the numbers indicate a relative position of the project based on project design rather than any quantitative measure, and are provided for illustration purposes only. Numbers on the y axis indicate no involvement (1), potential involvement (2), or full involvement (3). Numbers on the x axis indicate stages in innovation pipeline as follows: 1 – gaining knowledge about IP and innovation management, 2 – gaining knowledge about design thinking, collaborative economy, or financial instruments 3 – registration on platforms, 4 – matchmaking, 5 – access to equipment or services, 6 – joint research and development projects. In this type of display, the projects located in the upper right part are most suited for supporting technology transfer between research and industry.

just a single innovation stage, can represent an added value for an SME, through providing knowledge about a specific subject, thereby allowing other projects to offer support with the benefit of that gained knowledge.

Low-level- and mid-level-impact projects are thus important since they provide information and knowledge for companies that makes them suitable as target beneficiaries for further forms of support down the pipeline. For example, a highly relevant project, such as KETGATE, may not itself include in-depth analysis of mechanisms for defining intellectual property (otherwise provided by IP4SMEs) or in-depth analysis for setting up familiarity with available financial instruments (otherwise provided by finMED). However, as both are useful traits in signing cooperation agreements and looking for continued financing of pilot projects established within KETGATE, their execution provided grounds for setting up a fully-fledged innovation pipeline support. An SME thus more efficiently benefits from KETGATE services, having previously received services from IP4SMEs and finMED. Ranking of the projects (Figure 2) is therefore not a reflection of their quality or relevance but of their position within the complete support to technology transfer.

The processes developed within individual projects, from discovering innovation potential (e.g. IP4SMEs) to cascade funding of research and development projects (e.g. KET4CP), culminated in the development of a comprehensive SME innovation support system at the CTT that is flexible and adaptable to a company's level of innovation and particular needs. The projects proved important in strengthening of the technology transfer pipeline by developing ways of engaging various stakeholders, their auditing, developing of matchmaking platforms, and protocols for facilitating collaborative research, including voucher-supported cascade financing schemes.

It is the long-term goal of EU projects to not only develop processes for comprehensive SME support but also act as stepping stones for achieving continuing innovation activities between research / industry partners and building strong and inspirational success stories after the projects' closure. This is particularly important in the light of the fact that mechanisms established during a project, such as platforms, are often inactivated once the project is finalized. Efforts are in principle invested towards sustainability of platforms after the project's end, but platform maintenance is rarely guaranteed and/or requires dedicated funding from other sources. It is therefore important to enter into a project with a clear vision of its benefits and strong dedication to reaching relevant goals. Understanding the role of a specific project in the innovation pipeline is crucial to achieve this. Previous experience has shown that prudent attitude towards engagement with project target audience (from identifying relevant companies, identifying the right correspondent individuals, to right type of motivation) can lead not only to fruitful project collaboration but also to continued research-industry collaboration outside of the project.

Finally, we estimate that the culmination of the efforts described in this article will be seen on one hand within the European Innovation Council of the Pillar 3 in Horizon Europe, in particular in the creation of new high-tech-based companies stemming from Public Research Organizations. But the contribution of this myriad of projects should also be seen as important within further financing of the European Commission in the form of cascade funding, available to connect in massive numbers SMEs and the academia. Such numerous collaboration is required to build trust, to execute the contract / collaborative research and to improve the technological absorption capacity ever so needed to be improved in some parts of Europe, ours included.

5 REFERENCES

This work is a result of experience- and output-based analysis and does not include references as such. Below are given links to websites, wherever still active as of 30.9.2021, to individual projects analyzed:

KET4CP - https://www.ket4sme.eu/
Co-Create - https://co-create.interreg-med.eu/
EU-GIVE - https://www.eugiveproject.eu/
finMED - https://finmed.interreg-med.eu/
IP4SMEs - http://www.ip4smes.eu/
KETGATE - https://www.interreg-central.eu/Content.Node/KETGATE.html
Open I SME - https://www.openisme.eu/
Scale (up) Alps - https://www.alpine-space.eu/projects/scale-up-alps/en/home
SYNERGY - https://www.interreg-central.eu/Content.Node/SYNERGY.html

Proof of Concept cases at the Jožef Stefan Institute in 2020 and 2021

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ABSTRACT

The development of economy and society is inextricably linked to inventions and innovations from public research organisations. Technology transfer offices identify potentially suitable technologies for commercialization and support researchers in the field of intellectual property (IP), commercialization etc. However, financial resources are necessary for the further development of the identified technologies in order to reach higher levels of technological maturity. In EU, UK, USA and elsewhere the so-called Proof of Concept (PoC) funds are available on institutional, regional, national and international level. In Slovenia till 2021 we only had four PoC funds, all of them were institutional / internal, one of them the Jožef Stefan Institute PoC, created as the first one already in 1996. This paper focuses on the eleven Proof of Concept cases from the Jožef Stefan Institute that were financially supported in 2020 and 2021. We have shown their individual characteristics and the expected benefits for the projects due to the received PoC funding based on the project applications. The projects are dispersed across Technology Readiness Levels (TRL) of the so-called Valley of death (TRL 3-7). Further developments based on the received funding are in line with their current and expected TRLs – the most common are validation in the laboratory and / or in the relevant environment, prototype demonstration and testing. We have also made an overview of possible future scenarios for them on the basis of the expected CEETT Proof of Concept fund.

KEYWORDS

Proof of Concept, Entrepreneurship, Innovative financing, Technology Transfer

1 INTRODUCTION

A Proof of Concept phase (PoC) is a research practice and serves as an instrument of knowledge construction in an individual study and helps to build further understanding of certain objects, data, metrics, apparatus, processes, materials. A PoC research is composed from a set of activities (i.e. actions, movements, analyses, simulations, techniques, tests, etc) for the assessment, understanding, validation and exploitation of, and the learning about particular research object [1]. A PoC is used "to prove a concept through a practical model" [2]. The PoC phase is in research institutions in terms of technology transfer considered as critical for the success of both licensing and the creation of spin-off companies [3]. The POC therefore increases technology transfer office (TTO) chances of a larger percentage of the income stream from the commercialization of innovations so that it can fulfil some main tech-transfer goals, that is, return on investment, job creation, start-up creation, IP licensing and improving reputation at all levels in its own tech-transfer process [10]. Auerswald and Branscomb write that the most vital technology commercialization phase occurs between invention and product development when commercial concepts are created and verified and the best appropriate markets are defined. The PoC phase has a funding gap, caused by information and motivation asymmetries and institutional gaps between the science, technology and enterprises [4].

Such a gap is primarily due to the "embryonic" nature of the research organization-generated inventions, which tend to operate at the frontier of scientific advancements, thus involving considerable risks associated with their subsequent validation, industrialization and commercialization [5]. The time required to transform discoveries into products and the vast amount of resources needed to pursue the required development constitute a mix of high uncertainty and negative cash flows that decrease investment incentives and limit opportunities to secure funding. This pattern is especially pronounced in science-based sectors like life sciences, biotechnology etc. [5]. The gap and PoC positioning in regards to the stage of development and funding sources is also shown in Figure 1.

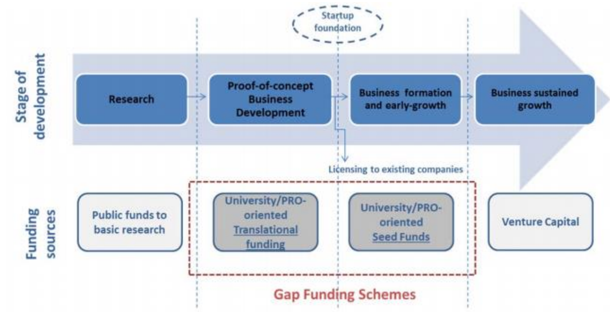

Figure 1: Representation of PoC in regards to Stage of development [5]

The lack of dedicated funding and support to help inventions from public research institutions to mature to the stage at which they are market and investor ready represents a major obstacle to effective knowledge transfer. Different support mechanisms address these gaps, at general policies level as well as on the level of specific, local initiatives, including research organizations funds [6, 7].

PoC funding programs are mechanisms that combine money, expertise and training to help new inventions and discoveries emerge and to demonstrate their technical and commercial feasibility. Such funds can appear under different names like PoC funds, proof-of-principle funds, translational funding, pre-seed funding, verification funding, maturation programs, innovation grants, ignition grants [5]. No matter the name they all have common objectives and characteristic, shown also in Table 1: to evaluate the technical feasibility and commercial potential of early-stage research ideas and technologies and to demonstrate their value to potential industrial partners and investors. Under the programs, the researcher/research team gets capital and assistance across a broad spectrum of areas, such as intellectual property rights, business plan development, market studies, networking etc. The ultimate goal is to advance the technology to a point at which it can be licensed to an external industrial partner or a start-up to be created to attract the interest of investors in later stages of development [5].

Table 1: Main characteristics of PoC funds [5]

	PoC Programs
Objective	Evaluate and support the technical feasibility and commercial potential of early stage technologies generated by public research organizations
Focus of investment	Primarily projects by individual researchers or research teams
Investments typology	Typically grants, but other forms are possible (i.e., loan, repayment schemes)
Investment stage	Pre-seed stage (typically before company formation)

As mentioned in the paragraph above, PoC funding schemes can be created internationally and nationally. In Slovenia, we do not have a national PoC funding jet. Some public research organizations have therefore developed their internal schemes. These schemes are available at the National Institute of Chemistry, University of Ljubljana, University of Maribor, and at the Jožef Stefan Institute.

2 PROOF OF CONCEPT FUND AT THE JOŽEF STEFAN INSTITUTE

2.1 Legal framework

The Jožef Stefan Institute (JSI) has in **1998** implemented the Internal Employment-Relate Inventions Act. At the same time, **the innovation fund** of the institute has been created.

The goal of the innovation fund is to enable the projects to increase their technology readiness level (TRL), increase their maturity and attraction towards potential customers, increase their suitability for external calls for proof of concept funds, and establish partnerships with the industry.

The innovation fund of the Center for Technology Transfer and Innovation (CTT) at the institute is filled only from the part of the incomings from the commercialized intellectual property of the JSI. Funds are being distributed through internal JSI calls prepared and managed by CTT based on a detailed internal act.

In this work, we will focus on the 2020 and 2021 cases.

2.2 Jožef Stefan Institute PoC calls in 2020 and 2021 [8]

Calls for funding of projects are intended to help move projects starting from at least the TRL 3 towards higher TRLs. The call is open for JSI researchers with a status of at least 50 % employment at JSI.

Table 2: Approved Jožef Stefan Institute projects in 2020 and in 2021 [9]

Y.	Title	JSI research department, project leader
2021	Upgrading the Open Clinical Nutrition Platform with a mobile application	Computer Systems (E7), Koroušič Seljak
2021	Data gap analysis for biocide regulatory protocol of apatite/gold/arginine as novel antimicrobial agent	Advanced Materials (K9), Vukomanović
2021	Connecting with industry partners to build an automated laboratory	Nanostructured Materials (K7), Suhadolnik
2021	Libra wireless pocket-size kitchen scale	Computer Systems (E7), Blažica
2021	Multifunctional coatings for the protection of metal surfaces	Physical and Organic Chemistry (K3), Rodič
2020	Apparatus for ultra-fast fluorescence lifetime measurement	Experimental Particle Physics (F9), Seljak
2020	Ceramic capacitive pressure sensor with doubled pressure sensitivity	Electronic Ceramics (K5), Malič
2020	Scaling of the synthetic method of electrochemical electrodes	Gaseous Electronics (F6), Filipič
2020	Predicting exacerbation of chronic heart failure based on telemedicine date	Intelligent Systems, (E9), Gradišek
2020	Preparation of synthetic blood substitute for testing medical equipment	Electronic Ceramics (K5), Kuščer
2020	CAUSALIFY – Exemplary in the dynamics of world events	Artificial Intelligence (E3), Grobelnik

The purpose of the call is to:
- define the technology to the extent that it is suitable for the official acceptance of the invention / technical improvement / registration of the intangible asset at the JSI;
- help with application for a larger concept verification and validation call;
- help projects to a higher TRL in order to increase the attractiveness of technology for potential customers or to use technology in a JSI spin-off;
- establish long-term partnerships with the industry.

Expected results for the approved / selected projects:
- upgrading their TRL and therefore increasing the value and attractiveness of the technology;
- higher possibility of selling or licensing the innovation;
- creating links with industry partners;
- getting ready to apply to a bigger tender for testing and validating the concept and
- participation in the selection of the best invention / innovation from public research organization at the International Technology Transfer Conference.

In 2020 six projects were approved and in 2021 five projects.

Each PoC project has its TT guardian in the Center for Technology Transfer and Innovation. The allocated TT experts are guiding the research teams in terms of IP, further financial possibilities, connecting with industrial partners, project preparations, technology assessments etc.

3 ANALYSIS OF PROOF OF CONCEPT PROJECTS FROM THE JOŽEF STEFAN INSTITUTE

We have looked at the approved projects from different points, as a source taking project applications:
- Current and expected TRL;
- Time needed to reach the expected TRL;
- Technological background of the projects and the markets they are targeting;
- The intellectual property protection of the projects;
- The type of the market the researches are targeting, trends on the market and the competition;
- Spin-out vs licensing plans;
- The benefits of the PoC financing for the project development.

As it can be seen from the Table 2, the projects are from three different areas of the Jožef Stefan Institute:
- Physics (2 projects)
- Chemistry and Biochemistry (5 projects)
- Electronics and Information Technology (4 projects).

The majority of projects has been at TRL 3 (6 projects) when applying for funds, 3 were at TRL 4, one at TRL 5 and one at TRL 7. In the next 12 months the TRL of all project will with the received financial help rise for at least one TRL. In two projects the rise would be event from TRL 3 to TRL 7 as shown in the Figure 2. The expected TRL is not known yet in four cases.

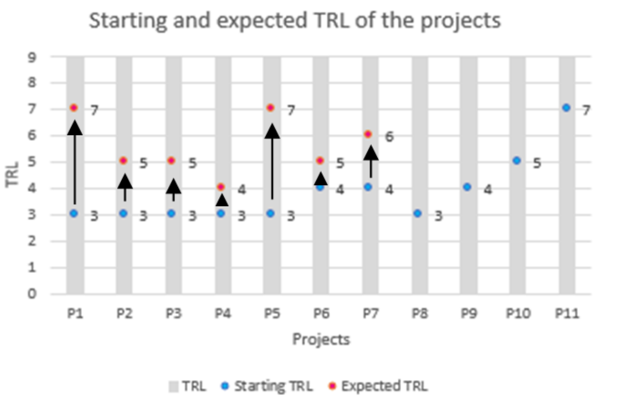

Figure 2: Starting and expected TRL of the JSI PoC cases

Based on the info from the applications, all the projects will be targeting world-wide market. Five of them will develop solutions for niche markets, other six are targeting wider audience – numerous users. It is important that six of the projects are trendsetters, the rest are developing solutions for current "hot" topics like environmental legislative requirements, health issues of the population, ageing population, solutions for non-animal tests in pharmacy, energy consumption. Six projects have little competitors and their competitive advantages are high. It is extremely interesting to observe where the science has its expected effect. This is shown in Figure 3. The Technological areas are the ones of the four broader activities of the Institute (Physics, Chemistry and Biochemistry, Electronics and Information Technologies, Reactor Engineering and Energy). A particular Technological area has been defined based on the research department of the applying team. The expected impacts / the targeted markets are listed as they were identified by the teams.

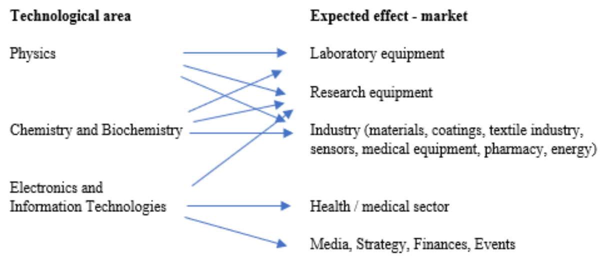

Figure 3: The Jožef Stefan Institute PoC projects and their expected effect on different markets

Three out of eleven teams are seriously considering the option of establishing a spin-out company. The rest wish to license the technology.

The main expected benefits for the projects due to the received financial resources are described below. To assure anonymity, the order of the projects below is not the same as in Table 2:

P1: start test cooperation with industrial partners, construction of a prototype, testing a prototype, preparation of detailed plans for the manufacturing of critical components of the device, applications to EU projects.

P2: analysis for regulatory protocol.

P3: designing a mobile application, user interface design, user testing of the application.

P4: running a trial with early adopters, improving the user experience of the demo, preparation of promo material, lowering the production costs.

P5: experimental / test cooperation with an industrial partner, pilot transfer of the solution to the industry, IP protection.

P6: developing industrial prototype and user interface, testing the prototype.

P7: developing a prototype, testing the prototype with the potential users.

P8: scaling-up the existing prototype, testing it for one of the possible applications, developing a method for simplifying the operating procedure.

P9: pilot testing, improvements needed for clinical testing, promotion.

P10: component validation in a laboratory environment, IP protection, preparation for suitable project calls.

P11: developing protocols for scale-up in the laboratory environment, validation in the relevant environment.

We have grouped the main expected benefits into four most common areas: 1. Developing a prototype, 2. Testing a prototype in a lab, 3. Testing a prototype with industry / potential users, 4. Preparing a support documentation i.e. documentation to fulfil the legislative requirements, IP protection documentation (patent applications and similar), project applications, communication / commercialization promo material etc). As it is shown in Figure 4 in seven projects researchers are developing a prototype, in four cases prototype will be tested in a lab, in nine projects prototype will be tested with industry or other potential users, seven sets of needed support documentation will be prepared as well.

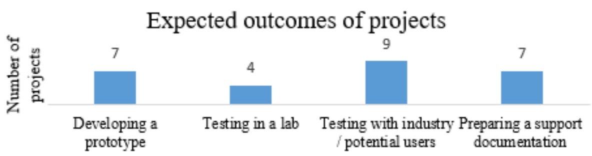

Figure 4: The Jožef Stefan Institute PoC projects and expected outcomes of project

With the rise of TRLs it is expected that the projects will gain also on the following areas:

- The teams will get additional team members with the expertise in business plan development, marketing, technology transfer, certification, etc (relevant for all the projects) or they will licence the technology to a company that will take over the future product / service and launch it on the market.
- Intellectual property (IP) will be better defined, IP management plan will be developed, relationships between researchers themselves and with host organizations will be arranged.
- The key market will be defined. All activities (research, development, financing, promotion) will follow the defined key market needs.
- The research towards the markets that are not promising will be abandoned.
- Further financing will be acquired also from external sources (relevant for all the projects).

4 CONCLUSIONS

Through the calls in 2020 and 2021 the main lessons learned for the the Center for Technology Transfer and Innovation team were:

- It is necessary to have PoC funds available at institutional / JSI level as well as on national level.
- The funds are welcomed by JSI researchers since the application is simple, the results are available soon and the support regarding the project funding and reporting is in-house.
- CTT gets through the application additional insights into the research activities of research departments and can offer its assistance to new research teams.
- Besides the funds that the teams get, it is necessary that CTT supports the projects also with the guidance on IP, further financial possibilities, connecting with industrial partners, project preparations, technology assessments etc.
- Market assessments and defining the target market are crucial for further development. In this step feedbacks from business sphere are priceless.
- The teams are in most cases composed from natural sciences and engineering experts. It is necessary to connect them with experts from human- and economics sphere as soon as possible in order to focus further development based on market needs.

In July 2021 the Central Eastern European Technology Transfer (CEETT) platform has been launched by the European Investment Fund (EIF) together with Slovenian SID bank and the Croatian bank for reconstruction and development (HBOR). The €40 million will be invested in venture capital funds and finance innovative technological research projects and the protection of the intellectual property of research organizations in Slovenia and Croatia (other Central Eastern European countries are not included).

The eleven JSI PoC projects have gained with JSIs' internal PoC funding in the past two years an excellent basis and will be ready for CEETT funding as soon as it is available.

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European Industrial Strategy - a great opportunity to strengthen the role of technology transfer offices

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ABSTRACT

The latest European (EU) industrial strategy of the EU Commission (EC) envisage increasing the innovation of small to medium-sized enterprises (SMEs) with the emphasis on the double transition to a green and digital economy. The Enterprise Europe Network (EEN), which operates within the EC and its 17 sector groups will be involved in achieving these goals. Optimized functioning of SMEs and PROs in the innovation ecosystem is extremely important and technology transfer (TT) will play a key role here.

This paper presents the interactions between sector groups and industrial ecosystems on the example of the BioChemTech sector group as it is important to understand them in order to act in line with the new EU strategy. A database of EEN profiles, namely all profiles marked for dissemination in the BioChemTech group were analysed and the technology, market and client outreach based on real business and technological offers and requests is thus presented in this paper. The BioChemTech sector group has the most direct applications in Health (30%), Digital Industries (10%), Agri-Food (9%), and Renewables (4%) and many indirect synergies with the same industrial systems in the areas of Industrial Products, Genetic Engineering/Molecular Biology and Consumer-Related Products. The sector group has already established contacts with clients in the field of Digital industries (5%) and Renewables (5%), which will need to be maintained, reinforced and upgraded in cooperation with other sector groups to ensure effective digitalization and sustainability of companies.

The results reveal a unique opportunity for TT offices (TTOs), as the future demand for digital and environmental solutions should increase in companies. TTOs should catch this wave and thus overcome the usuall bottleneck of disproportionately large share of technology supply compared to technology demand as presented in this paper.

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KEYWORDS

European Industrial Strategy, Enterprise Europe Network, Technology Transfer, Industrial ecosystems, Sector groups, BioChemTech, biotechnology, chemistry

1 INTRODUCTION

The EU Industrial Strategy of EC from March 2020 focuses mainly on the dual transition to a green and digital economy [1] aiming to increase the competitiveness of EU industry and enhancing the Europe's open strategic autonomy.

The EU industrial strategy defines 14 industrial ecosystems (Figure 1). The primary aim of the new industrial strategy is to increase the innovativeness of SMEs within these industrial ecosystems. According to the Single Market Programme (SMP COSME) the research and TT are considered as a core expertise to ensure efficient support for SMEs by providing support to industry-academia cooperation including the provision of technology expertise and technology infrastructure services to facilitate lab testing, validation and demonstration [2].

Figure 1: Industrial ecosystems according to European Industrial Strategy [1].

EEN, which is operating under the EC has established 17 Sector Groups - the groups of network partners, who commit to work together in order to meet the specific needs of their clients operating in a particular sector [3]. The following sectors are covered by the groups: Aeronautics, Space and Defence, Agrofood, BioChemTech, Creative Industries, Environment, Healthcare, ICT Industries and Services, Intelligent Energy, Maritime Industry and Services, Materials, Mobility, Nano and micro technologies, Retail, Sustainable Construction, Textile and Fashion, Tourism and Cultural Heritage and Woman Entrepreneurship [3].

It is difficult to directly link the mentioned sectors to industrial ecosystems shown at Figure 1. For example, biotechnology and chemistry and many others are not listed as relevant industrial ecosystems. The reasons for the thematic mismatches between industrial ecosystems and sector groups vary. Some sector groups are based on the political agenda or are covering different services. However, the majority of sector groups is based on technology areas as defined by ATI - Advanced Technologies for Industry (former KET - Key Enabling Technologies) [3] meaning that the sector groups were established to transfer the advanced technologies from relatively narrow scientific fields to a relatively wide spectrum of industrial ecosystems.

Determination of how the technological sectors are related to industrial ecosystems is important to ensure the optimal functioning of SMEs and PROs in the innovation ecosystem according to the EU industrial strategy [1]. The information should benefit to Jozef Stefan Institute (JSI) as a PRO and ATI Technology Centre [3] as well as the partners of Slovenian EEN consortium [2] and Consortium for Technology Transfer from PROs to economy (KTT) [4] coordinated by JSI. The EEN and KTT community is indeed acting on various relations: SME-SME, PRO-PRO, PRO-SME and SME-PRO

In this paper, we describe an example of solving the above issue from the perspective of technology, market and client coverage in case of BioChemTech sector. We further discuss the opportunities for TTOs brought by the new EU industrial strategy and how TTOs can use the given situation to consolidate their role and importance in the innovation ecosystem.

2 METHODOLOGY

The profiles published on the EEN website (https://een.ec.europa.eu/partners) were exported using the following filters: profile date: "from 1 June 2020 to 20 May 2021"; partners: relevant sector groups: "BioChemTech". The obtained 199 results were exported into the Microsoft Excel worksheet (registration and login to EEN intranet is required to easily export the profiles). The technology, market and NACE codes with corresponding descriptions were further analysed (each profile has a maximum of five technology, market and NACE codes). The incidences of different individual codes were calculated. The most relevant sector groups or industrial ecosystems were attributed to the sets of most frequent codes occurring within 199 profiles and graphically displayed at Figure 2, Figure 3, and Figure 4. The "Others" group within individual sub-areas of Figures 1 – 4 represents the sum of various different codes that each individually covered less than 1% of the overall BioChemTech area. The number of business and technology profiles presented at Figure 5 is based on the same set of exported data. Analyses were performed in May 2021.

3 RESULTS AND DISCUSSION

3.1 Technology outreach

BioChemTech sector mainly covers the technological field of biological sciences (39%) and industrial technologies (26%) mainly in the fields of biotechnology, chemistry and materials, which is not surprising (Figure 2). Within biotechnology and chemistry, there are some cross-cutting areas with other sectors. The largest overlaps are in the areas of healthcare (19% of profiles), agri-food (10% of profiles), environmental protection (8% of profiles) and ICT (8% of profiles). Smaller overlaps are also in the field of micro and nanotechnologies (2% of profiles) and advanced materials (7%) including textile materials (Figure 2).

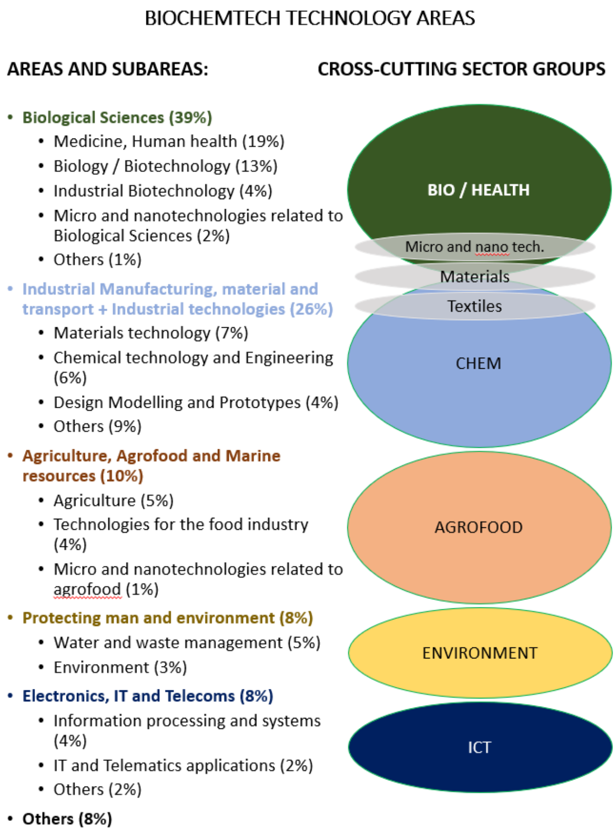

Figure 2: The incidence of EEN technology code descriptions and the representation of other cross-cutting sectors covering the same technology areas.

The field of Biotechnology is therefore interdisciplinary, which partly answers the question of why biotechnology and chemistry are classified as individual industrial ecosystems in new EU Industrial Strategy. Sectors such as biotechnology, nanomaterials, advanced materials etc. were established on the basis of ATIs, which are interdisciplinary by their nature and applicable in multiple industrial ecosystems simultaneously.

3.2 Market outreach

This interdisciplinarity can also be observed in Figure 3 representing the main markets of BioChemTech sector. Medical and Healthcare and Industrial products account for more than one half of the market, while other applications belong to various other industrial ecosystems, from Agri-food to Renewables and Digital Industries. Interestingly, there are a number of products in the ICT field intended for biotechnological applications and their development takes place hand in hand together with the ICT and BioChemTech experts as the knowledge has to be exchanged between these distinct groups of experts in order to build properly functioning medical/health/chemistry related computer applications. The said expert knowledge is intertwined in the fields of bioinformatics, assisted living facilities, electronic laboratory books, software for clinical study analyses, dietary needs, automation of laboratories, equipment management software etc.

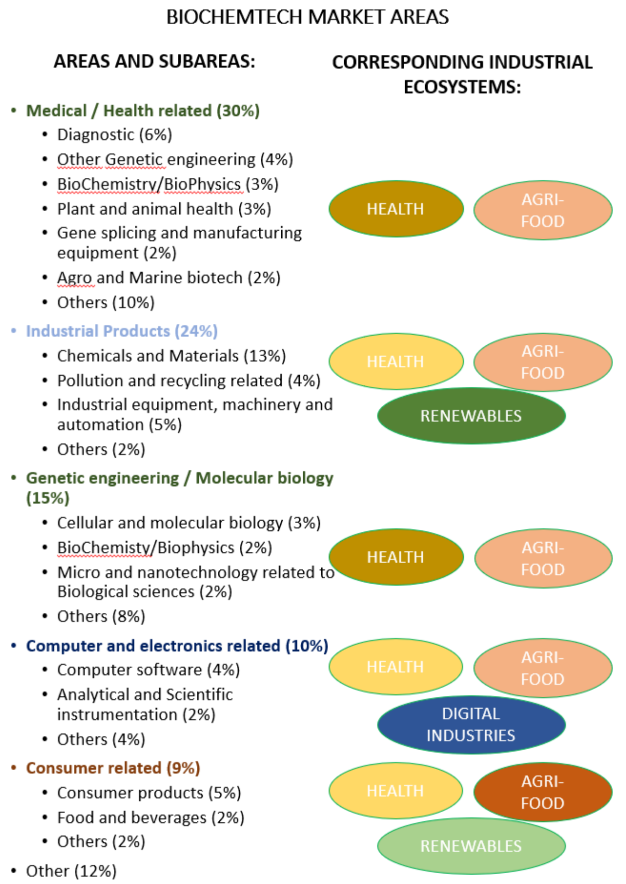

Figure 3: The incidence of EEN market code descriptions and the representation of corresponding industrial ecosystems.

It makes sense to maintain the established synergies with various industrial ecosystems, especially Healthcare and Agri-food in the upcoming years. However, from a strategic point of view, it is necessary to strengthen the integration with the Renewables and Digital industries in line with the new EU Industrial Strategy, which focuses most on digitalisation and sustainability of all industrial ecosystems [1]. For the mentioned integration, the BioChemTech sector group already seems to have established connections with the clients of the industrial ecosystems Digital industries (5% of clients from profiles) and Renewables (5% of clients from profiles), which only need to be strengthened.

3.3 Client outreach

Manufacturers of pharmaceutics, food and chemical products represent the largest share, 35% of clients of the BioChemTech sector group, while the representatives of Professional, scientific and technical activities represent only a slightly smaller share, 27% of clients (Figure 4). Almost equal representation of industrial partners and PROs should be considered as an unique opportunity for TT linking the technology demand of companies with technological supply of PROs, which is in line with the expectations of the latest Single Market Programme [2].

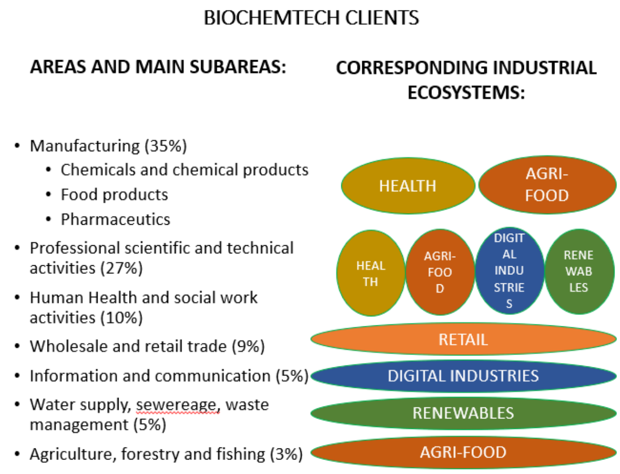

Figure 4: The incidence of NACE code descriptions and the representation of corresponding industrial ecosystems.

3.4 Opportunities for Technology Transfer

Figure 5 shows that there is a disproportionately large number of technology and business offers as compared to the number of requests. It is precisely this disparity that represents a bottleneck disabling the establishment of business and technological cooperation through matchmaking of supply and demand in commercial databases.

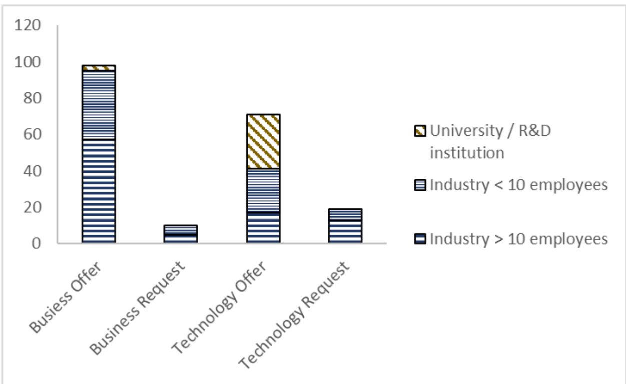

Figure 5: Number of profiles based on the profile type, organization type and number of employees in industry.

The technology offer of companies is higher as compared to the PROs at least in the BioChemTech sector. However, 58% of industrial clients in the segment are Micro Companies having less than 10 employees (Figure 5) and they are mostly start-ups and spin-offs (data not shown). Therefore, the knowledge included within the high number of technology profiles is coming predominantly from PROs. Analogously, the high number of business offers is coming from companies due to their desire to promote their products. The authors of this paper cannot find a good explanation for the low proportion of technology requests, except that they see it as a great window of opportunity for TTOs.

TTOs should play a key role in solving this problem by increasing the amount of technological requests gained from the companies. Direct marketing activities that lead to well identified topics of research with the companies by TTOs should be considered as a tool to bridge the above described lack of technological demand. For example, the direct marketing activities of Center of Technology Transfer and Innovation (CTT) at JSI include direct contacting of companies, promotion of technologies at brokerage events and other events, and physical visiting of companies: In the years 2017-2020 CTT visited 112 companies and identified 418 topics for cooperation with JSI. As a result of direct marketing CTT contributed to 35 license and 67 research and development agreements in years 2017-2020.

A relatively small proportion of the identified themes that lead to concrete agreements is best explained by well-known model of technology transfer funnel [6]. However, the TT funnel should not be taken as an excuse for not having successful commercialization cases at TTOs, but rather as an incentive to increase the quantity as well as the quality of company visits and identified topics [6].

On the other hand, in the future, the need for digitalization and sustainability is likely to arise in companies, which should have a positive impact on technology demand for digital and environmental solutions and thus positively influence the imbalance of technology supply and demand. TTOs, as experts in industrial ecosystems and technology sectors, should be able to help companies and PROs to establish collaboration and help especially SMEs to obtain national and EU funding.

4 CONCLUSIONS

Advanced Technologies for Industry (ATIs) areas are strongly intertwined (Figure 2) and have applications in several different markets (Figure 3) and consequently appear in several industrial ecosystems simultaneously (Figure 4) as shown on the case of BioChemTech sector.

The emphasis on digitalization, sustainability and environmental protection can only be established through active cross-sectoral integration, with the transfer of technologies from Digital Industries and Renewables related areas to other industrial ecosystems and the TTOs should play a crucial role, which is in line with EU Industrial Strategy [1] and the latest EU Single Market Programme [2].

Low technological demand (Figure 5) represents a bottleneck for successful TT and this paper suggests two ways of approaching this problem for the TTOs in the upcoming years:

(i) active seeking of the technological demand from companies at both national and international level and matchmaking the demand of companies with the offer of PROs;

(ii) introducing the digitalisation and sustainability to every company, which should in itself increase the technological demand of companies lacking of appropriate skills in the field of digitization and environmental protection.

The current situation is therefore a unique opportunity for TTOs that should be more adequately trained for:

(i) active searching and identifying the topics and research problems for further development and optimization of production processes and services in companies;

(ii) establishing research and development collaborations between the companies and PROs based on the interest of companies;

(iii) seeking for finance in the framework of national and EU projects for digitalization and sustainability.

5 ACKNOWLEDGEMENTS

Colleagues from BioChemTech sector group of the EEN and the European Innovation Council and SMEs Executive Agency are greatly acknowledged for a constructive discussion on the industrial ecosystems and their relations to various sectors. The colleagues from CTT are acknowledged for taking actions and improving the overall CTT results.

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Knowledge generation in citizen science project using on-line tools: CitieS-Health Ljubljana Pilot

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ABSTRACT

In this contribution, we describe the development of a tool for data visualization and treatment designed for the participants involved in the citizen science (CS) activities in Ljubljana, Slovenia, as part of the CitieS-Health H2020 project dealing with environmental epidemiology. The tool, a web application that enables volunteers to autonomously collect, edit and analyse the data, was designed to encourage their involvement in discovering and generating new knowledge, together with professional researchers and according to the principles of co-creation. Some preliminary lessons about the tool applicability and usability, including potential intellectual property aspects, are discussed.

KEYWORDS

Citizen science, co-creation, knowledge generation

1 INTRODUCTION

In recent years, CS is on the rise and there is a growing body of literature on various aspects of CS, its role and increasing importance in scientific research [1]. There is no single definition of CS as taxonomy depends on the type and level of involvement of participants, but in general citizen science defines the practice where non-professionals take part in the scientific research process. Such an approach brings many new opportunities, such as generation of new knowledge and understanding, but it also brings several challenges. Therefore, the European Citizen Science Association (ECSA) prepared a common set of ten core principles to consider in the CS projects, one of them emphasising the need to take into consideration legal and ethical issues surrounding copyright, intellectual property, data-sharing agreements, confidentiality, attribution and the environmental impact of any activities [2].

Intellectually property (IP) rights of participants in CS projects depend on the type of their involvement and contribution. To this end, Scassa and Chung [3] outlined typology of CS projects based upon IP issues and classified participant's contribution into following four broad categories: (i) classification or transcription of data; (ii) data gathering; (iii) participation as a research subject; and/or (iv) the solving of problems, sharing of ideas, or manipulation of data. The fourth category is of special interest from the IP point of view, as it demands bigger intellectual engagement from participants [3]. This is usually the case in the so-called co-created CS projects where citizens are invited to take part in all the phases of research activities [4].

Many potentials of environmental citizen science are recognised by scientific community, among others generation of new knowledge and facilitation of (in-depth) learning at the individual level [5]. However, it is necessary to take into account that volunteers in CS projects have a very different prior knowledge, as well as socio-economic background and education, and are usually inexperienced in analysing and processing the data gathered by themselves. Their motivation to participate can also vary [6]. Thus, appropriate specific tools tailored to the capability of the individual user are needed to empower and facilitate their integration into the process of knowledge generation. In this paper, we present some preliminary results and describe an example of creating a web application designed for the volunteers to independently process their own data gathered in Ljubljana, Slovenia, under the CitieS-Health H2020 project on noise exposure and health.

2 METHODS

2.1 CitieS-Health Project and Ljubljana Pilot Activities

Activities reported in this contribution were conducted within the frame of the Cities-Health, EU Horizon 2020 programme funded project on CS in environmental epidemiology (https://citieshealth.eu/). In Ljubljana pilot, citizens took part in co-designing citizen science study that addressed noise pollution and health. Altogether, 49 volunteers aged 10-67 participated in the study from November 2020 to June 2021. They were recruited during meetings and various engagement and empowerment activities organised with local NGOs, schools, private companies and based on contacts established in previous similar projects. Following the CitieS-Health methodological framework [7] that is based on co-creation with citizens in four phases of the project – initial identification of concerns and interests of citizens, followed by co-design of data collection protocols, data collection and analysing, and action - the following overarching research question was formulated: How do the quality of the living environment (with an emphasis on noise) and living habits affect the (mental) health and well-being of individuals? To this end, volunteers performed measurements and gathered information on various aspects of their living environment (noise levels, characteristics and perception of their surroundings, sleep quality and cognitive performance) using smartphone applications and physical activity trackers (Figure 1). Apart from the sleep questionnaire, they were prompted to do all the activities twice per day (morning and afternoon), and each individual collected the data for a minimum of seven days. Overall, 75 aggregated variables were collected, and over 1000 observations made, which resulted in over 50000 records/observations all-together.

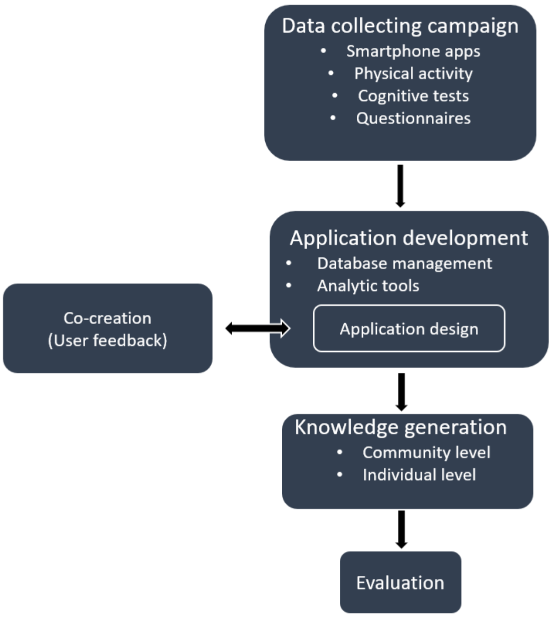

Figure 1: Schematic outline of the Ljubljana pilot

2.2 Challenges of Information Processing

As participants were collecting the data about themselves and their living environment, it was expected that they each get a personalized report on the data collected. On the other hand, participant's proactive contribution in all phases of the project, including data analysis and processing, is one of the key aspects of co-created CS projects such as CitieS-Health. However, the scale and variability of the data collected can present a challenge (60-75 variables depending on the user). Moreover, in discussion with participants in the planning and execution phase, it became clear that participants have very different interests and unalike perception on data processing. Therefore, a uniform report comprising all the topics and all the parameters might come across as too excessive and incomprehensible, at the risk of losing the desired information and consequently reducing the interest of volunteers in active participation. Moreover, as known form previous similar efforts [8], it has to be assumed that the reader is a layperson, and therefore information provided must be brief enough and concise, as too much information can create distraction. An alternative would be to send raw data to the participants, who would have to learn to use different data processing tools on their own, or the latter would have to be taken care of by researchers, which can be time consuming and not necessarily effective.

To overcome the aforementioned challenges, a web-based application was created for volunteers in Ljubljana pilot, which enables independent editing, visualization and analysis of data by participants, and thus their proactive involvement in discovering and generating of new knowledge.

2.3 Development of Web-based Application

2.3.1 Technical details. The application was developed using the R programming language, a free software environment for statistical computing and graphics, specifically the Shiny package. This environment allowed development of the application with relatively low effort and without using other languages (as the package translates the R code into HTML, CSS and JavaScript). Even though R applications are server side and are typically slow, this was not an obstacle, as the user count was sufficiently low. For reasons of data protection and privacy, the application along with the underlying databases was installed on internal institute's server. The application cleans, prepares and loads the data, and users only have access to their own data through password authentication. In this way, no data pre-treatment is needed from the participants' side, and they can proceed to immediate data processing.

2.3.2 Structure of the application. The application comprises the following four general sections: (i) the intro page, containing the overall instructions and overview of the application; (ii) data overview page, containing the overall activity summary, data tables, descriptions and graphs of individual variables, and their sleep quality assessment; (iii) data with spatial context, containing georeferenced information regarding movement patterns of the individual and noise measurements, overlaid with general maps of air and noise pollution; (iv) analysis tools, containing interactive plots allowing visualization and analyses of combinations of chosen variables. The latter comprises a boxplot/violin plot section, a scatterplot section, a radar chart section and a 3D plot section.

Following the principles of user-centred design, application was tested by three participants with varying degrees of knowledge. Their feedback and suggested improvements along with a smaller test group trial (15) helped us improve the usability of the application.

3 RESULTS

3.1 Functionality of the Web-application

In general, application enables three types of functionalities: Access to the raw data along with basic descriptive statistics, general data on the patterns of movement in space and sleeping habits, pre-processed by researchers, and specific tools for independent data processing (Figure 2). In this way, step-by-step approach is used, adding increased level of analytical complexity and dimensionality.

The main idea was to make the app straightforward and effortless for the users with no prior statistical knowledge. That's why it was designed with as few elements as possible to prevent cluttering and burdening the participants with too complex functions. Hence, some functionalities only became visible when relevant (example: the button to switch the confidence intervals on and off only becomes visible when the regression line is turned on). Moreover, the app was designed in a way that initial help sections are elementary and easily accessible (usually by hovering over a question mark or a mini tab besides the plots), with the option of deeper explanations on external links. Similar, as there were many variables to choose from, the feature of choosing between the main pre-selected variables (5 variables per argument) or all of them (between 60 and 75) was added.

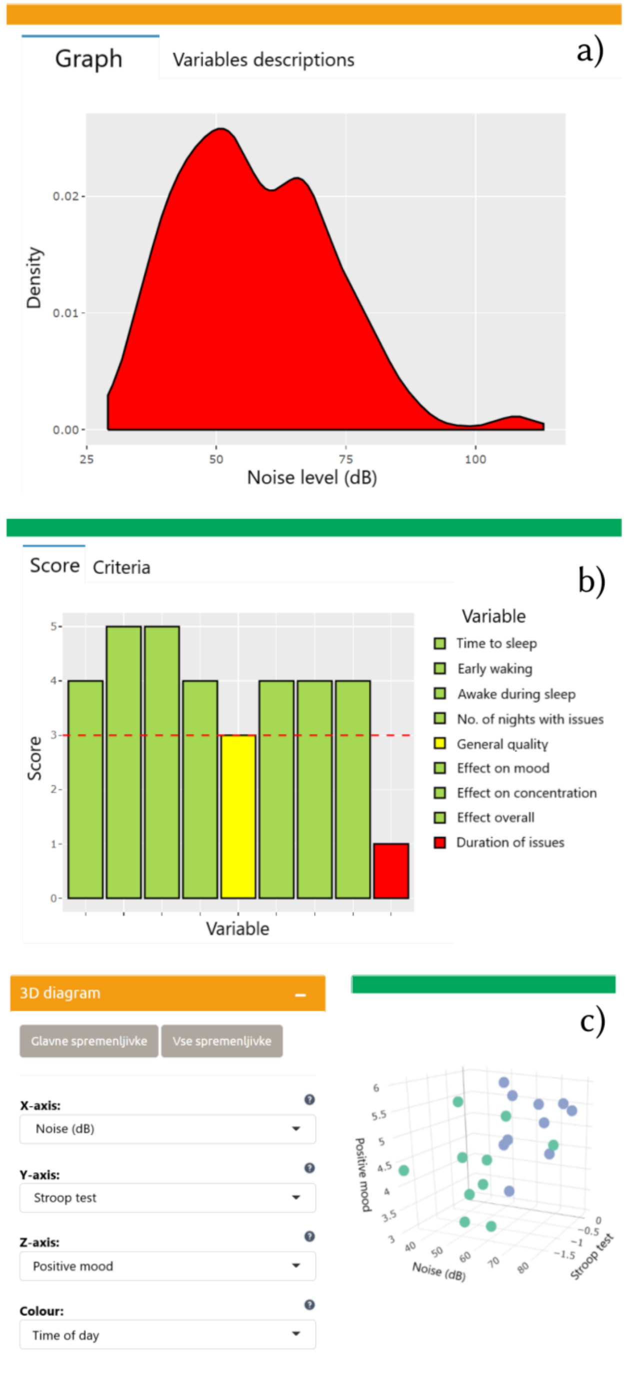

Figure 2: Examples of three types of functionalities: a) basic descriptive statistics b) general data pre-processed by researchers on general patterns of sleeping habits, c) tools for independent data processing

The primary advantage of this approach is that the users have the freedom to explore their own data, tailored according to their skills and interests. Initial descriptive statistics, general behavioural patterns and explanations are included to nudge the users in some directions, however the decision on which topics or variables they would focus is up to them. This approach offers more user-friendly experience than traditional paper reports, as it simplifies the experience and makes it more understandable for laypeople while it is not losing the professional and educational aspect.

3.2 User-experience Feedback

The results presented in this paper are preliminary in nature, as a more detailed analysis of the user experience will be evaluated in detail in the final phase of the project. However, based on the interactions with the volunteers involved so far, two general observations can be made. Lay volunteers show interest primarily in their own data and the level of their own exposure to environmental stressors, and are mostly interested in exposure to noise in the light of living habits, data on physical activity, and especially the quality of sleep. On the other hand, volunteers who have more experience with research, either within their profession or in general, recognize the added value of such tools. Among other things, it was proposed to expand the use of such an application for the continuous collection of a wider set of data in the living environment for the purposes of assessing the state of the environment, also as an aid to the work of inspection services and decision-makers.

4 CONCLUSION

The tool developed for the specific needs of the specific citizen science project described in this paper proves to be a very promising solution with the possibility of expanding its applications. Namely, it enables the interactive inclusion of lay people in data analysis, which gives them a personalized experience, maintains their engagement, and at the same time, in addition to creating new knowledge for the common good, users gain insight into their own living habits and quality of life. Its full potential however still needs to be explored. For this purpose, an evaluation will take place in the final phase of the project, where among others aspects of intellectual property, specifically if and to what extent participants perceive these aspects, as well as the possibilities of using newly acquired knowledge as a result of cooperation between researchers and volunteers acquired in the respective activities, will be analysed.

ACKNOWLEDGMENTS

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Overview of National Sources of Finance and Supports Available to Spin-Out Companies from Public Research Organizations *

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ABSTRACT

At Slovenian public research organizations numerous advanced technologies and know-how are generated, a lot of which have great commercial potential. One of the possible ways to bring these innovations to the market is by selling or licensing them to spin-out* companies established by the researchers, employed within the parent public research organization. However, the path to commercialization for the spin-outs can take a long time, mainly due to a lack of financial resources and the legal impossibility for the public research organization to participate in spin-off companies. Especially spin-out companies from the deep-tech fields require not only specific technical and business expertise, but also high capital investment. On the national level, there are available public sources of funding that can help companies in the initial phase. In general, these means are adequate for start-ups with no needs for special equipment, expensive materials, and highly qualified human resources, and so don't meet the financial needs of a deep-tech company.

In this paper, an overview of the existing financial initiatives, helps and sources of funds, which can be used to support spin-outs are given and some improvements are proposed that would make it easier for young spin-out to get off the ground and thus enable more effective transfer of deep-tech inventions and knowledge to the economy.

KEYWORDS

IP transfer, spin-out company, commercialization, financial initiatives, help, funds.

POVZETEK

Na slovenskih javnih raziskovalnih organizacijah nastajajo številne napredne tehnologije in znanje, ki imajo velik tržni potencial. Eden od možnih načinov komercializacije potencialnih inovacij je prodaja ali licenciranje spin-out**podjetjem, ki jih ustanovijo raziskovalci, zaposleni v matični javni raziskovalni organizaciji. Pot do komercializacije spin-out podjetja je dolga, predvsem zaradi pomanjkanja finančnih sredstev ter zakonsko onemogočenega sodelovanje javnih raziskovalnih organizacij pri ustanavljanju odcepljenih podjetij. Zlasti spin-out podjetja s področij globoke tehnologije zahtevajo poleg posebnega tehničnega in poslovnega znanja tudi visoke kapitalske naložbe. Na nacionalni ravni so na voljo javni viri financiranja, ki lahko pomagajo podjetjem v začetni fazi. Na splošno so ta sredstva primerna za zagonska podjetja brez potreb po posebni opremi, dragih materialih in visokokvalificiranih človeških virih, zato ne zadovoljujejo finančnih potreb odcepljenih podjetij s področja globoke tehnologije.

V tem prispevku je podan pregled obstoječih finančnih virov, uporabnih za podporo spin-out podjetjem. Predlagane so nekatere izboljšave, ki bi mladim spin-out podjetjem olajšale zagon in tako omogočile učinkovitejši prenos izumov in znanja s področja globoke tehnologije v gospodarstvo.

KLJUČNE BESEDE

Prenos IP, odcepljeno podjetje, komercializacija, finančna orodja.

1 INTRODUCTION

Knowledge and technology established at public research organizations in Slovenia are commonly transferred to the economy through the sale of the intellectual property rights, by licensing the technology to an existing company, or by setting up a new spin-out company. A spin-out is a new company established specifically to further develop and commercialize technology arising from the public research organization. The relationship between a spin-out company and its parent public research organization is in most cases based on a licensing relationship. The spin-out company is 100% owned by investors, of which at least one is a researcher in a working relationship with the parent public research organization.[1] Such an organization ensures the best possible and successful transfer of knowledge and close cooperation in the future.

Like all of the young companies, i.e. start-ups, the initial founding of a spin-out comes from the equity funding from founders also known as the 3F model (family, friends, and founders). A key difference between spin-outs and start-ups is the path to commercialization, which is much longer for spin-outs. A deep-tech spin-out usually aims to commercialize a complex product that acquires a long development and scale-up to manufacturing. The more complex the product, the more resources and time are required to bring it to the market. Before a young spin-out can generate sufficient revenues on the market and become attractive to outside investors, it has to live on various sources of funding, mainly public funding, which is commonly aligned with the needs of start-up companies and already established companies, but less suitable for deep-tech spin-outs. Commercialization of deep-tech technologies requires

* A company linked to the parent organization based on licensing relationships (the company is wholly owned by investors, at least one of whom is a researcher in an employment relationship at the parental organization).[1]**Napaka! Vira sklicevanja ni bilo mogoče najti.**

** Podjetje, povezano z matično organizacijo na podlagi licenčnih razmerij (podjetje je v celoti v lasti vlagateljev, od katerih je vsaj eden raziskovalec v delovnem razmerju v matični organizaciji).[1]

besides highly skilled personnel, the resources for expensive materials and specialized equipment. An excellent example of financial support to commercialize deep-tech technologies are the calls supported by the European Innovation Council (EIC), e.g. programmes Pathfinder, Transition, and Accelerator.[2] These calls allow the applicant, e.g. a spin-out company, to develop according to the innovative idea, to develop the appropriate marketing model, to elaborate and scale the new product up to pilot production and to find first customers. Coaching and specific meetings are organized to connect directly with the companies that are the potential end-users of the product or service to be developed. In this way, the pilot product can be transferred to a suitable industrial environment at an early stage of development, and based on the received feedback adapted and optimized. It should be noted that EIC calls are overcrowded with applicants and the success rate is very low, so very few spin-outs get this chance. It is clear that most action should be taken at national level first. A good national funding mechanism would be welcome to create a supportive environment also for spin-out companies in the deep-tech fields that bring particular innovation and specialized knowledge.

2 PUBLIC SOURCES OF FUNDING

For newly establishes Slovenian companies there are few means of funding especially through the Slovenian Enterprise Fund, which, together with SID Bank and with the support of the Ministry of Economic Development and Technology, offers a wide range of financial incentives and assistance. In the following subchapters, we summarized and reviewed the available public funding's in the terms of support for a spin-out company. Only the support important for spin-out companies is discussed, although there is additional support available for established businesses.[3]

2.1 Grants

The aim of support of grants is primarily for research and development activities that are in line with the national and/or EU programme and policy priorities. The grants enable some coverage of costs for human resources and certain investment activities. Support in form of grants can also be called by larger EU initiatives and independent bodies, such as EIT Climate KIC [4], EIT Digital [5], EIT Food [6], EIT Raw Materials [7] other EITs, Bio-based Industries (BBI) [8], etc.[3] The aim of the European Institute for Innovation and Technology (EIT) is to increase Europe's innovation capacity by nurturing entrepreneurial talent and supporting new ideas. To make this possible, the EIT sets up various Knowledge and Innovation Community, (KICs) specialized in different challenges, such as climate, digitalization, food, raw materials, energy, etc. One of their activities is also grants for start-ups. They offer business-oriented acceleration programmes and aim to prepare a company for greater growth in the region and make it investment-ready. Usually, numerous entrepreneurial training courses are offered to boost the business. These services are highly appreciated and help the new business to secure the best possible path. However, a lean spin-out, especially from the cutting-edge technology sector, usually does not have free human resources that can be used only for these tasks. Most deep-tech spin-outs see the biggest gap in raising the technology level of their innovative product, especially above TRL5 where the technology needs to be demonstrated and developed into the real product. Most deep tech inventions require a long and costly development to raise the TRL and make all the necessary adjustments and scaling. Very few options are available to finance these needs and the grants described are not very suitable although they are welcome.

2.2 Subsidies, loans, guarantees, and equity

These funds are derived from EU financial assistance to support EU policies and programmes in form of all types of loans to companies to invest in research and innovation. It also provides guarantees to help recipients get loans from banks and other lenders and on better terms. In Slovenia, these funds are mainly managed by Slovenian Enterprise Fund (SEF) and SID Banka.[3]

2.2.1. SEF Programme »YOUNG ENTERPRISES«

In the scope of a newly formed spin-out company, the Slovenian Enterprise Fund (SEF) offers the product Programme »YOUNG ENTERPRISES« for companies younger than 5 years. The purpose of the programme is to provide the initial financial support for entrepreneurial ideas and/or for already established young companies that have a guaranteed market and demonstrate the potential increase in added value per employee. The programme is primarily aimed at companies with a high share of their own knowledge, innovation, and the potential of creating products or services with high added value. It enables a comprehensive financial support adapted to development phases for young companies with initial support solely through public funds and subsequent public-private financing. There are few supports available in regard to the company's stage of development among which the most adequate for new spin-out is the start-up Incentives for innovative start-ups "SEF TWIN". It purposes the support of start-up companies with a potential for rapid growth and that develop innovative products, processes, and services with high added value for a broader market.[9]

The "YOUNG ENTERPRISES" programme is highly welcomed and appreciated by start-ups with innovative ideas that do not require much effort to reach the required TRL. Such examples include various IT -based services and interesting products that are high risk but can be developed to the development stage with relatively little funding. In contrast, cutting-edge technology areas typically require much larger investments in equipment, materials, and various human resources with specialized technical knowledge and skills. The time required for growth is usually much longer. It is very likely that most of these companies would not be able to sustain the financial incentives of the programme because of the time and resources required to grow rapidly to the stage where venture capital could be available.

In many cases, eligible costs serve almost exclusively IT -based start-ups and allow for the purchase of computers and related equipment, but not materials, such as chemicals, or special equipment needed to develop the new products. Nor can they fund the rental of laboratory space, which is urgently needed for the development of cutting-edge technology inventions. For this reason, the programme mainly includes SMEs with interesting but technologically relatively simple products, but not many spin-outs from research institutes and university operating in the deep-tech field of innovation. [10]

Another instrument implemented by the SEF are the substantive support programmes in form of vouchers such as Small Value Incentives, Content support for young innovative companies, and Abroad training for high-tech companies.[9] The support enables the financing of e.g. intellectual property protection, certificates of quality, internationalization costs, networking and information, fast-growth accelerator programmes. For example, the Patent, design, trademark vouchers are meant to cover the costs of preparing the application dossier and/or maintaining and/or extending legal protection for the intellectual property at national, European and international patent offices, including the costs of the patent attorney, official fees and translation costs. The available means are between 500,00 and 5.000,00 € for applications without substantive examination and between 500,00 and 9.999,99 € for applications with substantive examination. Based on practical experience this amount is enough to cover the cost from application till grand at individual national offices, such as the SIPO, UK IPO or at the European Patent Office (EPO).[10]

2.2.2. SID Bank Fund of Funds

The SID Bank Fund of Funds was set up in 2017 by the Ministry of Economic Development and Technology and SID Bank and is intended for the use of European cohesion funds. These funds are aimed at the financing of sustainable economic growth and, development, investments in innovation and current operations through debt financing in four areas: research, development and innovation, small and medium-sized enterprises, energy efficiency, and urban development. The Fund of Funds includes many repayable forms of financing, which are extremely welcome at later stages of development, i.e. at higher TRLs, especially after reaching TRL9. At this stage, a deep-tech SME is fully confident in its successful technology and knows exactly what investment is required to develop pilot production into real production and grow the business beyond early adopters and byers. The instruments managed by the SID Bank which can be of interest to spin-out companies are the (i) Loans to finance research, development, and innovation (RDI) (enable to cover the cost of development, improvement or launch of a new or improved product, process, or service, etc.) and (ii) Micro loans for SMEs (SME micro) (applicable to cover the costs of business process, investments in property, plant, and equipment). These instruments draw funding from the European Cohesion Policy funds and funds from financial intermediaries. However, for earlier TRL stages, the Fund of Funds is most likely too risky, especially for deep tech.[11]

2.3 Awards

Lower financial support is possible to be obtained through innovation prizes such as the Rector's Award for the Best Innovation at the University of Ljubljana [12], EIT Jumpstarter [13], EIT Awards [14], BASF Innovation Hub [15], etc. Such awards are important to raise awareness of the novelty and publicize the spin-out company, but too early notes could also mean too much of a push in a particular direction that could become a side track.

2.4 Benefits

The national Corporate Income Tax Act (ZDDPO-2) enables spin-out companies benefits in form of tax deductions which are possible to claim corporate income tax (CIT) tax deductions for 100% investment in research and development, investment in in-house R&D activities and for the purchase of R&D services, investment in equipment and intangible assets at 40 % of the amount invested.[16] It should be noted that these benefits do not include the investments made with the help of the projects, not even the part in which the company has to participate. This part ranges from 30% to 50% or even higher, depending on the financing arrangements of the instrument. This can be a large amount, especially for large investments in specialized equipment likely required by the deep-tech.

2.5 Non-financial forms of public aid

Non-financial forms of state aid are available through support environments and networks across Slovenia. They offer assistance mainly as services for potential entrepreneurs, and SMEs, such as technical assistance, advice, mentoring, guidance, workshops and training, competence building, opening up new business opportunities and exchanges of good practice.[3]

3 WHAT IS MISSING

3.1 Venture capital fund along the lines of the EIC

Support should be developed along the lines of the European Innovation Council (EIC), which is an example of good practice that should be transferred to Slovenia.

The steps needed to set up such a support would first and foremost require an appropriate legal basis, which is currently lacking - this could change with the new Research and Innovation Act, we are expecting soon. Furthermore, it is necessary to ensure coordinated action and support from funders - Slovenian Research Agency (ARRS), Public Agency for Entrepreneurship, Internationalization, Foreign Investments and Technology (SPIRIT), Slovenian Enterprise Fund (SEF), and other existing or future funders of such projects. In this way, coordinated and continuous funding of successful projects on the area of higher TRLs could be ensured, without interruptions in the (co-)financing of the development of a specific technology.

3.2 Innovation projects at national research agency – the new financial instrument to balance the basic science funds

To develop innovation at the scale required, especially for deep-edge technology, we need a new funding instrument. This instrument is best located at ARRS, which currently with the new law needs to upgrade its funding of science with innovation funding.

Beneficiary projects should be funded at a realistic cost of 100,000.00 € per year upwards (similar to the ERC Proof of Concept grants, which offer a lump sum of 150,000.00 € for a period of 18 months) [17], comparable to the projects and funding levels of typical basic research projects at ARRS. The Agency also finances the so-called larger research projects with higher funding. The allocation of funds for innovation projects should consider the real costs of the project and not a fixed amount which is current praxis for research projects. In view of the final added value that could be generated by the company with such support, the proposed sum is actually low. The number of innovation projects selected should be in line with the number of projects awarded for basic science at national level.

The envisaged financial support should finance promising research that has already been funded as a basic research project by the ARRS and as such should have priority for funding. This would achieve greater funding coherence and justify the rationality of funding basic research and ensure higher added value of funding that if serving just excellent science. Additionally, it would create systematic and continuous financial support in Slovenia from idea to market entry, especially in the field of deep-tech. This is a basic requirement for entering the innovation-based community and could bridge the gap between basic science and the start-up opportunities already available in Slovenia.

3.3 Other possibilities

In order to improve all opportunities to make our original deep-tech knowledge available to the economy, especially that generated by spin-out companies as a result of the pre-funding of basic research, we recommend that the other financial initiatives adopt some changes. To this end, the SEF programme "YOUNG ENTERPRISES" could make appropriate changes to support SMEs with more complex needs. It should also be thoroughly discussed whether the corporate tax deductions for investments in in-house R&D activities and for the purchase of R&D services and equipment during an R&D project are also possible for the part that the company has to co-invest through its own participation.

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Note: Researcher who wish to establish a spin-out company can acquire more information at the Technology Transfer Office of the parental research organization.

Application of 3D printing, reverse engineering and metrology

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ABSTRACT

Examples of transfer of knowledge in the field of 3D printing, reverse engineering, and metrology will be presented in this paper. The first chapter contains the description of the concept of the Learning Factory, within which knowledge is created and transferred to the economic entities in the environment. Technologies of 3D printing, reverse engineering, and metrology are subsequently described and various examples of development projects for the local industry are presented. A conclusion regarding the realized activities is given at the end.

KEYWORDS

3D print, reverse engineering, metrology, Learning Factory, transfer of knowledge

1 INTRODUCTION

The Learning Factory at the Faculty of Mechanical Engineering, Computing and Electrical engineering (FSRE) has the basic goal of enabling students to experience many problems that will be present in the production facilities where they will soon be operating. At the same time, the Factory also provides engineers from local companies with the opportunity to get acquainted with new technologies that were not present at the time they were studying.

The set goals are achieved through several projects: “Reconnecting universities and enterprises to unleash regional innovation and entrepreneurial activity” (Kno wHUB) and “Increasing competitiveness of micro, small and medium-sized enterprises through digitalization” (IC SMED). The main goal of the KnowHUB project is to build HUBs as a link between higher education institutions, the business environment and the wider community. The main goal of the IC SMED project is to increase the competitiveness of micro, small and medium enterprises with the help of digitalization. Through these projects, conditions have been established to help and support local businesses in the areas of 3D printing, reverse engineering, and metrology. Students, assistants, and engineers from local companies are introduced to 3D printing, 3D scanners and 3D scanning through practical examples. Also, they can actively participate in the development and adjustment of materials for the implementation of training and laboratory exercises, as well as in the organization of training, laboratory exercises and exercises on real examples. The practical work of printing and scanning objects is done in the premises of the Learning Factory.

*Article Title Footnote needs to be captured as Title Note

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2 3D PRINT, REVERSE ENGINEERING AND METROLOGY

2.1 Rapid prototyping - 3D print

Several 3D printers were procured at FSRE through the project.

• Stratatys F 270 is an industrial type of F123 series printer with FDM technology. It uses materials for model/support: PLA, ABS-M30, ASA, TPU, 92A/QSR.

• MakerBot Method X Carbon Fiber Edition uses carbon fiber reinforced material, ABS, ASA, SR30, PLA, PVA.

• Zortrax M200 Plus uses LPD/FFF printing technology. It uses dedicated M series material.

• Ultimaker 2+ is a small 3D printer that is programmed within the Cura software package. The software is easy to use and allows you to move objects, load multiple objects for printing, and change resolutions and other settings.

2.2 Reverse engineering in general

Modern manufacturing companies that want to maintain and improve competitiveness in the global market are forced to systematically update existing and find new ways to reduce operating costs in all aspects of their operations.

The process of transforming an idea into a functional product consists of a series of steps that in some cases can be iterated several times. Such a setting implies a significant expenditure of time and financial resources during the product development process, without a guarantee of a positive outcome of the entire process. These reasons were sufficient to try to find ways and methods of shortening the time of product development and spending financial resources related to the product development process in everyday engineering practice. One of the ways of reducing the time and cost of the new product development process is reverse engineering.

In a narrower sense, reverse engineering can be defined as the process of duplicating an existing component, assembly, or product, without the aid of a drawing, technical documentation, or computer model (Figure 1). In the context of the aforementioned, the technique of reverse engineering can be applied to analyze and study the internal working parts of the machine, for example, to compare the current device with the performed analyzes in order to obtain suggestions for improvement.

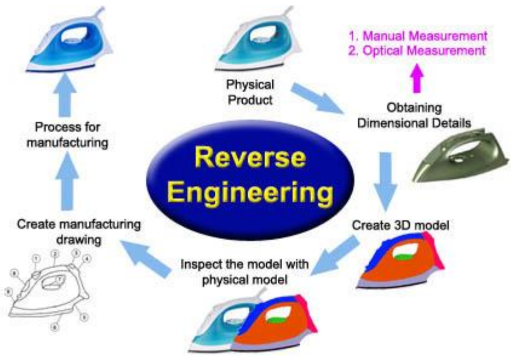

Figure 1. Reverse engineering process [1]

Unlike "classical" engineering design that starts from the abstract - the idea implies its elaboration through conceptual and then detailed CAD design, design based on the principles of reverse engineering begins with a physical object which is then translated into a CAD model, possibly adapted or refined and in the end manufactured by one of the CNC, that is, RP technologies [2].

2.2.1 Reverse Engineering and Metrology at FSRE In the "Learning Factory" at the Faculty of Mechanical Engineering, Computing and Electrical Engineering, within the KnowHUB project, several tasks related to the topic of reverse engineering were performed. 3D digitization, for example, scanning of workpieces is performed using the scanner GOM ATOS Compact Scan 8M. Processing is done within the GOM Inspect Suite 2020 software package, and CAD model generation is done using the reverse engineering tool Geomagic for SolidWorks.

2.2.1.1 GOM ATOS Compact Scan. A new class of compact 3D scanners for 3D metrology and control (Figure 2). Light, compact construction of the trigger probe opens new areas of application and provides adaptability for three-dimensional measurement of components such as cast and injection molded parts, cores and models, interiors, prototypes, and similar. Adopts blue light technology, combines scanning and measurement, adjustable measuring range, complete and portable measuring system, compact trigger probe with integrated control unit, etc.

Figure 2. 3D scanner within the FSRE Learning Factory

2.2.1.2 GOM Inspect Suite. GOM Inspect Suite is a comprehensive software package for simple or complex measured tasks during the entire quality control process - from 3D product scanning, polygon network editing, CAD model import, GD&T analysis, statistical trend analysis, digital editing, etc. (Figure 3)

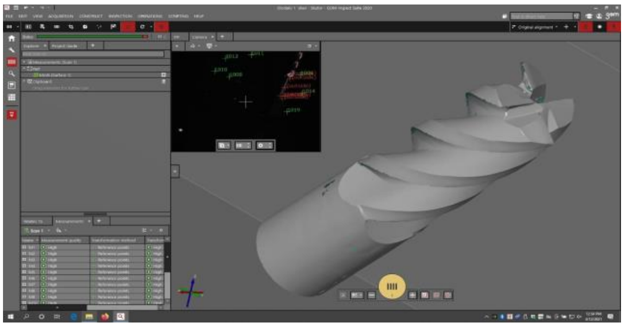

Figure 3. The appearance of the workspace inside the GOM scanning module

2.2.1.3 Geomagic for SolidWorks. Represents a set of software tools for reverse engineering that provides advanced capabilities for point clouds and polygon networks to become usable in the product construction and redesign process. Data can be imported or scanned directly into SolidWorks. Supports all major scanners and portable CMMs as well as importing standard point cloud and network formats.

2.3 Metrology in general

Metrology is a scientific discipline that deals with measurement in all its theoretical and practical forms. Basic metrology deals with the scientific assumptions of measurement, technical metrology covers the procedures and methods of measurement, and legal metrology covers the applications prescribed by law. Metrology includes all theoretical and practical aspects of measurement, deals with methods of measuring physical quantities, realization, and maintenance of standards of physical quantities, development and production of measuring instruments, and analysis of measurement results. Metrology has been developed to the level of applied science.

2.4 Integration of rapid prototyping and reverse engineering processes

With the help of the characteristics of the process of rapid prototyping and reverse engineering, the possibilities provided by their combination and adequate application provide numerous advantages that are primarily reflected in the ability to reduce time and reduce costs of product development/redesign, and in certain conditions in the production of tools and ready-to-use products. The integration of these approaches ensures the transition of the problem of transformation, that is, the translation of a virtual product from a digital form stored in the appropriate CAD software into a real tangible form-object and vice versa (Figure 4). Namely, reverse engineering ensures the generation of 3D CAD models based on a real object, and the model is transformed into a suitable real prototype/product relatively quickly and without significant human involvement by applying the process of rapid prototyping.

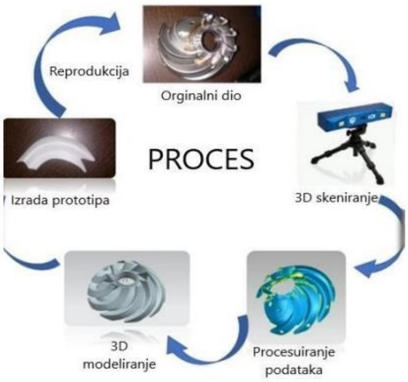

Figure 4. Integration process [3]

3 APPLICATION OF 3D PRINT, REVERSE ENGINEERING AND METROLOGY

Various examples of the application of 3D printing, reverse engineering, and metrology will be presented in this chapter.

3.1 Reverse engineering applied on metal joints for FSRE

The task aims to generate a CAD model (original geometry or redesign) of metal couplings with the intention of small series production (3D printing technology) for the needs of the "Learning Factory" if the prototype satisfies during testing (Figure 5).

All aforementioned elements were made with 3D printing technology after scanning and processing (Figure 6).

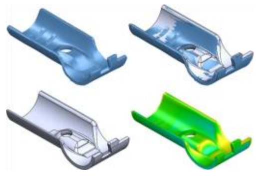

Figure 5. Reverse engineering on G-1S connector (polygonized mesh - scanned piece and CAD model - CAD model - deviation display)

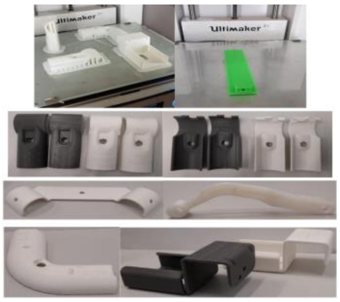

Figure 6. Scanned elements made with 3D printing technology

3.2 Reverse engineering on the example of a pulley for the local company “ZEC”

This task aimed to use reverse engineering to obtain the geometry of the pulley profile using a CAD model to make an equal part since the original part is frayed (Figure 7).

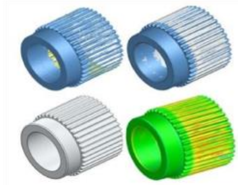

Figure 7. Scanned pulley, 3D model of the pulley and deviation display

3.3 Reverse engineering on the example of a part of a plastic injection tool for a local company “Weltplast”

The task aims to generate a 3D model of a part of a plastic injection tool since the original part is frayed (Figure 8).

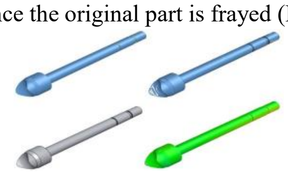

Figure 8. Reverse engineering on a part of a plastic injection tool

3.4 Reverse engineering on the example of dental spoons for the local company "MA-COM"

This task aims to create a CAD model (and technical documentation) of dental spoons for taking dental impressions (Figure 9).

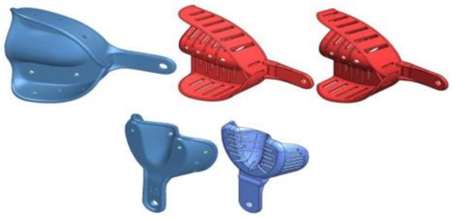

Figure 9. Scanned spoons U1 and U4 and redesign of the spoon

3.5 Reverse engineering applied on a lever for the company "SIK"

The task aims to create a new lever with 3D printing technology using the process of reverse engineering (Figure 10).

Figure 10. Reverse engineering on a lever

3.6 Reverse engineering applied to the pool shutter

The task aims to create documentation based on a damaged shutter and then create a new part by reverse engineering and 3D printing.

In this specific case:

- No spare parts on the market
- No shutter drawing
- No tools for making shutters

Shutter requirements:

- Must be made with 3D printing
- The material must be elastic due to the installation requirements
- The material must be resistant to sunlight

A drawing of the shutter in SolidWorks and a prototype of the shutter obtained by 3D printing are shown in Figure 11.

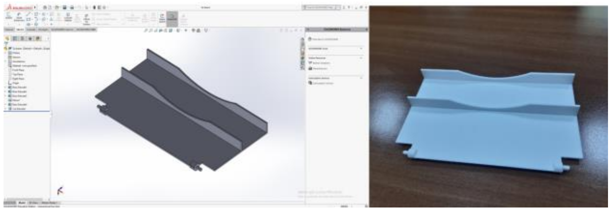

Figure 11. Drawing of the shutter on the pool and a prototype of the shutter made by 3D printing

3.7 Metrology applied on a milling cutter for the company "Škutor"

In the FSRE Learning Factory, several tasks related to the topic of metrology were performed.

The objects that have to be measured were first subjected to a scanning process performed using a GOM ATOS Compact Scan 8M scanner. The measurement process itself is performed within the GOM Inspect Suite 2020 software package within the measurement module [4].

The task aims to determine the dimensions of cutters with a diameter of Ø20 and Ø12 and to prepare accompanying documentation ((Figure 12).

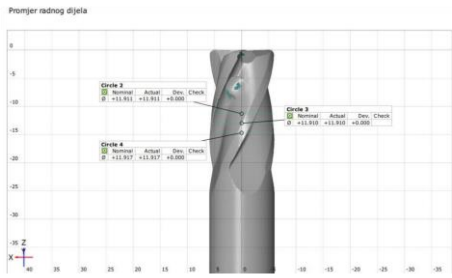

Figure 12. Display of the measurement report page

4 CONCLUSION

The technology of rapid prototyping with 3D printing in combination with a 3D scanner and appropriate software using reverse engineering can significantly speed up the path to the finished product, which is extremely important for relevant companies.

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Towards the Market: Novel Antimicrobial Material

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ABSTRACT

The Jožef Stefan Institute has developed novel antimicrobial nanogold composite and patented it (EP2863751 B1). In comparison with widely used silver, the material is less toxic to human and environment and has better antibacterial properties. Good antiviral effect has also been shown. In the period 10/2020-04/2021 the technology for applying this material on textile has been developed within KET4CleanProduction project. This was an important step towards higher TRLs. Before entering the market, the novel material must be tested according to Biocidal Product Regulation (EU No 528/2012). This includes toxicity and efficacy testing and submission of the dossier to European Chemical Agency. In order to successfully enter the market, suitable industrial partner which will scale up the production of the material and commercialize it is needed. Horizon Europe calls represent interesting financial tool to support this endeavour to reach higher TRLs.

KEYWORDS

technology transfer, antimicrobial material, gold, proof of concept study, technology readiness level

POVZETEK

Institut "Jožef Stefan" je razvil nov protimikrobni kompozit na osnovi zlata in ga patentiral (EP2863751 B1). V primerjavi s široko uporabljenim srebrom je material manj strupen za ljudi in okolje ter ima boljše protibakterijske lastnosti. Dokazan je bil tudi dober protivirusni učinek. V obdobju 10/2020-04/2021 je bila v okviru projekta KET4CleanProduction razvita tehnologija za nanašanje tega materiala na tekstil. To je bil pomemben korak k višjim stopnjam TRL. Pred vstopom na trg je treba novi material preskusiti v skladu z Uredbo o biocidnih proizvodih (EU št. 528/2012). To vključuje testiranje toksičnosti in učinkovitosti ter predložitev dokumentacije Evropski agenciji za kemikalije. Za uspešen vstop na trg je potreben ustrezen industrijski partner, ki bo povečal proizvodnjo materiala in z njem vstopil na trg. Razpisi programa Horizon Europe predstavljajo zanimivo finančno orodje, ki podpirajo tako prizadevanje za doseganje višjih stopenj TRL.

Information Society 2021, 4–8 October 2021, Ljubljana, Slovenia

KLJUČNE BESEDE

prenos tehnologije, antimikrobni material, zlato, študija preverjanja koncepta, stopnja tehnološke zrelosti

1 INTRODUCTION

In year 2012 DDr. Marija Vukomanović published her second PhD thesis with title 'Sonochemical synthesis and characterization of hydroxyapatite/metal-based composite materials for biomedical applications' which represented the work performed at the Advanced Materials Department, Jožef Stefan Institute [1]. Furthermore, the research group identified an invention that was made within this work – a novel antimicrobial material and its production method. Together with the Institute's Center for Technology Transfer and Innovation technology and market potential was evaluated. In the same year, a Slovenian patent application was filed. Due to high potential of the technology a PCT application was filed next year and in the beginning of 2015 an entry in European phase was made. In the period 2015-2018 European patent office examined the patent application and expressed their opinion about patentability. Necessary modifications of the claims were made and the European patent EP2863751B1 was granted in 2018 and no opposition has been filed afterwards [2].

2 ANTIMICROBIAL MATERIALS

Novel trends in developing antimicrobial technology are associated with the use of multifunctional nanosystems. The challenges for the use of nanotechnology are focused into: (i) nanoparticles loaded with antimicrobial substance(s) able to control their release and (ii) "nanoantibiotics" – nanoparticles with antimicrobial nature. The main drawback of the first strategy is dependence of the released substance on the properties of the carrier that provides conditions potentially favourable for bacterial resistance. The second strategy is based on the development of novel antibacterial nanoparticles and it has been applied for many different materials including silver, copper-, titanium-, zinc-, cerium- oxides, doped hydroxyapatite, carbon nanotubes, NO-releasing nanoparticles, fullerenes and clay nanoparticles. Among all of the listed materials, silver is the most economic and most effective in action against various bacterial stains. However, as for the silver, the majority of listed materials are leaching and they release active component (particularly reactive oxygen species) which provides action against bacteria. The mechanism is highly non-selective and has the very similar contribution to the death of bacterial cells as to the death of mammalian cells. Even composites with bioactive component (like apatite) do not mitigate toxic effect of silver and selectivity indexes remain quite low [3].

Contact- based antimicrobials, designed to perform antimicrobial action without leaching any active substance, are exceptional solution for above described problem. Mainly designed as functionalized polymers, contact-based antimicrobials usually contain high density of charged functional groups (i.e. quaternary ammonium compounds, alkyl pyridiniums, or quaternary phosphonium). They use multiple charges to attach and interact with bacterial membranes providing their disassembly. As observed in antimicrobial peptides and polymers, the main limitation of these systems is low chemical stability, pronounced susceptibility to enzymatic degradation and conformational changes induced by environmental stimuli. These are very good targets for potential inactivation mechanism that will lead to losing their antimicrobial potential.

Innovative contact-based antimicrobials, based on functionalized gold, invented by our group at the Advanced Materials Department, Jozef Stefan Institute, is a step ahead in comparison to the common contact-based antimicrobials and very promising alternative (Figure 1) [4]. They use surface-associated guanidinium groups to physically disintegrate bacterial cells. Bactericidal effect is enabled in a range of gram + and - bacterial strains and is associated to the surface potential of bacterial membranes. Due to bioinert gold and natural-sourced functionalizing agents, concentrations toxic to human and animal cells are up to 20 times higher than biocidal, confirming high selectivity. In addition, since they are functionalized using direct bonding of charged, small molecules to the surface on nanoparticles (rather than formation of long polymeric chains) they keep their stability under different environmental stimuli, including presence of enzymes. With better stability and safety, the novel kind of contact-based antimicrobials is overcoming general difficulties with common contact-based antimicrobials and significantly decreases possibility for inactivation.

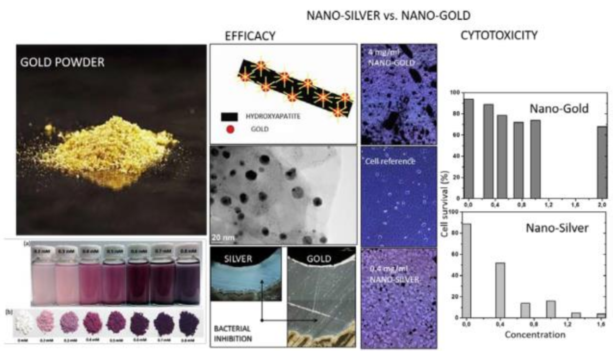

Figure 1: Current state of the invention: gold powder its efficacy and cytotoxicity in direct comparison to nano-silver.

3 TOWARDS HIGHER TRLS

3.1 Initial steps in finding R&D partners

After filing the priority Slovenian patent application for the novel antimicrobial material first attempts to establish connections with relevant industry partners have been made. These efforts have been enhanced by the Center for Technology Transfer and Innovation (CTT) after the European patent was granted.

CTT has used several channels and media to promote the invention and find suitable partners to reach higher TRLs. The initial step was to publish technology offer in Enterprise Europe Network, which is the largest brokerage network for companies (SMEs and others), research institutes and universities. It brings together 3,000 experts from more than 600 member organizations from Europe and beyond [5]. The technology offer is published for maximum two years and has to include information about the technology, owner organization, advantages and innovation, information about partner sought, cooperation type and keywords. Enterprise Europe Network includes also topic specific groups, called Sector Groups. The invention was presented and promoted in SG Materials in which we also have a member.

In 2018 the innovation was presented at the International Exhibition of Inventions ARCA, Zagreb Croatia with the help of partners from the Slovenian Consortium of Technology Transfer (Figure 2). A silver medal was awarded for this innovation [6]. This contributed to general promotion of the invention.

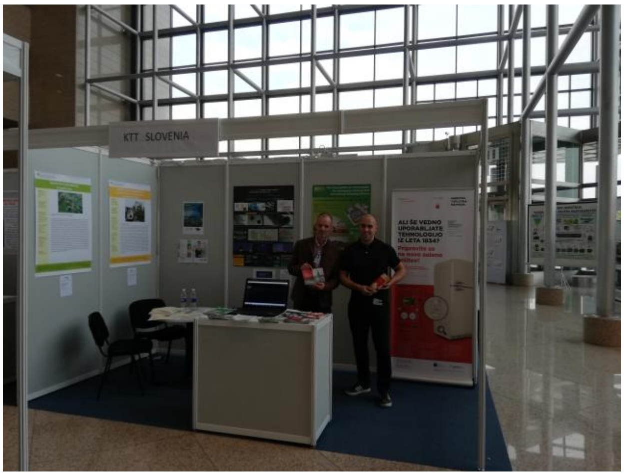

Figure 2: Presentation of inventions at the International Exhibition of Inventions ARCA, Zagreb, Croatia.

As antimicrobial materials can be applied in many different fields (cosmetics, medical devices, plasters, filters, paints, dentistry, textile etc.) it was hard to decide and look for a partner from specific industry so we decided to make a broad search of partners for different applications. We contacted producers of implants and other medical devices, filters, toothpastes, medical plasters, plastics, seats, which represented the entities nearer to end user in the value chain of antimicrobial materials. This resulted in scarce response. Additionally, we contacted also companies that produce active antimicrobial component and companies that produce antimicrobial mixtures – masterbatches. Sometimes these two activities are performed by the same company. We received an important feedback from UK masterbatch producer about the relevance of Regulation (EU) No 528/2012 also named Biocidal Products Regulation – BPR [7]. They told us that if we want to enter European market with novel antimicrobial component, we have to perform the necessary toxicity and efficacy tests. They estimated costs for a new BPR product registration to > 1 million €.

3.2 EU Biocidal Product Regulation

Although the regulations often limit the entry of new technologies on the market due to its high costs it is important to confirm the safety and efficiency of the technologies in order to provide long term benefit for the society.

Regulation (EU) No 528/2012 concerning the making available on the market and use of biocidal products was accepted by the European Parliament and Council on 22 May 2012 and is successor of Directive 98/8/EC. BPR concerns biocidal products, which are used for protection of people, animals, materials or products against pathogen organisms like bacteria, viruses or fungi and comprise active component. The aim of this regulation is to improve the market of biocidal products in EU and provide high level of safety for humans and environment.

For each biocidal product or its active component, it is necessary to acquire permission, before it can be placed on market. The active components can be available on the market in some occasions also during the procedure of their registration. The regulation aims to simplify and unify the procedure for EU member states. It also aims to maximize the sharing of available data and minimize the amount of tests on animals.

Novel biocidal active components and biocidal products are submitted to European Chemical Agency – ECHA and national authorities (i.e. Chemicals Office in Slovenia). The data is managed and available on the Register for Biocidal Products (R4BP 3). Another IT tool, IUCLID, is used for preparing the applications.

According to Annex II of BPR the tests performed for registration of any new active substance should comply with the relevant requirements of protection of laboratory animals, set out in Directive 2010/63/EU of the European Parliament and the Council of 22 September 2010 on the protection of animals used for scientific purposes and in the case of ecotoxicological and toxicological tests, good laboratory practice, set out in Directive 2004/10/EC of the European Parliament and of the Council of 11 February 2004 on the harmonization of laws, regulations and administrative provisions relating to the application of the principles of good laboratory practice and the verification of their application for tests on chemical substances or other international standards recognized as being equivalent by the EU Commission or the ECHA. Tests on physic-chemical properties and safety-relevant substance data should be performed at least according to international standards.

Due to high standards needed for the tests, these are very expensive. The tests are performed stepwise and in dialog with ECHA. Some tests are then performed only if the results of first set of tests are not satisfactory or ECHA decided they are necessary. The amount of tests also rises for nanomaterials, which might involve additional risk.

As the procedure to prepare and submit the data, needed for registration of novel active component is very demanding and extensive, companies often employ consultants to manage this procedure. For this reason, we also contacted such consultant companies to see, how we can use their support. They informed us is that the first step is to perform Data Gap Analysis, where existing data is reviewed and a list of necessary further tests to be performed is made. Preparation of this document costs 10.000-30.000 €. We received different information for the costs of toxicity and efficacy tests according to suitable standards, which varied between 0,5 and 3 million €. The ECHA fee for application of novel active substance is 120.000 €, whereas there are additional fees for registration of biocidal products, which is additional procedure performed at ECHA and national agencies of countries, where the biocidal product is to be placed on market. Management, registration procedure and communication with ECHA, which is done by consultant companies costs 150.000-480.000 €. Due to high costs, companies that want to place novel biocidal products also form a consortium and jointly finance this procedure. Only the applicant that submitted results of tests can make reference to this data. If another company wishes to place such product on the market and hasn't performed any procedure at ECHA or national offices, they have to purchase a license to make reference to already submitted data. This creates a specific situation on the market, similar to patent system.

3.3 Proof of Concept study on textile

In the frame of Interreg project KETGATE CTT and partners organized brokerage event for SMEs and research organizations from Central Europe [8]. Due to COVID-19 pandemic it took place online in May 2020. 124 participants attended short 1:1 meetings. We had a meeting with Hungarian textile producer, which uses silver to prepare antimicrobial clothes. We introduced them our invention and they were interested to investigate the possibility to apply our material on their textile products. Due to relatively low TRL (at that time TRL4) and high risk associated with the material, we had to find a financing program for this kind of cooperation. The call KET4CleanProduction offered Proof of Concept study for SMEs which wanted to use Key Enabling Technologies, developed at the research organizations. The KET4CleanProduction was a Horizon Europe project with its own fund of 2 million € for the call, that was open in period 2018-2020 and granted projects received 50.000 € of lump sum. In the KET4CleanProduction network we also identified suitable partner for this Proof of Concept – a Portuguese textile institute – and the project was granted [9].

In the period 10/2020-04/2021 the project to apply the Au/apatite nanoparticles on textile took place. The nanoparticles were synthesized and sent for further application – deposition on textile. For the functionalization of the cotton textile, one of the suitable method was found the most efficient one in terms of yield of the functionalization, leading to higher amounts of nanoparticles bonded to the textile substrate. Textiles (cotton) obtained after single washing were confirmed to have bacteriostatic effect in *P. aeruginosa*, as Gram negative strain, and strong bactericidal effect in Gram negative *E. coli* and Gram positive *S. epidermidis* and *B. subtillis* (Figure 3). Antimicrobial effect was detected on contact with textiles; it followed contact-based mechanism of Au/apatite nanoparticles and confirmed their very stable bonding to the cotton textile. The gold-based nanoparticles also showed high antiviral activity, even at low concentrations.

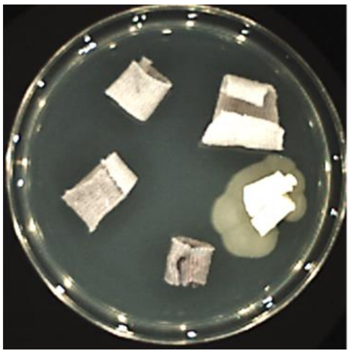

Figure 3. Antibacterial test on Au/apatite nanoparticles bound to textile.

3.4 Horizon Europe project

The KET4CleanProduction project represented strong support to reach higher TRLs. It proved that the novel antimicrobial can be applied on end product and still keeps its excellent antimicrobial function. This project paved further way towards entry of the novel material on the market. We identified next three tasks that needed to be performed in the following steps:

- Testing the toxicity and efficacy (antibacterial, antiviral, etc.) of the composite nanogold material and preparation of the documentation according to the Biocidal Product Regulation (EU 528/2012)
- Development and optimization the technology for textile application and for other relevant applications
- Scaling up the nanogold composite production process

In order to reach planed goals, we had to (i) find suitable partners and (ii) get a funding on the scale of few million €. When the end of previous period for EU financing was approaching, new set of large R&D funding package for 2021-2027 - Horizon Europe - was announced. We identified suitable call for our plan: HORIZON-CL4-2021-RESILIENCE-01-20: Antimicrobial, Antiviral, and Antifungal Nanocoatings (RIA) [10]. Activities within the project are expected to start at TRL 3 and achieve TRL 6 by the end of the project. The budget of the call is 23 million € and it is expected to fund 4-5 projects. The deadline is in the end of September 2021. This call is directly related to the well-being of citizens in the context of COVID-19 virus pandemic. It aims to minimise the risk of spread of infections from harmful pathogens arising from everyday human activities; and create a healthier living and working environment and offer holistic solutions to people with health issues. The research should focus on sustainable synthesis of nanocoatings/nanocomposites with effectiveness against a range of pathogens.

We decided to keep the consortium created in KET4CleanProduction and add new required partners. We contacted different antimicrobial active component producers and received higher interest, presumably due to demonstrator on textile and a plan regarding the Biocidal Product Regulation. We also contacted different companies – producers of high traffic objects, where antimicrobial materials need to be applied. Currently 10 partners are forming consortium which is about to be finalized and project plan submitted.

The project is expected to have an important impact on prevention of spreading of already known and novel pathogens (bacteria, viruses, fungi, etc.) by limiting their transmission through different surfaces. In the first place, the project will provide demonstrators on face masks, hospital linen, protective clothes, textile handles for public transport, pull handles for doors or textile sheath for pull handles, paper for everyday use, banknotes, passport, plastic covers for door handles, working surfaces in healthcare sector (i.e. hospitals) and areas where food is prepared. Furthermore, it will explore the opportunity to include it in the antimicrobial masterbatches, which can be used for wide variety of end products. The demonstrators will pave the way to other possible usage of novel antibacterial material based on gold as the demonstrators of the project will include various materials like cotton; different polymers such as polyester, polypropylene, polyamide; cellulose; mineral composite; metals etc. This will enable the opportunity to relatively easily apply it also on other products in the hospitals, long-term care facilities, public transport, public offices, restaurants and bars, sport facilities, shopping centres, cinemas and theatres as well as other places frequently visited by general public. The efficiency of the novel material among wide range of pathogens including bacteria, fungi, viruses and yeast will be evaluated. Special emphasis will be given to virus SARS-CoV-2 including its latest variants.

The longterm vision is that a French manufacturer of composite materials will sign license agreement with JSI, start to produce the novel gold composite on industrial level, register it at the ECHA and enter the market with it. Producers of different antimicrobial products, members of the consortium shall be first clients and further promotion will be made to successfully increase the sales share.

ACKNOWLEDGMENTS / ZAHVALA

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ABSTRACT

The paper informs on current state and future prospects of technology transfer in Belarus. It outlines legislation in the field of technology transfer; key features of the research and development system; system and instruments of technology transfer; structure and mission of the Republican Centre for Technology Transfer, the Business Cooperation Centre "Enterprise Europe Network Belarus" and its services provided to innovation activity agents. Finally, the recommendations are given to improve legislation in the field of technology transfer in Belarus.

KEYWORDS

Technology transfer (TT), legislation, public research organizations, intellectual property rights (IPR), spin-off, R&D contracts

1 INTRODUCTION

Belarus is a country with 9,5 million inhabitants, 451 public R&D organizations (PROs) and 25600 research personnel. The structure of research personnel remains practically unchanged: researchers – 65,2%, technicians – 6,5%, support personnel – 28,3% [1, 2].

Belarus is a small, open, upper-middle income economy. The country is not well endowed with natural resources. It largely relies on imported energy and raw materials and has a historical specialization in processing. The main activities of Belarusian industrial sector are engineering (agricultural technology and specialized heavy vehicles), potash fertilizers, and refining (which relies on oil supplies from Russia). These sectors depend heavily on external demand. Trade openness is among highest in the region, with a ratio of merchandise exports to GDP of 48% in 2020 (52% in 2019) [2].

Belarus is ranked 64th in the Global Innovation Index 2020 [3], that is eight places up from the 2019 and 22 places higher than in 2018. Belarus has demonstrated progress in a number of indicators reflecting the practical results of innovations in the production sector. Belarus highest rankings were in Human Capital and Research (37th place), Infrastructure (46th place), and Knowledge and Technological Output (58th place). The achieved results are due to the constant improvement of legislation in the field of technology transfer (TT).

Information Society 2021, 4–8 October 2021, Ljubljana, Slovenia

2 THE LEGISLATIVE CONTEXT

The purpose of the legislation and policies of the Republic of Belarus in the field of TT is to facilitate the transfer of technologies developed with government funding in order to ensure sustainable growth of national economy and to increase competitiveness of local products [4].

Currently, Belarus has more than 50 regulatory legal acts related to TT.

The analysis of Belarusian legislation shows that it regulates the following relationships in the field of TT:

1. Public funding of fundamental and applied research
2. Transfer of developed technologies to state enterprises and organizations
3. Transfer of developed technologies to enterprises and organizations with a mixed form of ownership, small business, and foreign firms
4. Dissemination of information in the field of TT
5. Establishment of organizations related to TT (technology transfer centers, science and technology parks, venture capital organizations)
6. Ownership of inventions and remuneration for using the inventions.

In recent years the government expenditure on R&D in Belarus was at 0,45% of GDP [2]. In the next five years Belarusian economy and science are faced with the task of reaching R&D financing of 1% of GDP.

While allocating public funds for applied research to contactor the state enterprise is simultaneously assigned to commercialize anticipated research results. If, for some reason, the state enterprise is not using the developed technology or product, the contractor is obliged to pay back the allocated funds to the state budget.

Every year Belarusian PROs create over 400 new products and technologies for commercialization at state enterprises [1, 2]. The plan for this year is to introduce about 470 new technologies and products.

After Belarus gained independence in 1991, the first normative act regulating the acquisition of property rights on the results of scientific and technical activities and the disposal of those rights was the Presidential Decree No. 432. According to it, property rights resulted from research subsidized (in whole or in part) by public funds were obtained by the state. The IP right holders could be a government customer and (or) a research contractor – PRO. Legal practice showed that de facto, the state retained ownership of IP rights and consequently research contractors were not interested to commercialize them.

In 2013, the Presidential Decree No. 59 approved new Regulation on the commercialization of the results of scientific and technical activities created at the expense of state funds, which expanded opportunities for research contractors to obtain rights on results of R&D activities. Still, in spite of the amendments made to Decree No. 59 in 2018, the legal procedures to obtain IP rights remain overly complex and unwieldy. Research contractors do not have "the right to risk", due to the requirement to pay back funds in case of failure to commercialize the developed technology of product. Since the state retains the IP rights the transfer of technologies developed with government funding to private enterprises and foreign companies is carried out not through the sale or licensing of IPR, but under commercial agreements with technical assistance, research and technical cooperation agreements, and joint venture agreements. For the same reason the Belarusian PROs don't create spin-offs.

The Belarusian law on patents for inventions, utility models and industrial designs was amended several times [5]. This law regulates the property and associated personal moral relations arising in connection with the creation, legal protection and use of inventions, utility models, and industrial designs. The legislation is in harmony with international treaties and, in principle, it enables the protection of intellectual property objects of domestic and foreign entities. In addition, some government decrees have set the legal framework for the sharing of royalties and other IPR incomes between inventors and employers [1]. According to legislation, remuneration is paid in the amount and on terms specified in agreements between the employee and the employer – the minimum level of remuneration shall be determined by the Council of Ministers of the Republic of Belarus [6].

Legislation doesn't limit maximum remuneration to authors (co-authors) for the created objects of industrial property rights. If the employer decides to keep an invention as a secret know-how, then the reward for the creation of objects of industrial property rights to authors, co-authors and individuals should be paid as a lump sum within three months of employer's decision. Businesses may combine both options: keep some inventions secret and patent the other abroad (e.g. innovative export products). The inventor should be compensated equally regardless of the option.

The dissemination of information in the field of TT is regulated by the Law of the Republic of Belarus No. 250-Z "On scientific and technical information" dated 05.05.1999, and the Law of the Republic of Belarus No. 170-Z "On state secrets" dated 19.06.2010 [7, 8].

The establishment of organizations related to TT regulates the Presidential Decree No. 1 "On approval of the Regulations on the procedure for creating subjects of innovation infrastructure and amendments and additions to the Decree of the President of the Republic of Belarus dated September 30, 2002, No. 495" dated 03.01.2007 [9]. According to it, the center for technology transfer (CTT) is an organization with an average number of employees up to 100 persons, tasked to ensure the transfer of innovations from the sphere of their creation to the sphere of practical use. A scientific organization with a separate TT subdivision with at least 7 employees can also be recognized as CTT, and use all privileges and advantages granted to CTT by law. In Belarus CTTs are not funded from the state budget.

3 THE REPUBLICAN CENTRE FOR TECHNOLOGY TRANSFER

The Republican Centre for Technology Transfer (RCTT) was established in 2003, under the aegis of the State Committee on Science and Technology of the Republic of Belarus, the National Academy of Sciences of Belarus, the United Nations Development Programme and the United Nations Industrial Development Organization [10].

RCTT's primary goal is to facilitate transfer of technologies developed in Belarus and abroad for sustained growth of the country's economy and increase the competitiveness of Belarusian industry and agriculture, provide advice to CTTs in the country.

Tasks set for RCTT:
- create and maintain information databases meant for serving clients in the technology transfer sector;
- provide RCTT clients with access to foreign technology transfer networks;
- assist innovation activity agents in development and promotion of their innovation and investment projects;
- train specialists in research- and innovation-related entrepreneurship;
- establish RCTT offices across the country, to create a unified national network of technology transfer centers;
- promote international technical and scientific cooperation and exchange of experts.

RCTT is a consortium with the headquarters in Minsk. It's made up of:
- 5 regional offices and 30 branch offices at research organizations, institutes, universities, enterprises in Brest, Vitsebsk, Homel, Hrodna, Lida, Minsk, Mahileu, Novapolatsk and other cities and towns across Belarus;
- 91 foreign partners in 23 countries: Armenia (3), Azerbaijan (2), China (25), Denmark (1), Great Britain (2), Germany (4), Georgia (1), India (1), Iran (1), Italy (1), Lithuania (1),

Moldova (1), the Republic of Korea (4), Poland (3), Kazakhstan (6), Russia (19), the USA (2), Sweden (1), the Republic of South Africa (1), Uzbekistan (2), the Czech Republic (2), Ukraine (7), Vietnam (2).
- 2 overseas field offices.

RCTT staff is a certified member of 12 technology transfer networks, in particular, Russian Technology Transfer Network (since 2004), yet2.com (since 2005), AUTM (since 2012), Enterprise Europe Network (since 2015) and others.

RCTT offers its services to innovation activity agents in Belarus as well as foreign companies and investors.

RCTT has a web-portal (https://ictt.by), with several subject sections and databases such as: "Virtual exhibition of the NAS of Belarus"; "Catalogue of innovation offers by organizations of the NAS of Belarus"; "New partnership opportunities", to present in real-time offers and requests from RCTT, EEN, and AUTM networks; "Catalogs"; "Manuals"; "Investment and venture funds"; "Crowdfunding"; "IP auctions"; "IP insurance"; "Legislation" covering the laws and regulations applicable to innovation activity in Belarus and foreign countries; "Technoparks of Belarus", and others.

RCTT provide services to more than 250 Belarusian state organizations, private enterprises and individuals. The National Academy of Sciences, Belarusian State University, Belarusian National Technical University are among the centre's clients. With the support from RCTT in 2003–2020 more than 6200 Belarusian specialists have been trained and instructed in various fields of technology transfer at 510 local and international workshops, seminars and exhibitions.

RCTT was involved in implementation of more than 30 international projects related to improving the competencies of researchers and representatives of small and medium-sized businesses funded by UNDP, UNIDO, FP7, Baltic Sea Region Programme, CEI, Latvia, Lithuania and Belarus Cross Border Cooperation Programme, The Swedish Institute, Chinese Government and others.

Since 2015 RCTT is a coordinator of the project "Creation of the Business Cooperation Centre "Enterprise Europe Network Belarus" (BCC "EEN Belarus")". The aim of the project is to encourage the provision of services to support cross-border business cooperation, technology transfer, and research collaboration on the basis of mutual benefit via the Enterprise Europe Network.

4 FURTHER DEVELOPMENT

The 18 years of RCTT work experience show that to improve commercialization of technologies developed with government funding in Belarus, it is necessary to develop and adopt:

1. a law similar to Bayh-Dole Act;
2. legislative acts that will allow the contractor to restrict access to research results and inventions if public disclosure could damage commercial interests;
3. legislative acts requiring inclusion into job description of employees of all state organizations engaged in R&D the obligation to engage in TT, and the administration of organizations to take into account TT activities when assessing the work of employees;
4. legislative acts stimulating the transfer of technologies developed with government funding to small businesses ("gratuitous" transfer);
5. legislative acts stimulating the creation and funding of TT organizations (departments); and
6. introduce the technology transfer course into the curricula of higher educational institutions.

5 CONCLUSIONS

This paper provides an overview of the current state of technology transfer in Belarus. It highlights several legal issues that need to be addressed in the future to make technology transfer more efficient.

ACKNOWLEDGMENTS

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[8] Law of the Republic of Belarus of June 19, 2010 No. 170-3 "On State Secrets" (as amended on December 10, 2020).

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DODATEK / APPENDIX

ITTC 14

14th International Technology Transfer Conference

LET'S INNOVATE THE FUTURE

INTRODUCTION AND AIM OF THE CONFERENCE

Conference topic: how to survive the valley of death?

How to enable investors in early stage deep tech ventures: buying a lottery ticket vs building the jackpot?

How to integrate the PoC funding in the national and regional innovation ecosystem?

What is the role of TTOs, PROs, governments and industry in the setting up a successful PoC funding scheme?

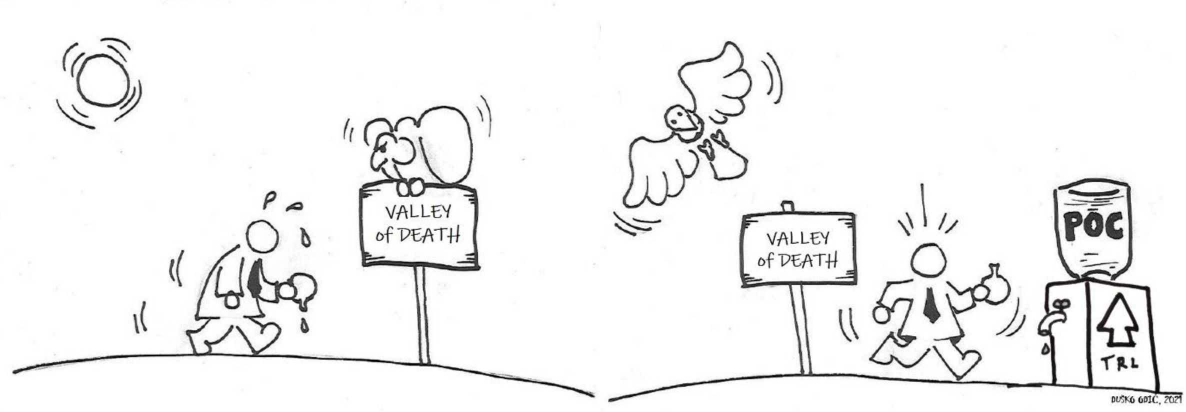

Illustration: Dusko Odić. 2021.

Objectives of the Conference

The main aim of the Conference is to promote knowledge exchange between academia and industry, in order to strengthen the cooperation and transfer of innovations from research labs into industrial exploitation. The Conference goal is also further strengthening the knowledge base and experiences of technology transfer professionals at public research organisations.

In the past events, we hosted more than 2600 participants, including investors, inventors, researchers, students, technology commercialization and intellectual property experts, start-up funders, industrial development experts etc. We have successfully organized twelve competitions to award the teams with their technology and business proposition with the biggest commercial potential, which led to successful start-ups and licensing contracts. Biannually we organise Research2Business (R2B) pre-scheduled meetings in order to give the participants additional opportunity to meet and discuss possible cooperation. Researchers presenting their work being financed by Slovenian Research Agency (ARRS) is another channel for enterprises to get familiar with recent discoveries and development opportunities.

Conference prize for the best innovations in 2021

The main objective of the special prize for innovation is to encourage commercialization of inventive/innovative technologies developed at public research organizations and to promote cooperation between research organizations and industry. One of the main objectives is also promoting the entrepreneurship possibilities and good practices in the public research organizations. Researchers are preparing business models for their technologies and present them to an international panel of experts in a pitch competition. They need support in many aspects of their path from research to industrial application. The researchers and their team need assistance, knowledge and tools to develop business models, find appropriate partners, form a team, and secure financial resources to bridge the gap from publicly funded research to the market, either in their own start-up (spin-out) company or by licensing out their technology. How shall they do it and how can we help them?

The Conference pitch competitions in the last eleven years resulted in spin-out company creation or licensing case development in at least one case per competition each year. In many cases, young researchers that participated in pitch competition in the past years, have been involved for the first time in an organized and structured process of development business model around their technology and preparation of the targeted (pitch) presentation about their planned venture to investors and technology commercialization experts.

WIPO IP Enterprise Trophy

The aim of the WIPO IP Enterprise Trophy is to stimulate Slovenian enterprises to intensify their cooperation with public research organisations. We wish to expose as a good practice those enterprises that are constantly and methodologically using the IP system in their business activities.

WIPO Medal for Inventors

The goal of the WIPO Medal for Inventors is to award inventive and innovative activity of Slovenian public researchers and to recognize their contribution to national wealth and development.

Research2Business meetings

In the course of the conference, pre-scheduled Research2Business (R2B) meetings will take place, allowing the representatives of companies and research institutions to discuss possible development solutions, inventions and commercially interesting technologies. Such meetings present an excellent basis for possible future research cooperation and business synergies.

Opportunities arising from publicly funded research projects / presentations of successful scientific projects

Researchers will be presenting their work that is being financed by Slovenian Research Agency.

Scientific papers on TT and IPR

Experts on TT, IPR, researchers that cooperate with industry and others have been invited to submit their scientific papers. The accepted papers have been presented by the authors. This year’s topics were: Key factors for successful technology transfer from different points of view (researchers, knowledge transfer experts, enterprises); Key inventions and their protection for the greater good; Market perspective through different TRL phases; Financing different TRL phases; Setting-up internal Proof-of-Concept funds at public research organisations; Lowering the Proof-of-Concept risks; Shortening the time-to-market for different technological fields; Spin-out vs spin-off; Key trends in IP protection and TT for mid TRL phases; Examples of IP protection in Artificial Intelligence; The role of patents in Artificial Intelligence; Activating the IP protection and TT players in the SEE region; National IP protection: a profit or a hindrance; Governmental support vs institutional support of IP protection and TT; IP and internal secret know-how: who prefers what and why; Other, chosen by the contributor

School section

A parallel section "Connecting the education system with academia: Presentations of selected research topics from the Jožef Stefan Institute and proposals for cooperation" took place. The section was aimed at primary and high school teachers where selected research topics from the Jožef Stefan Institute (JSI) and proposals for cooperation were presented.

Key stakeholders

The conference involves different key stakeholders in the process, public research organizations as knowledge providers, technology parks as infrastructure providers, business accelerators, intellectual property offices, IP attorneys, agencies, consultants, capital (venture capital companies, agencies, business angels, development banks), SMEs, international enterprises, private innovators, and others.

Target audience and benefits

Target audience of the conference are researchers, students and post-graduate students with entrepreneurial ambitions, representatives of industry, established and future entrepreneurs, innovators and also representatives from governmental institutions and policy-making organizations.

Introduction to the International Technology Transfer Conference

The International Technology Transfer Conference (ITTC) is organized by the **Jožef Stefan Institute** (Center for Technology Transfer and Innovation) for the 14th year in a row. The first ITTC was organized in 2008. The ITTC has, through the years, been presented in different formats and it is currently organized as part of the International multiconference Information Society (IS2021), organized by the Jožef Stefan Institute.

The Center for Technology Transfer and Innovation at the Jožef Stefan Institute is the coordinator of the project KTT (2017-2022), coordinator of Enterprise Europe Network Slovenia, and is a financially independent unit. The CTT is presently involved in 4 projects, having recently been involved in three additional ones. The Conference has been organized with the support of partners from the KTT project (2017-2022).

The previous project KTT, from 2013 through 2014, was the first project within which technology transfer in Slovenia was systematically funded from national funds. There were 6 partners involved, but the project only lasted for 17 months.

The current KTT project, 2017-2022, comprises 8 partners, all public research organizations (PROs), represented by their respective technology transfer offices (TTOs), namely, 4 leading institutes and 4 renowned universities.

The project's mission is twofold: the strengthening of links and increasing the cooperation of PROs and industry and the strengthening the competences of TTOs, researchers and enterprises. Most (80%+) of the finances go to human resource financing.

Support of Slovenian Industry

The goal of the KTT project is to support the industry in Slovenia, rather than an outflow of knowledge abroad or great profit for PROs. Collaboration between PROs and SMEs in Slovenia should be strengthened. However, Slovenian companies prefer contract and collaborative cooperation to buying licenses and patent rights. Also, a relatively low added value per employee and a low profit margin are not stimulating the research-industry collaboration.

Investing into Intellectual Property Rights

Despite the above stated it is important to invest in patents and other forms of intellectual property (IP). Investments in intellectual property increase licensing opportunities and the IP position of the Slovenian knowledge worldwide.

Research2Business meetings

One-to-one research-to-business pre-scheduled (virtual) meetings allow the representatives of companies and research institutions to discuss possible development solutions, inventions and commercially interesting technologies. Such meetings present an excellent basis for possible future research cooperation and business synergies. The meetings focus on applications, solutions and expertise in natural sciences like electronics, IT, robotics, new materials, environment, physics, chemistry and biochemistry. Companies and researchers book meetings also with technology transfer experts from the Center of technology transfer and innovation. The meetings are held virtually through b2match platform.

The Research-to-business meetings at the Conference were co-organized in collaboration with the Enterprise Europe Network partners.

Strengthening the Competences of TTOs

The goal of the KTT project is to establish technology transfer centers in Slovenia as integral parts of PROs, which shall, first and foremost, strive to serve the interests of the researcher and the PRO. The TTOs shall assist the researcher throughout the entire procedure of the industry-research cooperation, by raising competences and educating, taking care of legal and administrative issues, and promote research achievements among the industry. Lastly, TTOs shall support the cooperation already established by research groups.

ACKNOWLEDGEMENTS

The editors and organizing committee of the Conference would like to express cordial thanks to all who helped make the 14th International Technology Transfer Conference a success.

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for their evaluation and selection of the awardees of the WIPO IP ENTERPRISE TROPHY and WIPO MEDAL FOR INVENTORS.

INTRODUCTION TO THE ITTC CONFERENCE AS A WHOLE

Value creation should be at the heart of valorization activities and denotes a process where stakeholders' benefits are articulated, created, and captured throughout the valorization process. Value in this sense is, however, not static or absolute. Value is relative and usually changes with the stakeholders addressed. Hence, value creation implies, wherever it is meaningful and possible, that the benefits for a stakeholder must be higher than the efforts, risks and resources needed to obtain the promised benefits.

Turning any publicly financed knowledge, i.e. intellectual property in its broadest sense to socio-economic benefits calls for a much wider scope of activities than just industrial rights management. The Center for Technology Transfer and Innovation at Jožef Stefan, if anyone, has always been very much aware of this. Thus, we have set in motion in the past ten years of our existence, based on the dowry of additional 15 years of a Technology transfer office of Jožef Stefan Institute, many different changes. These changes have influenced the Institute and the society around us. We have created processes that any Slovenian public research organization would be able to use. We have created an internal ecosystem of activities and interactions with essential innovation actors, allowing us to research, assess, understand, co-create, offer, and fine-tune the academia-industry-society helix on the most bottom-up, most influential level. We are proud of that.

Now we must go on. We created a proof of concept of activities – of what the ecosystem in our environment could look like in a scalable way. Others should take the essential elements (codes of practices we have so prudently developed through the past 10 years of our existence) and use them to their liking and the capacities of their institutions. There are differences among actors in the ecosystem. But once these differences have been understood, there are just similarities that can be harvested in the quest for better valorization results.

We are all unique. And we are all very similar. Acknowledging this means not fighting better from us but building on their experience. "*Yeah, everybody wants change. Don't nobody wanna change though. (NF)"* We need to creatively and constructively take part in knowledge valorization for a better future, even if it means it is our turn to change.

Day 1

OVERVIEW OF THE PROGRAMME

7 October 2021 (hybrid teleconference, virtual and live)

MAIN SESSION

08.30 – 09.00	**Registration**
09.00 – 09.15	**Welcome address** (in Slovene language) Prof. Dr. Mitja Slavinec, State Secretary, Ministry of Education, Science and Sport Simon Zajc, State Secretary, Ministry of Economic Development and Technology Prof. Dr. Boštjan Zalar, director, Jožef Stefan Institute
09.15 – 10.30	**Round table: Future of Knowledge Transfer in Slovenia and EU** (in Slovene language) Prof. Dr. Gregor Majdič, University of Ljubljana Prof. Dr. Boštjan Zalar, Jožef Stefan Institute Prof. Dr. Maja Ravnikar, National Institute of Biology Prof. Dr. Klavdija Kutnar, University of Primorska Prof. Dr. Matej Makarovič, Faculty of information studies in Novo mesto Prof. Dr. Urban Bren, University of Maribor Prof. Dr. Robert Repnik, Slovenian Research Agency Gregor Klemenčič, Deep Innovations Gregor Umek, mag., Ministry of Economic Development and Technology mag. Damjana Karlo, Ministry of Education, Science and Sport
10.30 – 12.00	**Pitch competition: Best innovation with commercial potential**
12.00 – 13.00	Lunch break
13.00 – 13.20	**Award announcement: Best innovation with commercial potential** **Award announcement: WIPO IP Enterprise Trophy**
13.20 – 15.30	**Keynote speech: PoC funding of research spin-offs** Matthias Keckl, Managing Partner, Fraunhofer Technologie-Transfer Fonds (FTTF) GmbH **Keynote speech: CEETT Platform – Central Eastern European Technology Transfer Platform** Natalija Stošicki, Director, Investments and EU Programmes Department, SID Bank / SID – Slovenska izvozna in razvojna banka **Paper presentations: scientific papers on technology transfer and intellectual property**

15:30 – 16.50	**Opportunities arising from publicly funded research projects / presentations of successful scientific projects** **Award announcement: WIPO Medal for Inventors**
16.50-17:00	Closing

PARALLEL SESSION I

10:00 – 13:20	**Research2Business meetings (R2B meetings)**

PARALLEL SESSION II

13:20 – 15:20	**Connecting high-school education system with academia: Presentations of selected research topics from Jožef Stefan Institute and proposals for cooperation** Povezovanje šolskega sistema z akademsko sfero: Predstavitve izbranih raziskovalnih tem Instituta "Jožef Stefan" in predlogi za sodelovanje Agenda (in Slovene language) 13:20-13:25 Uvodni pozdrav 13:25-13:40 Predstavitev možnosti sodelovanja Instituta »Jožef Stefan« z šolstvom, CTT - Obiski instituta »Jožef Stefan« med šolskim letom - Dan odprtih vrat in Teden odprtih vrat na IJS - Izobraževanja, usposabljanja in predavanja za učitelje in profesorje - Mentorstva pri raziskovalnih nalogah dijakov - Aktivnosti promocije znanosti in raziskovalnega dela - različne evropske - projekte in iniciative ter druge aktivnosti (Znanost z in za družbo / Science - with and for society) 13:40-14:20 Predstavitev odsekov s področja kemije, biokemije, materialov in okolja - Odsek za znanosti o okolju, O2 - Odsek za biokemijo, molekularno in strukturno biologijo, B1 - Odsek za fizikalno in organsko kemijo, K3 - Odsek za Sintezo materialov, K8 14:20-14:30 Predstavitev odsekov s področja fizike - Odsek za tehnologijo površin, F4 14:30-15:00 Predstavitev odsekov s področja elektronike in informacijske tehnologije

	- Odsek za umetno inteligenco, E3 - Laboratorij za odprte sisteme in mreže, E5 15:00-15:20 Morebitna dodatna vprašanja za raziskovalce 15:20 Zaključek

WELCOME ADDRESSES

From 9:00 to 09:15

Honourable Speakers:

Prof. Dr. Mitja Slavinec, State Secretary

Ministry of Education, Science and Sport

Povzetek uvodnega pozdrava / Abstract of the Welcome address

Govorca veseli in se zahvaljuje organizatorju konference, Centru za prenos tehnologij in inovacij na Institutu »Jožef Stefan«, da ima uvodni nagovor na zelo pomembnem srečanju.

Na izvedbeni ravni, kjer znanje nastaja, sodelovanje dobro poteka. Sodelovanje je odlično na univerzah in institutih, prav tako je okrepljeno sodelovanje med izobraževanjem in raziskovanjem na institucionalni osnovi, kar dokazuje tudi udeležba na današnjem dogodku, saj so prisotni predstavniki univerz in raziskovalnih institutov.

Na drugi strani se zna gospodarstvo tudi relativno hitro povezati, ker jim to narekuje njihova gospodarska pobuda. Največ lahko naredimo na tem, kako ta znanja in raziskave čimprej prenesti v gospodarstvo.

Pri raziskovanju je možno zaznati najmanj dve ravni. Pri bazičnih raziskavah je Slovenija na nekaterih področjih v svetovnem vrhu. Manj uspešni smo pri prenosu in implementaciji aplikativnih raziskav v celotni družbi in gospodarstvu.

Država je od leta 2017 dalje s 6 mio EUR podprla pravo pot za prenos tehnologij, ki se odvija s pomočjo pisarn za prenos tehnologij. MIZŠ namerava to podporo še okrepiti in okrepiti sodelovanje z MGRT. Nujno je sodelovanje z MGRT, ker MIZŠ podpira nizke TRL-je in MGRT višje. Vendar srednji TRL-ji še vedno »ostajajo v zraku«.

K sodelovanju je potrebno poleg MGRT povabiti še Gospodarsko zbornico Slovenije, ki ima povezovalno vlogo in dostop do gospodarstva. S sodelovanjem vseh deležnikov bo Slovenija postajala družba, kjer se bo več delalo z glavo in manj z rokami.

Simon Zajc, State Secretary,

Ministry of Economic Development and Technology

Povzetek uvodnega pozdrava / Abstract of the Welcome address

Živimo v nenavadnih časih, ko je COVID-19 razkril pomanjkljivosti in šibke točke slovenskega gospodarstva in nabavnih verig. Slovenski gospodarski model mora biti z uvedbo inovacij v gospodarstvo odpornejši za prehod v zeleno družbo.

V Evropski skupnosti se vsi usmerjamo v zeleni, digitalni prehod. Prehod je mogoče narediti samo na krilih inovacij, ki so ključni dejavnik uspeha podjetij, konkurenčnosti nacionalnih držav in Evropske skupnosti kot celote ter družbe, ki je usmerjena k okolju prijaznem načinu življenja.

Načrt za okrevanje in odpornost (NOO), ki bo podlaga za koriščenje razpoložljivih sredstev iz Sklada za okrevanje in odpornost (RRF), nam ponuja veliko priložnosti za okrevanje.

V Slovenski industrijski strategiji 2021-2030, ki jo je pripravilo Ministrstvo za gospodarski razvoj in tehnologijo, so začrtali zelen, digitalen in ustvarjalen razvoj industrije in gospodarstva do leta 2030.

Na drugi strani je na evropski lestvici upadla slovenska inovacijska uspešnost v primerjavami z drugimi državami EU. Slovenija ne sodi več med močne, ampak zmerne inovatorje, ker je imela padec uspešnosti v obdobju 2018 – 2020. Velik izziv predstavlja zagotovitev stabilnih vzpodbud države za znanost. Na drugi strani moramo v naslednjih desetih letih zagotoviti tako podjetniške naložbe v raziskave in inovacije kot naložbe na raziskovalnem nivoju.

Pri tem ne moremo računati samo na evropska sredstva, ampak tudi na našo premišljenost pri dodeljevanju nacionalnih sredstev za ključne finančne instrumente, ki bi jih morali izvajati vsako leto brez vmesnih premorov.

Ministrstvo za gospodarski razvoj in tehnologijo bo okrepilo vlogo SPIRIT-a na področju inovacij in tehnologij ter pri podpori povezovanju med industrijo in javnimi raziskovalnimi organizacijami.

Ministrstvo bo še naprej spodbujalo prenos znanj in tehnologij na trg z vzpostavljenimi strateškimi, razvojnimi in inovacijskimi partnerstvi, ki po začetnih težavah delujejo vedno bolje prav zaradi vzpostavljenih povezav s številnimi podjetji, društvi in raziskovalnimi organizacijami.

Pomembno je, da se bodo vsi deležniki v Sloveniji prizadevali za prenos inovacij na trg – iz baznega razvoja v tržne aplikacije.

Prof. Dr. Boštjan Zalar, director,

Jožef Stefan Institute

Povzetek uvodnega pozdrava / Abstract of the Welcome address

Govorec je v uvodnem in pozdravnem nagovoru izpostavil Center za prenos tehnologij in inovacij (CTT), vodjo centra dr. Špelo Stres, njene sodelavke in sodelavce, ki so organizirali že 14. Mednarodno konferenco o prenosu tehnologij. Na teh konferencah sodelavke in sodelavci CTT z učinkovitim prenosom tehnologij v prakso še posebej krepijo sodelovanje med znanstveno sceno in gospodarstvom.

Pisarne za prenos tehnologij naj bodo ključne v procesu prenosa tehnologi ter pri sodelovanju z deležniki, ki so dobro vpeti v inovacijskem sistemu. Najpomembnejša vprašanja, ki bi jih bilo potrebno nasloviti, so:

- Vzpostavljanje sklada za preverbo koncepta na nacionalni in na institucionalnih ravneh
- Problematika ustanavljanja odcepljenih podjetij
- Odnosi med raziskovalno in tehnološko infrastrukturo ter centri odličnosti
- Večji družbeni vpliv javnih raziskovalnih organizacij in univerz ter njihovo boljše povezovanje z družbo
- Vloga odprte znanosti v povezavi z intelektualno lastnino
- Vpliv razdrobljenosti raziskovalnega sistema v Republiki Sloveniji ter ocenjevanja učinkovitosti sistema in vpliva na kakovost delovanja pisarn za prenos tehnologij
- Sodelovanje med SRIP-i in pisarnami za prenos tehnologij

Na današnji konferenci so prisotni skupaj s pisarnami za prenos tehnologij vsi, ki soustvarjajo inovacijski sitem v Sloveniji.

Na zaključku pozdravnega nagovora se je govorec zahvalil sodelavkam in sodelavcem Centra za prenos tehnologij in inovacij za organizacijo današnje okrogle mize in za že 14. dogodek po vrsti.

ROUND TABLE: THE FUTURE OF KNOWLEDGE TRANSFER IN SLOVENIA AND EU

From 09:15 to 10:30 (in Slovene language)

Moderators:

Dr. Špela Stres, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Dr. Vojka Žunič, National Institute of Chemistry, KnowledgeTransfer Office

Round table speakers:

Prof. Dr. Gregor Majdič, University of Ljubljana

Prof. Dr. Boštjan Zalar, Jožef Stefan Institute

Prof. Dr. Maja Ravnikar, National Institute of Biology

Prof. Dr. Klavdija Kutnar, University of Primorska

Prof. Dr. Matej Makarovič, Faculty of information studies in Novo mesto

Prof. Dr. Urban Bren, University of Maribor

Prof. Dr. Robert Repnik, Slovenian Research Agency

Gregor Klemenčič, Deep Innovations

Gregor Umek, mag., Ministry of Economic Development and Technology

Mag. Damjana Karlo, Ministry of Education, Science and Sport

Povzetek okrogle mize / Abstract of the Round table

Okroglo miza sta odprli moderatorki dr. Špela Stres, MBA, LLM, Vodja Centra za prenos tehnologij in inovacij na Institutu ''Jožef Stefan'', in dr. Vojka Žunič, Vodja pisarne za prenos znanja na Kemijskem inštitutu.

Uvodni nagovor moderatorke dr. Špele Stres:
Podatki o inovacijah in internacionalizaciji kažejo, da je potrebno omogočiti skladno in na mejnikih temelječe financiranje inovacij ter podpreti internacionalizacijo. Naš cilj je, da izboljšamo politike za celostno nemoteno preoblikovanje rezultatov raziskav v ekonomsko in družbeno vrednost.

Moderatorka dr. Vojka Žunič je predstavila udeležence okrogle mize:

- prof. dr. Gregor Majdič, rektor Univerze v Ljubljani
- prof. dr. Boštjan Zalar, direktor Instituta ''Jožef Stefan''
- prof. dr. Maja Ravnikar, direktorica Nacionalnega inštituta za biologijo
- prof. dr. Klavdija Kutnar, rektorica Univerze na Primorskem
- prof. dr. Matej Makarovič, dekan Fakultete za informacijske študije v Novem mestu
- prof. dr. Urban Bren, prorektor za prenos znanja Univerze v Mariboru

- prof. dr. Robert Repnik, direktor Javne agencije za raziskovalno dejavnost Republike Slovenije
- mag. Gregor Umek, vodja Sektorja za industrijo, spodbujanje inovativnosti in tehnologije v Direktoratu za internacionalizacijo, podjetništvo in tehnologije (Ministrstvo za gospodarski razvoj in tehnologijo)
- mag. Damjana Karlo, vodja Sektorja za strukturne sklade na področju raziskovalno-razvojne dejavnosti (Ministrstvo za izobraževanje, znanost in šport)
- Gregor Klemenčič, Deepinovations (Nizozemska)

1. Gregor Klemenčič, sr. principal innovation researcher for e-health data driven solutions za Philips Research (Medical systems) na Nizozemskem in soustanovitelj ter solastnik mednarodnega podjetja Deep Innovations B.V

Gospod Klemenčič je predstavil svoj pogled na inovacijski sistem v naslednjih točkah:

- Innovation to market – I2M
- Research to application – R2A
- Value proposition creation – VPC
- The game of rules – IPR
- Earning models

Curiosity is a personal characteristic of a researcher or entrepreneur. A researcher is looking for an inspiration, learning from white papers and colleagues. Researcher combines different sources of information. It looks like a child play for clever people.

Creation is also creation of products and services and how to apply. This is a game for elderly researchers.

Researchers have to understand the buyer and not try to sell unique selling points and not even unique buying reasons. Researchers have to find out why buyers become hungry for new innovation applications.

We have fundamental, applied and complementary research. Researchers have to try as fast as they can to combine information from different sources domains. It's a lot of hard work and play as well. If you play, you may do a mistake. Researchers have to learn fast and make NOT TO DO list to ignore or mitigate the risk.

Provocative design is another applied approach in the innovation system. Researchers design new solution or concept and they test them with people without asking them what they want.

Mixed research teams with different skills from different research areas with non-standard combination of knowledge will bring applications out of the box.

New school doesn't believe much in IP as the old one. Also, how to make money with innovations is different from the old school. New school prefers to organize focused micro meetings, attract micro investors and apply IP stacking or block chain to trace effort input as output values.

Iztočnica okrogle mize – dr. Špela Stres:
Winston Churchill je rekel, Personally I'm always ready to learn, although I do not always like being taught. Del napredka v človeški zgodovini je povezan s posebno sposobnostjo ljudi, da smo se sposobni učiti. Zato bomo danes uporabili svoje znanje in naslovili nekaj ključnih tematik, ki bodo opredeljevale vsebino področja prenosa znanja in njegove valorizacije v prihodnosti.

2. Prof. dr. Gregor Majdič, rektor Univerze v Ljubljani
Vprašanje: Problematika ovir z ustanavljanjem odcepljenih podjetij. Glede na vaše izkušnje tudi iz podjetniškega sveta, če bomo z novim Zakonom o znanstveni razvojni in inovacijski dejavnosti lahko JROji postajali solastniki odcepljenih podjetij, je to pametno, ker bodo institucije v bolj zgodnjih fazah lahko upravljale z inovacijami v podjetniških vodah ali dodaten zaplet, v katerem bodo JRO upočasnjevali razvoj mladih podjetij proti trgu?
Ali se vam zdi, da smo zreli za ta korak?

Prof. dr. Gregor Majdič:
Tak sistem je vzpostavljen v številnih zahodnih državah, dobro deluje ter prinaša velike koristi za akademsko sfero in gospodarstvo, če ta proces pravilno izvajamo.

Če se bodo javne raziskovalne organizacije, ki so običajno velike in nekoliko bolj okorne kot so majhna podjetja na trgu, preveč vmešavale v samo delovanje podjetij na trgu, ko bodo le-ta naskakovala nove trge in se internacionalizirala, to zna biti ovira.

Če pa bodo raziskovalne organizacije preko pisarn za prenos tehnologij to upoštevale in pustile malim podjetjem samostojnost, hkrati pa sodelovale pri potrebni pomoči, pa je to zagotovo lahko velika prednost in nova dodana vrednost, ki bo omogočila takšnim podjetjem, da bodo lažje prišla na trg in lažje izhajala iz akademskih institucij ter prenašala znanje v gospodarstvo v Sloveniji in v mednarodnem prostoru.

3. Prof. dr. Maja Ravnikar, direktorica Nacionalnega inštituta za biologijo
Vprašanje: Vzpostavljanje sklada Proof-of-Concept. Na NIB ste prav v letošnjem letu uspešno ustanovili novo visokotehnološko podjetje. V letu 2021 so SID banka, HBOR in EIF podpisali pogodbo za prvi PoC sklad v regiji. Na posamičnih institucijah, IJS (od leta 1998), UL (od leta 2020) in UM (od leta 2020) - PoC skladi delujejo že nekaj časa in podpirajo raziskovalce na njihovi poti proti trgu. Kako se do tega opredeljuje NIB? Je 40 mio EUR v skladu PoC za dve državi preveč za regijo, ki je šele na začetku svoje poti povezovanja z gospodarstvom ali pa celo premajhen vložek za regijo, ki mora nujno ustvariti množico gazel, da se bo vrnila med inovacijsko uspešne države?

Prof. dr. Maja Ravnikar:
Na NIB smo pred desetimi leti ustanovili prvi spin-out Biosistemika. Pri tem je podjetju zelo pomagal mehanizem projektov VALOR. PoC skladi bodo omogočali javnim raziskovalnim organizacijam, da pridejo v svojih raziskavah na srednje TRL-je, ker takšnega financiranja v tem trenutku v Sloveniji ni.

V letošnjem letu smo na NIB za novoustanovljeno podjetje pridobili močne investitorje, ki so lahko takoj investirali samo v opremo več kot milijon evrov in odkupili intelektualno lastnino, vendar to ni običajno stanje pri ustanavljanju spin-out podjetij.

Če bodo sredstva PoC sklada primerno odrejena, bo to velik korak naprej, ker akademska sfera in javne raziskovalne organizacije nimajo dovolj potrebnih sredstev za premagovanje »doline smrti«.

ARRS financira tako bazične kot aplikativne projekte, ki pa se ocenjujejo več ali manj kot bazični. Projekti izkazujejo svojo aplikativnost z zainteresiranostjo podjetij za takšno vrsto raziskav. Takih financiranih projektov je v Sloveniji bistveno premalo.

4. Mag. Damjana Karlo, vodja Sektorja za strukturne sklade na področju raziskovalno-razvojne dejavnosti (Ministrstvo za izobraževanje, znanost in šport)
Vprašanje: Kako vidite problematiko ustanavljanja odcepljenih podjetij na MIZŠ? Kako vidite možnosti pomoči zasebnim podjetjem v solastništvu JRO, v luči državnih pomoči? Vemo, da bi na nekaterih področjih (biotehnologija, medicina, nanomateriali, itd) morali biti začetni vložki v bodoče gazele precej veliki, tudi milijonski.

Mag. Damjana Karlo:
Z novim Zakonom o znanstvenoraziskovalni in inovacijski dejavnosti (ZZRID) je predvidena možnost za ustanovitev odcepljenih podjetij. To in celotno področje inoviranja je tipično medresorsko vprašanje predvsem med MIZŠ in MGRT.

Najprej so potrebne reforme institucij in obeh ministrstev ter kadrovske in vsebinske krepitve tako ministrstev kot njihovih izvajalskih agencij – ARRS in SPIRIT, ki smo se jih lotili v okviru Načrta za okrevanje in odpornost.

Prenizko javno financiranje je vplivalo tudi na padec uspešnosti Slovenije v kazalnikih Evropskega inovacijskega indeksa. Slovenija mora priti do 1% javnega financiranja za raziskovalno-razvojne dejavnosti iz različnih virov, ki so sedaj na razpolago v Načrtu za okrevanje in odpornost ter v okviru evropskih kohezijskih sredstev za naslednjih 10 let, ki jim morajo slediti tudi sredstva iz nacionalnega proračuna.

MIZŠ iz evropskih kohezijskih sredstev financira povezovanje gospodarstva z raziskovalno sfero ter s tem razvojno-raziskovalne projekte na TRL lestvici od 3 do 6, ki se jim s financiranjem priključi tudi MGRT na višjih ravneh tehnološke pripravljenosti.

Zagotovljeni so formalni pogoji za ustanovitev odcepljenih podjetij, za katera so potrebni tudi veliki finančni vložki. MIZŠ teh vložkov v odcepljena podjetja ne more financirati iz opravljanja javne službe. Prav tako je potrebno poleg vzpostavitve finančnih instrumentov pritegniti tudi partnerje, ki imajo veliko raziskovalne opreme in znanja.

5. Prof. dr. Robert Repnik, direktor Javne agencije za raziskovalno dejavnost Republike Slovenije
Vprašanje: ARRS določa v Pravilnikih (Pravila za oblikovanje cen za uporabo raziskovalne opreme, obveščanje in poročanje o uporabi raziskovalne opreme) način določanja cen in upravljanja z raziskovalno in tehnološko infrastrukturo v Sloveniji. Kakšne priložnosti še vidimo med podjetji in JRO ter centri odličnosti, ki imajo infrastrukturo, ki bo jo lahko potrebovala podjetja? Kako podjetjem dovolj na glas povedati, da imamo opremo, ki jo potrebujejo, a je pri nas še niso našli?

Prof. dr. Robert Repnik:
Srednji del TRL-jev je v Sloveniji resen problem. Nižji TRL-ji (predvsem TRL 1-2, pogojno TRL 3) spadajo v področje znanosti, ki jih pokrivata MIZŠ in ARRS v skladu s smernicami resornega ministrstva.

Na drugi strani podporo pri premostitvi srednjih TRL-jev nudijo MGRT, SPIRIT, Slovenski podjetniški sklad in tudi Gospodarska zbornica Slovenije.

Za rešitev problematike srednjih TRL-jev je ključno zavedanje deležnikov in njihovo soglasje, da je problem srednjih TRL-jev v Sloveniji resen in je zato potrebno premostiti dolino smrti.

Za uspešno premostitev je potrebno sprejeti skupno odločitev, da je to nujno ter zagotoviti institucionalno podprtost in pokritost premostitvenega procesa.

Prav tako morajo skupno nastopiti vsi, ki pokrivajo posamezne skupine TRL-jev. Nižje TRL-je pokrivajo znanstveniki, višje pa gospodarstvo, medtem ko je »srednja množica« prazna.

Ljudje, ki delujejo na teh področjih in stojijo za temi skupinami TRL-jev, morajo začutiti svojo osebno motivacijo, da uspešno izkazujejo svoje talente skozi rezultate.

Govorec je prepričan, da obstajajo še nekateri talenti, ki jih je potrebno aktivirati za vstop na področje srednjih TRL-jev. Pri tem sta možna dva pristopa, in sicer, da ustvarimo skupino ljudi, ki bi delala na področju srednjih TRL-jev, ali pa motiviramo obe skupini raziskovalcev, da aktivirajo svoje lastne talente in začnejo delovati tudi na področju srednjih TRL-jev.

Raziskovalna oprema je drugi segment, ki odgovarja in naslavlja težavo srednjih TRL-jev. En del je že vzpostavljen, ker se skozi ARRS plačujejo investicije v nakup raziskovalne opreme na javnih raziskovalnih organizacijah. Taka oprema na javnih raziskovalnih organizacijah že obstaja, vendar podjetja premalo poznajo možnosti, kako do nje dostopati.

V Evropi obstajajo primeri dobre prakse, ki pa jih ni mogoče enostavno preslikati v naše okolje, da bi delovali. V Sloveniji bi morali najprej dobro pregledati seznam opreme, preveriti, če je ustrezno vpisana in ažurirana. Potem bi lahko seznam opreme promovirali pri gospodarskih družbah, da podjetja spoznajo, kakšne možnosti obstajajo.

6. Prof. dr. Urban Bren, prorektor za prenos znanja Univerze v Mariboru
Vprašanje: Kaj sploh je povezovanje z družbo? S stališča univerze, katere raziskovalno delo obsega velik delež naravoslovno tehničnih vsebin? Gre bolj za članke in sodelovanje na konferencah, za neformalne razgovore in občasno naključno pomoč tistim podjetjem, ki so bolje informirana in se bolje znajdejo pri dostopanju do JRO, ali pa bi se morali potruditi vzpostaviti enoten sistem, v katerem bi vsako, še tako majhno, če le dovolj aktivno in radovedno podjetje prišlo v stik s pravim raziskovalcem, pa tudi dobilo dostop do ustrezne infrastrukture za izvedbo meritev za potrebe podjetja?

Prof. dr. Urban Bren:
Univerza v Mariboru izhaja iz gospodarske pobude. Na dolgi tradiciji sodelovanja z gospodarstvom gradimo naprej. Včasih je bilo tako sodelovanje naključno in stihijsko na podlagi osebnih poznanstev. Danes pa projekta KTT1 in KTT2 vzpostavljata institucionalno in

formalizirano raven sodelovanja. Na ta način lahko univerze in javne raziskovalne organizacije delujejo kot enotna vstopna točka (one-stop-shop) za sodelovanje z industrijo.

V vzhodni kohezijski regiji smo zelo razpršeni. Tako ima Univerza v Mariboru svoje institucije še v Krškem, Brežicah, Velenju, Celju, Hočah in pri Murski Soboti. Na ta način se znanje bliža uporabnikom v regije, kar je pomembno za enakomeren razvoj države. Prav tak »one-stop-shop« pristop preko kohezijskih regionalnih središč lahko opolnomoči Slovenijo in jo naredi mnogo odpornejšo.

Pomembno pa se je zavedati, da prenos znanja ne vključuje zgolj tehnologij za gospodarstvo, ampak tudi prenos v negospodarstvo, v javne institucije in občine.

7. Prof. dr. Klavdija Kutnar, rektorica Univerze na Primorskem in prof. dr. Boštjan Zalar, direktor Instituta ''Jožef Stefan''
Vprašanje: **Vloga Centrov odličnosti.** Leta 2009 je bilo s strani MIZŠ ustanovljenih 7 Centrov odličnosti, ki so spremenili slovensko raziskovalno pokrajino in jo razgibali, predvsem tudi glede ponujanja dostopa do raziskovalne infrastrukture.

IJS ima veliko izkušenj s centri odličnosti, saj je že ob ustanovitvi deloval kot ustanovitelj v treh različnih, na različnih področjih, pomemben del sodelovanja z industrijo poteka tudi danes z njihovo pomočjo.

Univerza na Primorskem, kot soustanovitelji zasebnega raziskovalnega zavoda Innorenew, katerega soustanovitelj je tudi nemški Fraunhofer WKI, se dobro zaveda pomembnosti povezave med temeljnim in uporabnim raziskovanjem, kot pravne oblike, ki omogoča tudi sodelovanje slovenskih in mednarodnih deležnikov.

Kako vidite razvoj področja centrov odličnosti v Sloveniji v prihodnje? Si želimo nove CO in zakaj ali zakaj ne? Kaj to pomeni za nadaljnje drobljenje raziskovalnega prostora v Sloveniji? Kako skozi Centre odličnosti s pomočjo javnih raziskovalnih organizacij urediti odnos glede raziskovalne in tehnološke infrastrukture ter ponujanje le-te podjetjem, saj vemo, da je vsaj del opreme nepopolno izkoriščen, podjetja imajo potrebo po rabi, vendar do realizacije zaradi zapletenosti sistema ne pride? Kako vidite centre odličnosti na lestvici nivoja tehnološke pripravljenosti TRL? In kako so s centri odličnosti ter raziskovalno infrastrukturo, ki prehaja v tehnološko infrastrukturo, povezane pisarne za prenos tehnologij kot most med njimi?

Prof. dr. Klavdija Kutnar:
Univerza na Primorskem (UP) je nastala na drugačen način kot Univerza v Mariboru. UP je imela predvsem družboslovno in humanistično usmeritev, hkrati pa izjemno željo za sodelovanje z gospodarstvom v lokalnem okolju. Sodelovanje je bilo oteženo, ker ni bilo razvoja na naravoslovno-tehničnem področju. V naslednjih osemnajstih letih so vzpostavili odlična in tudi nekatera vrhunska nišna naravoslovna področja. Pri tehnologiji pa je bilo težje, ker so v ozadju zelo veliki finančni stroški. Zato so iskali rešitve za okrepitev področja tehnike in tehnologij.

V tem konceptu so s pomočjo evropskih sredstev s še osmimi drugimi institucijami ustanovili Center odličnosti.

Center odličnosti Innorenew ne drobi raziskovalnega prostora, ampak krepi znanstveno odličnost in povezovanje različnih institucij. Preko Centra odličnosti so združili različne kompetence in znanja, da so naredili preboj v znanstveni odličnosti. Vsi partnerji so vstopili s strateško odločitvijo. Zato Center odličnosti ni konkurenca, ampak partner, ki so mu podelili polno avtonomijo.

V UP želijo, da bi prišli do tako močnih pisarn za prenos tehnologij kot jih ima njihov odlični partner Fraunhofer. Le-ta deluje na način, da zaposleni strokovni sodelavci najprej presodijo vsak znanstveni članek, če ima potencial za preboj in prenos v industrijo. Potem se odločijo, ali gredo v patentiranje in zaščito intelektualne lastnine, ali v odprto znanost.

V Sloveniji se razlikujejo cilji javnih raziskovalnih institucij, ki stremijo k odprti znanosti in podjetij, ki zasledujejo druge cilje. Zato imajo pisarne za prenos tehnologij pomembno vlogo, da povežejo gospodarstvo z raziskovalno sfero.

Raziskovalci UP, ki so najaktivnejši v povezovanju z gospodarstvom, imajo največ težav z ohranitvijo svoje raziskovalne pozicije na univerzi, ker takšnega sodelovanja ne morejo uveljavljati v habilitacijskih merilih. Zato si na UP prizadevajo, da bi dali več točk v habilitacijskih postopkih dodani vrednosti prenosa znanja v gospodarstvo.

Komentar moderatorke dr. Špele Stres:
Profesionalizacija dela v pisarnah za prenos tehnologij bi bila pravi korak v smeri, da bi se tovrstno podporo lahko nudilo.

Prof. dr. Boštjan Zalar:
Govorec meni, da Centri odličnosti sodijo na tisti del lestvice nivoja tehnološke pripravljenosti TRL, kjer govorimo o dolini smrti. Centri odličnosti bi lahko bili zelo učinkoviti na tem področju.

Raziskovalci imajo dokaj deljena mnenja o uspešnosti Centrov odličnosti, ki so bili ustanovljeni v drugem valu v letih 2008 in 2009 in so žal sovpadali s svetovno gospodarsko in finančno krizo. Centri so bili mišljeni kot injekcija v raziskovalno opremo, ki bi bila na uporabo podjetjem. Vendar se je prav v tem obdobju dogajalo podfinanciranje osnovne znanosti. Namesto, da bi država za takšne iniciative našla dodaten denar, je del denarja prenesla iz enega sektorja v drugega.

Centri odličnosti so potrebni, saj se lahko preko njih podpre in mednarodno uveljavi prioritizirano področje znanosti, npr. digitalno transformacijo, kvantne tehnologije in umetno inteligenco, kjer Slovenija kot majhna država naredi preboj v svetovnem merilu.

Pomembno vlogo pri tem ima na IJS pisarna za prenos tehnologij, ki je vez med akademijo in gospodarstvom, predvsem s pravno in sistemsko podporo, z ovrednotenjem učinka in doprinosa raziskovalčevega izuma k dodani vrednosti.

V Sloveniji bo potrebno na pisarne za prenos tehnologij gledati kot na nekaj nujnega, saj sploh niso umeščene v današnjim sistem financiranja. Delo v pisarnah za prenos tehnologij je specifično, ker potrebuje visoko izobražen kader. Od odločevalcev se pričakuje, da bodo na boljši način uredili delo in financiranje pisarn za prenos tehnologij kot del javno raziskovalnih organizacij.

8. Prof. dr. Matej Makarovič, dekan Fakultete za informacijske študije v Novem mestu
Vprašanje: **IKT.** Glede na to, da je ena od temeljnih usmeritev dela Fakultete za informacijske študije prav informatika kot področje raziskav in da je velik del na delo raziskovalcev vezanih inovacij po svoji naravi software. Stanja na področju zaščite programske opreme v Evropski Uniji oz. v Evropi še vedno ne moremo obravnavati kot povsem pravno urejenega, niti kot pravno neurejenega. Področje zato narekuje številne priložnosti za nadaljnje delo. Kako vidite smernice za obravnavo programske opreme, da bi izboljšali stanje s katerim se znanstveniki na področju računalništva soočajo predvsem pa nagrajevanju iz izumov, povezanih s programsko opremo v slovenskem inovacijskem prostoru?

Prof. dr. Matej Makarovič:
V času digitalne transformacije je paradoksalno, da je področje patentov in nagrajevanja inovacij na področju programske opreme do neke mere nedorečeno.

Kadar je inovacija samo na področju programske opreme in ne vključuje strojne razsežnosti, ne omogoča klasičnega polnega preskusa patenta oziroma njegovega tehničnega doprinosa. S tem so raziskovalci, ki inovirajo samo na področju programske opreme, v neenakopravnem položaju, saj se postavlja neka arbitrarna meja pri patentiranju.

To vprašanje bi morali reševati na nivoju Evropske unije. V Sloveniji bi lahko na nacionalnem nivoju uredili npr. nagrajevanje, ki ni samo denarno. Raziskovalce - informatike pritegnejo tudi dobri odnosi, priznanja in možnosti napredovanja.

Z razmislekom glede kriterijev habilitacije in točk, ki se izračunavajo na osnovi SICRIS baze, je možno urediti nagrajevanje inovacij na programski opremi, ki nima strojne dimenzije. Tehnični preskusi patentov namreč prinesejo veliko več točk. To bi lahko bilo priporočilo za ARRS in NAKIS, da se ta dimenzija pri kriterijih za projekte in habilitacije bolj upošteva.

9. Prof. dr. Gregor Majdič, rektor Univerze v Ljubljani
Vprašanje: Eden od prijaviteljev European Digital Innovation Hub (e-DIH) je tudi Fakulteta za elektrotehniko UL. S prehodom inovacij na digitalno področje je programska oprema postala pomemben del sodobnih izumov in stvaritev, hkrati pa predstavlja izjemno pomemben del intelektualne lastnine – tako v slovenskem kot evropskem prostoru. Obenem je prav to področje v praksi najmanj urejeno tudi glede ustanavljanja odcepljenih podjetij, poleg tega pa podjetja v Sloveniji ne dobijo dovolj podpore pri procesih digitalizacije. Kako vidite možnosti, da se to v praksi izboljša in kako so v te napore vpeti vzporedno ali v sodelovanju tako TTO kot DIHi in kje vidite sinergije med njimi?

Prof. dr. Gregor Majdič:
Vsekakor bi tu morale biti povezave in vzporednice. Nenazadnje gre za veliko vzporednic. Pri digitalni transformaciji govorimo od dveh stvareh.

En del so podjetja, ki izvajajo in tržijo digitalne inovacije, na drugi strani pa so pomemben del podjetja, ki proizvajajo druge produkte in pri svojem delovanju uporabljajo digitalna orodja.

Pri ustanavljanju novih podjetij, ki delajo na področju digitalizacije, imajo pisarne za prenos tehnologij klasično vlogo. Pri pomoči pri digitalizaciji drugih podjetij bi pisarne za prenos znanja prav tako lahko imele podobno podporno vlogo kot jo imajo pri drugih vidikih ustanavljanja nekega podjetja, npr. s pomočjo pri birokratskih in finančnih vprašanjih. Tudi pisarne za prenos znanja bi se lahko posvetile digitalizaciji tako, da bi v svoje delovanje vključile digitalizacijo, pomoč podjetjem, našle načine, kako tudi z digitalizacijo pomagati podjetjem, ko se ustanavljajo, prihajajo na trg ter iščejo nove poti za internacionalizacijo in scale-up ter kako pri tem čimbolj izkoristiti digitalizacijo.

Govorec lahko na podlagi lastnega primera, kot znanstvenik na področju znanosti o življenju, ki se ne spozna na digitalizacijo, vidi veliko pomoč pisarn za prenos znanja pri tem.

10. Prof. dr. Urban Bren, prorektor za prenos znanja Univerze v Mariboru
Vprašanje: **Ob tem ne smemo pozabiti, da je eden od prijaviteljeDIH tudi UM.** Naslednje vprašanje pa je **povezano z Open Science.** Univerza v Mariboru se v okviru vzpostavljanja odprte znanosti kot pomemben akter na slovenskem parketu glede naslavljanja vsebin Open Science, še posebej v kontekstu Ustanovitve Slovenske skupnosti odprte znanosti. Kakšna je v**loga TTOjev v upravljanju z IL in hkratnemu spodbujanju raziskovalcev h konceptu odprte znanosti.** European Open Science Community že od leta 2013 vzpostavlja sistem za hranjenje in ponovno uporabo podatkov iz raziskav, ki jih financira država. Če vemo, da je skozi celoten H2020 OpenScience postajal pojem za dostopanje do podatkov, ali smo v večini raziskovalnih skupin danes vsebinsko pripravljeni na dele projektov, kjer je potrebno opisati pretekle data-sete, njihovo validacijo ter prakse open science? Open science sicer ni v nasprotju z zaščito IL, vendar pa oboje sledi nekim pravilom, ki jih je potrebno upoštevati, da se doseže maksimalen vpliv raziskav, kako so z zagotavljanjem vpliva povezani TTOji in če v Sloveniji niso, zakaj ne? Kako vidimo razvoj vseh teh področij v Sloveniji in ali jih vidimo povezano?

Prof. dr. Urban Bren:
Univerza v Mariboru ima resnično številne repozitorije odprte znanosti, ki jih uporabljajo tudi druge institucije.

Vsekakor se odprta znanost sliši odlično na papirju. Odprta znanost je financirana iz javnih sredstev, zato so tudi izsledki javno dostopni. V tem mozaiku pa smo pozabili na založbe, ki večinoma niso javne, zasledujejo tržni princip in zahtevajo plačilo za objavo prispevkov znanstvenikov.

Znanstveniki tako sami plačujemo za odprte članke. Na drugi strani pa mnogo založb zahteva članarino ali direktno plačilo na spletni strani za prebiranje člankov.

Posledično se lahko zgodi, da znanstvenik ne bo mogel objavljati, ali pa bo zelo težko objavljal, če ne bo imel raziskovalnega projekta, s katerim si bo kupil odprtost svojih člankov. ARRS sicer najboljše članke v posamezni kategoriji naslavlja preko njenega razpisa.

Še večji strah in problem pa je v primerih, ko je s tem povezano podjetje, ki ga skrbi, da ne bi izgubilo svoje intelektualne lastnine.

Javnost podatkov, ki jih moramo zasledovati v skladu s strategijo odprte znanosti, predstavlja večji izziv od javnosti objav. Lahko se zgodi, da bo kdo drug na znanstvenikovih odprtih podatkih napisal članek. Še večji izziv pa bi nastal za podjetje, ki sodeluje z javnim zavodom in bi na ta način delilo svoje podatke s konkurenco.

11. Mag. Gregor Umek, vodja Sektorja za industrijo, spodbujanje inovativnosti in tehnologije v Direktoratu za internacionalizacijo, podjetništvo in tehnologije (Ministrstvo za gospodarski razvoj in tehnologijo)
Vprašanje: **Reforma inovacijskega sistema.** V okviru Načrta za okrevanje in odpornost je predvidena tudi reforma na področju RRI. Deležniki inovacijskega okolja v Sloveniji pogosto med seboj niso dovolj povezani. Kako na MGRT razmišljate o možnostih izboljšanja povezav in koherentnosti delovanja inovacijskega okolja?
Kako bi po vašem mnenju lahko dosegli boljše sodelovanje JROjev in gospodarstva ter politike v Sloveniji, tudi z namenom izboljšanja procesov prenosa tehnologij iz JRO v gospodarstvo?

Mag. Gregor Umek:
Reforma RRI znotraj Načrta za okrevanje in odpornost je ključna in predvideva sprejem novega Zakona o znanstvenoraziskovalni in inovacijski dejavnosti (ZZRID). Prav tako je ključna vpeljava novega modela upravljanja in povezovanja deležnikov inovacijskega sistema predvsem preko razvojnega sveta. MGRT je s strani ministrstva, ki naslavlja gospodarstvo, predvidel vključitev direktorjev SPIRIT-a in Slovenskega podjetniškega sklada ter predstavnike SRIP-ov v razvojni svet, ki naj bi na strateški ravni usklajeval politiko.

V programskem svetu sodelujejo MGRT, MIZŠ, Ministrstvo za kmetijstvo in SVRK s svojimi izvajalskimi agencijami, ki implementirajo ukrepe. Trenutno je v pripravi postopek za evalviranje in standardizacijo ukrepov.

Zato sta ključni okrepitvi ARRS-ja in SPIRIT-a, v katerem je predvidena zaposlitev 15 novih ljudi. Področje inovacij bi se upravljalo v okviru Agencije SPIRIT na trodelnem sloju na način, da bi se vse finančne spodbude izvajale preko Agencije, kar je boljše z vidika upravljanja, prav tako podjetja vse dobijo na enem mestu. Tudi vsa mednarodna dejavnost bi se izvajala v sklopu Agencije SPIRIT, kar bi dalo slovenskim inovacijam prepoznavnost na mednarodni ravni. Prav tako bi se v Agenciji upravljali in koordinirali vsi deležniki.

Pri reformi RRI je zelo pomembno, da MGRT v okviru obstoječih razpisov za spodbujanje raziskav in razvoja ter demo pilotov, uvaja v skladu z Načrtom za okrevanje in odpornost načelo, da vsi ukrepi, ki bodo znotraj teh razpisov, ne smejo škodovati okolju. Kar 40% meril mora biti vezano na trajnost in zeleni prehod, kar je ključno tudi v naši industrijski strategiji, v kateri moramo doseči zeleni prehod.

Prav inovacije lahko pripomorejo k zelenemu prehodu, kar je govorec ilustriral na primeru Steklarne Hrastnik, ki je s pomočjo pilotov naredila inovacijo na steklarski peči s ciljem ničelne ogljičnosti.

Pri reformi RRI je ključno stabilno financiranje. Ker imamo pomanjkanje integralnih sredstev, nastanejo vrzeli med več finančnimi kohezijskimi perspektivami, v katerih podjetja ne morejo dve leti dostopati do sredstev.

Ključno je, da se tudi z novim Zakonom o znanstvenoraziskovalni in inovacijski dejavnosti MGRT zavezuje k 1,25% javnemu financiranju, ker morajo imeti podjetja stalen dostop do teh sredstev.

Prav tako je ključno povezovanje vseh ukrepov MGTR-ja in MIZŠ-a za podporo/ financiranje lestvice nivojev tehnološke pripravljenosti, da lahko tudi podjetja na eni točki dostopajo do vseh ukrepov.

MGRT konkretno sodeluje z Gospodarsko zbornice Slovenije pri Načrtu za okrevanje in odpornost, ki lahko da odziv s terena, kaj dejansko podjetja potrebujejo in kje so izzivi, ki jih mora nasloviti MGRT.

Če bomo v Sloveniji želeli financirati vse, kar je vključeno v Načrtu za okrevanje in odpornost, so ključne sheme državnih pomoči. Brez ustreznih shem ni možno financirati investicij pri demo pilotih in zelenega prehoda. Evropski komisiji je potrebno predlagati, da je nujna večja prilagodljivost države članice, ki je omejena s shemami državnih pomoči.

Podvprašanje:
Vloga strateško razvojno inovacijskih partnerstev (SRIP). Vzporedno z vzpostavitvijo Konzorcija za prenos tehnologij s strani MIZŠ se je na MGRT vzpostavil sistem S4 in SRIPi. Danes vidimo, da SRIPi in TTO opravljajo komplementarne storitve (SRIPi informiranje in mreženje podjetij tudi za namen vzpostavljanja tematik za razpisne sheme), TTO pa pri vzpostavljanju odnosov JRO-podjetja igrajo bolj operativno vlogo podpore posamičnim primerom sodelovanja pri vzpostavljanju vsakodnevnih, mukotrpnih gradenj odnosov med posamičnimi podjetji in JRO. SRIPi in TTO se torej prekrivajo v manjšem deležu svojih aktivnosti. Kako naj se vzpostavi aktivna povezava in sinergije med obojimi?

Mag. Gregor Umek:
SRIP-i in pisarne za prenos tehnologij so deležniki inovacijskega sistema, ki z različnim delovanjem povezujejo javne raziskovalne organizacije in gospodarstvo. Pisarne za prenos tehnologij želijo prenesti znanje iz JRO-jev v gospodarstvo. SRIP-i delujejo širše in krepijo razvojno-raziskovalno in inovacijsko dejavnost med gospodarstvom, JRO-ji in tudi drugimi deležniki na področju razvoja. Predvsem pa je vloga SRIP-ov, da povezujejo vse te deležnike v mednarodne verige vrednosti na področju internacionalizacije.

MGRT z MIZŠ in drugimi deležniki sodeluje pri projektu Evropske komisije z naslovom »Strengthening the innovation eco-system in Slovenia«. Ključno sporočilo projekta je, da morajo bolje povezati vse deležnike inovacijskega eko sistema, za kar bodo v Načrtu za okrevanje in odpornost predvidena konkretna finančna sredstva (3 mio EUR) za mreženja, organizacijo delavnic in opolnomočenje med vsemi deležniki. Na ta način lahko povežemo SRIP-e, pisarne za prenos tehnologij in vse deležnike.

12. Mag. Damjana Karlo, vodja Sektorja za strukturne sklade na področju raziskovalno-razvojne dejavnosti (Ministrstvo za izobraževanje, znanost in šport)
Vprašanje: **Konzorciji za prenos tehnologij.** Če pogledamo skozi zadnjih 15 let, Leta 2008 je le redkokdo poznal določbe v Zakonu o izumih iz delovnega razmerja, ki opredeljujejo obvezo države, da financira TTOje za delo z raziskovalci, posebej. Leta 2013 je konzorcij za prenos tehnologij financiral MGRT za slabi dve leti. Rezultati niso bili navdušujoči, čeprav so bili zahtevani rezultati minimalni. Leta 2015 so najprej MGRT, nato pa še skupno SVRK in MIZŠ zavrnili možnost financiranja novega konzorcija za prenos tehnologij, od leta 2017 pa pod okriljem MIZŠ konzorcij uspešno deluje. Kako vidite razvoj področja v zadnjem desetletju na MIZŠ in kako vnaprej, ne toliko glede financiranja, ki je sicer pomembno za trajnostni razvoj področja. Temveč: kako vidite strateški razvoj področja prenosa znanja, njegovega pomena za Slovenijo, možnost in načine profesionalizacije aktivnosti in predvsem povezave z drugimi strateškimi instrumenti?

Mag. Damjana Karlo:
MIZŠ je ta izziv že naslovil iz preteklih izkušenj pri pripravi nove raziskovalne in inovacijske strategije Slovenije do leta 2030. V strategiji namenjajo še večjo težo sistemskemu urejanju področja prenosa znanja, da se okrepi sistemska podpora z integralnimi sredstvi, ki jih 20 JRO-jev pridobi za delovanje. Znotraj teh sredstev bo vsak JRO v skladu s svojo avtonomijo opredelil, koliko sredstev bo namenil področju prenosa tehnologij. MIZŠ želi, da se na vseh 20 JRO ustanovijo pisarne za prenos znanja.

MIZŠ namerava iz evropskih kohezijskih sredstev 2021-2027 nadgraditi obstoječi konzorcij KTT v približno enakem obsegu, ker so praktično že letos doseženi ali preseženi vsi kazalniki projekta, ki se zaključuje 30. junija naslednje leto.

MIZŠ si bo prizadeval, da ne bo prišlo do vrzeli v financiranju in načrtuje objavo javnega razpisa za nadgradnjo konzorcija KTT iz evropske kohezijske politike 2021-2027 takoj, ko bodo izpolnjeni vsi formalni pogoji na ravni države, kar bi lahko bilo od druge polovice leta 2022 dalje.

Komentar moderatorke dr. Špele Stres:
Obe ministrstvi (MGRT in MZIŠ) sta usklajeni v svojem delovanju, da preprečita vrzel v financiranju. Še posebej želi MIZŠ preprečiti vrzel pri financiranju konzorcija KTT. Vendar se projekt KTT zaključuje 30.6. naslednje leto, kar pa pomeni operativno težavo in nastanek vsaj minimalne vrzeli, če bodo razpisi objavljeni v drugi polovici leta 2022.

Kadri za prenos tehnologij, ki so se razvili in profesionalizirali v okviru konzorcija, so izjemnega pomena in bi jih pisarne za prenos tehnologij želele obdržati. Zato bi bilo potrebno vrzel v financiranju čimbolj skrajšati.

13. Prof. dr. Boštjan Zalar, direktor Instituta ''Jožef Stefan''
Vprašanje: **Razdrobljenost.** Kako razdrobljenost raziskovalne sfere (slišali smo, da govorimo o 20 JRO in nekaj desetih nejavnih, ki prav tako izvajajo raziskovalno dejavnost, predvsem iz evropskih sredtsev) v Sloveniji vpliva na kvaliteto storitev TTOjev na posamičnih organizacijah? Je smiselno in upravičeno pričakovati visokokvalitetne storitve za raziskovalce, od vzpostavljanja raziskovalne strategije in pridobivanja financiranja za vse faze TRL (kot npr. pri Fraunhoferju, kjer pregleduje jo vse znanstvene članke raziskovalcev in se odločajo, ali gredo v odprto znanost ali patentiranje), do kapitalizacije na trgu? So take storitve celostno sploh zaželene, saj deloma posegajo v raziskovalno svobodo?

Prof. dr. Boštjan Zalar:
V dvomilijonski naciji ne moremo preslikati učinkovitih rešitev iz velikih nacij, ki so svoje sisteme že zgradile. Zato bomo vedno doživljali rahlo razdrobljenost raziskovalne sfere. Pri reševanju določenega tehnološkega problema se je potrebno ozreti tudi v tujino, ker ni nujno, da bomo v svojem ožjem okolju našli tehnološko rešitev.

Na drugi strani se dnevno postavlja vprašanje, od katere stopnje tehnološke pripravljenosti dalje potrebujemo podporo pisarn za prenos tehnologij. Postavlja se tudi dilema, ali je vse, kar delamo v znanosti (npr. merjenje mase črne snovi v vesolju), možno uvrstiti na lestvico TRL. V znanosti je še vedno en del, kjer bi morala biti lestvica znanja – na kateri stopnji znanja smo in ne na kateri stopnji tehnološke pripravljenosti.

V Sloveniji naj se zgledujemo po dobrih zgledih iz tujine. Evropa je ustanovila Evropski raziskovalni svet. V programu Obzorje Evropa imamo sedaj tudi novo institucijo - Evropski inovacijski svet, ki se ukvarja z vprašanjem, koliko daleč naj posega na lestvici TRL – ali že v osnovni znanosti, ali sploh ne.

ZAKLJUČKI

Gregor Klemenčič, Deepinovations (Nizozemska)
Kot zunanji opazovalec in nekdo z ogromno izkušnjami iz obeh strani, JRO in gospodarstva v inovacijskem sistemu, še posebej glede na to, da ste vanj umeščeni v bolj razvitem tujem okolju, ki se mu želi Slovenija s svojo inovacijsko dejavnostjo približati. Kako v luči današnjega pogovora gledate **na vlogo in pomen različnih deležnikov v inovacijskem okolju**? Kako močno lahko **politika, JRO in TTOji vplivajo na** zagotavljanje inovativnega mišljenja, internacionalizacije, prenosa znanja in izkoriščanja rezultatov? Prosim za zaključno misel.

Zaključna misel:
V njegovem raziskovalnem okolju razdrobljenost obstaja in ni problem, ker gre za razdrobljenost po temah (npr. informacijsko-komunikacijske tehnologije, biotehnologija). Tudi pisarne za prenos tehnologij so praviloma uspešne, še posebej, če se povezane z gospodarskimi zbornicami, drugimi raziskovalnimi organizacijami in komercialnimi firmami.

V pogledu od spodaj navzgor imajo znanstveniki s svojim zagonom, znanjem in interesi možnost, da se srečujejo z drugimi znanstveniki in start-upi. Na zelo uspešnih mikro srečanjih na določeno temo se znanstveniki povežejo in izmenjujejo znanje z drugimi raziskovalci, se povezujejo z malimi, srednjimi podjetji ter pridobijo tudi mikro financiranje.

Komentar moderatorke dr. Špele Stres:
Mikro srečanja so v tej luči vzpostavila B2R sestanke, ki se dogajajo on-line vzporedno s konferenco in iz katerih se lahko razvije dolgoročnejše sodelovanje.

Zaključne misli drugih udeležencev okrogle mize:

Mag. Damjana Karlo:
Znanje je potrebno ne samo ustvariti, ampak ga tudi prenesti v družbo - tako v gospodarstvo kot v širši sistem, zaščititi in pripeljati do inovacij ter na ta način izboljšati našo mednarodno konkurenčnost in izboljšati kakovost življenja.

Prof. dr. Robert Repnik:
Pristop, o katerem smo danes govorili, je pravilen. Vendar ga je potrebno kombinirati s pristopom od spodaj navzgor. Pri tem je potrebno upoštevati, kateri motivacijski elementi bi ljudi prepričali v to, da bi se začeli ukvarjati s srednjimi stopnjami tehnološke pripravljenosti. Prav tako se je potrebno osrediniti na področja, kjer je največ možnosti, potencialov in priložnosti in kjer ima Gospodarska zbornica pomembno vlogo.

Mag. Gregor Umek:
Najpomembnejše je povezovanje med vsemi deležniki, ki je tudi del reforme v Načrtu za okrevanje in odpornost. Povezovanje od spodaj navzgor je zelo pomembno in MGRT že

sodeluje z Gospodarsko zbornico in drugimi deležniki. MGRT mora pridobiti informacije s terena, se primerno odzvati in temu primerno voditi politiko.

Prof. dr. Matej Makarovič:
Ko govorimo o javnem financiranju in javnem raziskovanju, je predvsem pomembno, da služi tudi popravljanju »tržnih napak«, torej zagotavljanju tega, česar trg sam ne zagotavlja. Tipičen primer tega je področje trajnostnega razvoja.

Prof. dr. Maja Ravnikar:
Biti moramo aktivni na promociji znanosti, saj s tem osveščamo družbo in gospodarstvo, kaj je na voljo v Sloveniji. Poleg tega so zelo pomembne mehke veščine in izobraževanje raziskovalcev, kako pravilno pristopiti in se pogovarjati z gospodarstvom ter kako jim ponuditi tehnološke rešitve. Zato so nujno potrebne okrepitve pisarn za prenos tehnologij in znanja.

Prof. dr. Urban Bren:
V Sloveniji imamo dobro izdelan sistem financiranja temeljne znanosti. Aplikativna znanost šepa - kot da potrebujemo samo katalizatorje, potem pa bo prenos znanja stekel sam od sebe. Dejansko pa ta proces stalno potrebuje potisk energije in finančnih sredstev. Potem učinki prelivanja naredijo tak prenos znanja vzdržen in v dobrobit celotne skupnosti. Nekatera odlična orodja kot so mladi raziskovalci v gospodarstvu, mladi raziskovalci na začetku kariere in projekti TRL 3-6 so že razvita in jih je potrebno zgolj kontinuirano uporabljati.

Prof. dr. Gregor Majdič:
V Sloveniji imamo ogromno odlične znanosti, tako bazične kot aplikativne, čeprav sam nikakor nisem zagovornik takšne delitve na bazično in aplikativno znanost saj menim, da je znanost ena. Šepa pa nam pa prenos znanja, premalo znamo izkoristiti to znanje in ga prenesti na trg, da bi imelo tudi ekonomske učinke. Zato potrebujemo pisarne za prenos znanja, ki opravljajo zelo dobro vlogo in je njihov pomen potrebno še okrepiti. So pa v Sloveniji problem tudi kapitalske spodbude in pretakanje kapitala, saj nimamo pravih inštrumentov in vlagateljev v mlada zagonska podjetja. To je posebno velik problem na področju naravoslovja in deloma tehnike, saj so na teh področjih potrebni višji finančni vložki, ki se povrnejo v daljšem časovnem obdobju in zaradi tega je pogosto težko pridobiti zagonski kapital za podjetja s takšnih področij.

Prof. dr. Klavdija Kutnar:
Sporočilo današnje okrogle mize je, da je zelo pomembno povezovanje slovenskih raziskovalnih institucij. Prav partnerji iz drugih institucij so pomagali Univerzi na Primorskem, da so svojo dejavnost dvignili na višji nivo.

Prof. dr. Boštjan Zalar:
Prenehajmo se pogovarjati o temeljnosti in aplikativnosti, raznih lestvicah, saj linearne linije vse med sabo prepletejo.

Zaključna beseda: dr. Špela Stres

Če smo začeli s citatom Winstona Churchila o tem, da se moramo učiti celo življenje, naj tudi končamo na tak način. Vedno se bomo soočali z izzivi, in izzivi bodo vedno večji od nas. G. Churchil je glede našega odziva na izzive rekel Fear is a reaction courage is a decision. Z iskrenim upanjem, da bomo pri soočanju s prihodnostjo pogumni, se vam najlepše zahvaljujemo za vaše sodelovanje na tej izredno zanimivi okrogli mizi.

PITCH COMPETITION: BEST INNOVATION WITH COMMERCIAL POTENTIAL

From 10:30 to 12:00

Moderator:

Robert Blatnik, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Evaluation commission:

Dr. Jon Wulff Petersen, Plougmann Vingtoft

Matthias Keckl, Fraunhofer Technologie-Transfer Fonds (FTTF)

Nina Urbanič, Slovene Enterprise Fund

Gregor Klemenčič, Deep Innovations

Presentation of six (6) selected business model proposals from public research organizations to the technology transfer experts.

Course of the competition

Robert Blatnik, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

The 14th annual competition for the best innovation in 2021 at public research organizations (PROs) aims at stimulating the researchers from public research organizations to develop business models for commercialization of their inventions. The competition was initiated with a public call, which was open to authors of inventive technologies. Eligible authors are individuals, employed at PROs, which are developing innovative technologies and their teams into a viable business model. Possible business models are either licensing the technology to industrial partners or commercialization in a spin-out company. The teams have prepared description of their technology and the key discoveries that underpin the commercial activity (licensing or spin-out creation). An important part of description is the proposed business model and customer value proposition. The pitch presentations are following the guidelines, which were introduced by the Organizer of the Conference at the dedicated preparatory webinar and individual consultancy which was organized for the teams. At the webinar the researchers learned the main guidelines on how to prepare their pitch presentation. In a series of individual consultation and rehearsal of the pitch session we went through the process of preparing a pitch of their invention and business model to a potential investor or a partner in a future venture; either licensing the technology to an industrial partner or via commercializing of the technology in their own spin-out company. We have discussed which are the stronger points in the specific business model of participants and how to prepare an effective and appealing presentation for the intended audience of their pitch. The guidelines for preparing a pitch included the following elements: Cover / Introduction slide (name & compelling tagline); Deal (what you are selling, to whom, for what price); Market & segmentation (target customer, market size, trends); Customer value proposition and why now; Product (the solution); Financials; Impact; Competitive advantage; Team & founder's/inventor's dream; Summary / three key points to remember. The written description of the proposed invention/innovation included the following chapters: Title of the idea with a brief commercial tagline; Summary; The Science; The Opportunity (problem and solution); The Plan (Development stage and Business model); The Team; Impact.

The teams and their applications with the proposed business models were evaluated by an international panel of experts which constituted the evaluation commission. The members of the evaluation commission are the following experts: Matthias Keckl, Managing Partner, Fraunhofer Technologie-Transfer Fonds (FTTF) GmbH, Gregor Klemenčič, Founder and co-owner, Deep Innovations B.V., Nina Urbanič, Adviser for equity investment monitoring, Slovene Enterprise Fund, and Dr. Jon Wulff Petersen, Director, Technology Transfer, Plougmann Vingtoft.

The experts evaluated the proposals in two phases. The 1st phase was the evaluation of written descriptions and the 2nd phase was the evaluation of the five-minute pitch at the Conference. The evaluation experts used the predetermined evaluation criteria which were already defined in the public call. The Criteria for evaluation are Application with weight of 10 points, Value Chain with weight of 3 points, Market size and development costs with weight of 2 points, Competition with 1 point, the Team with 3 points, IPR and Regulatory with one point. All criteria together bring at the most 20 points for written application. After the pitch the experts exchanged their views and opinions and selected the winner(s). The Criteria is presented in the Table 1.

The traditional pitch competition, which this year had its 13th anniversary, motivated six innovative and entrepreneurial research teams to prepare their pitch and apply for competition. Members of the teams have participated in the preparatory workshop and rehearsal to develop their pitch and receive comments for improvements of their proposed business model. The workshop was organized by Center for Technology Transfer and Innovation as part of the KTT project, financed by Slovenian Ministry of education, science and sport. Members of the teams are entirely or partly employed or study at the PROs, Jožef Stefan Institute, Jožef Stefan International Postgraduate School, University of Belgrade. Members of the teams are also the founders or employed at industrial partners, which are already involved in the technology and business model development.

Criteria	**Short description of the criteria**	**Max. points**
Application	Which problem is the technology solving? Has this been verified with end users? What is the Technology Readiness Level (TRL)? How many different applications can the technology be used for? Is there a well-defined end-user for this technology? Is there any barrier to the end-user adopting this solution? Is there a clear existing end user need for this solution? How well does this solution match the users' needs? When will this solution be ready for market? Will this solution have a social impact or bring other benefits to people?	10
Value chain	Where does the technology fit in? How well does the technology fit the existing value chain?	3
Market size and development costs	How is the market size in relation to the development costs? How large is the potential customer community for this product? 1000, 100K, 1M, 100M? How strong is the competition in this market? How receptive will the market be to your idea? What total market share do you expect to get in 5 years? How aligned are the market drivers to the proposed solution? What Is the perceived value by the end user? What is the perceived Strength level overall? What is the perceived Weakness level overall? What is the perceived Opportunity level overall? What is the perceived Threat level in your overall? Only limited development is required before an investor will commit. Funds are available to complete the development investor or other sources (e.g. PoC). The time to market Is shorter or comparable to the time scale for any competition. For VC's: The costs associated with taking the product to market is at least 25 times smaller than the value of the market.	2
Competition	What do the end users use today? Any other technology underway? Which is the expected competition level when you will hit the market How good is the present solution (not yours) in solving the problem? How good will any expected future solutions (not yours) be in solving the problem?	1

	How good will your solution be in solving the problem? How strong is your market differentiator?	
The team	Are the inventors, members of the team, dedicated to the idea? The researchers have unique skills, have experience with tech transfer, and are enthusiastic about following the project through The team has the technical, business, marketing, financing skills needed to understand and develop the idea into a marketable product?	3
IPR & Regulatory	Can the intellectual property of the technology be protected? How strong is the patent likely to be? How dense is the IPR landscape in this technology area in terms of pending and granted patents? How strong is the IPR competition? How complex is the regulatory system in this area Is the technology ready for investment?	1

Table 1: Criteria for evaluating the applications (source: Jon Wulff Petersen, TTO A/S, Denmark)

Abstracts of the competing teams and their technologies

Real-time fluorescence lifetime acquisition system – RfLAS

Authors/inventors: Andrej Seljak, Rok Dolenec, Rok Pestotnik, Matija Milanič, Peter Križan, Samo Korpar

PRO: Jožef Stefan Institute

Abstract:

The present pandemic has shown us how vulnerable we are, and challenged the human knowledge-based capacity to adapt very quickly. Biomedical engineering has produced one of the most outstanding up to date solution to avoid severe consequences due to Covid complications. One of the key tools used in biomedical engineering is measuring of the fluorescence response. This method is non-invasive, sample non-destructive, provides functional and structural information, biochemical parameters, oxygen concentration, pH, and other vital parameters, that enable the study of the interaction of proteins, and is sensitive enough to monitor cellular environment and metabolic states. Moreover, fluorescence is used in material sciences to characterize novel materials or screening drug production as examples. This key tool is made using complex electronic and optical elements, which makes market accessible devices very expensive.

We constructed a novel device, which compared to the current state of the art is about 10 times faster, provides extended capabilities, can be made the size to fit into a portable suitcase, and allows for very competitively pricing on the market, even considering initial small productions. This lands it perfect for start-ups and tech giants in the field, to access tools for future discovery. The technology is also scalable into a variety of different systems for different purposes. Our primary target are therefore biomedical and bioengineering companies, research institutes, universities, and companies requiring specific know how or OEM products.

We expect this technology to enter the biotech market, which alone is expected to hit 2.44T USD in 2028 [*]. This estimate is 3 times higher compared to pre Covid times (about 2 years ago). We present the newly developed device and its envisaged future.

*https://www.grandviewresearch.com/press-release/global-biotechnology-market

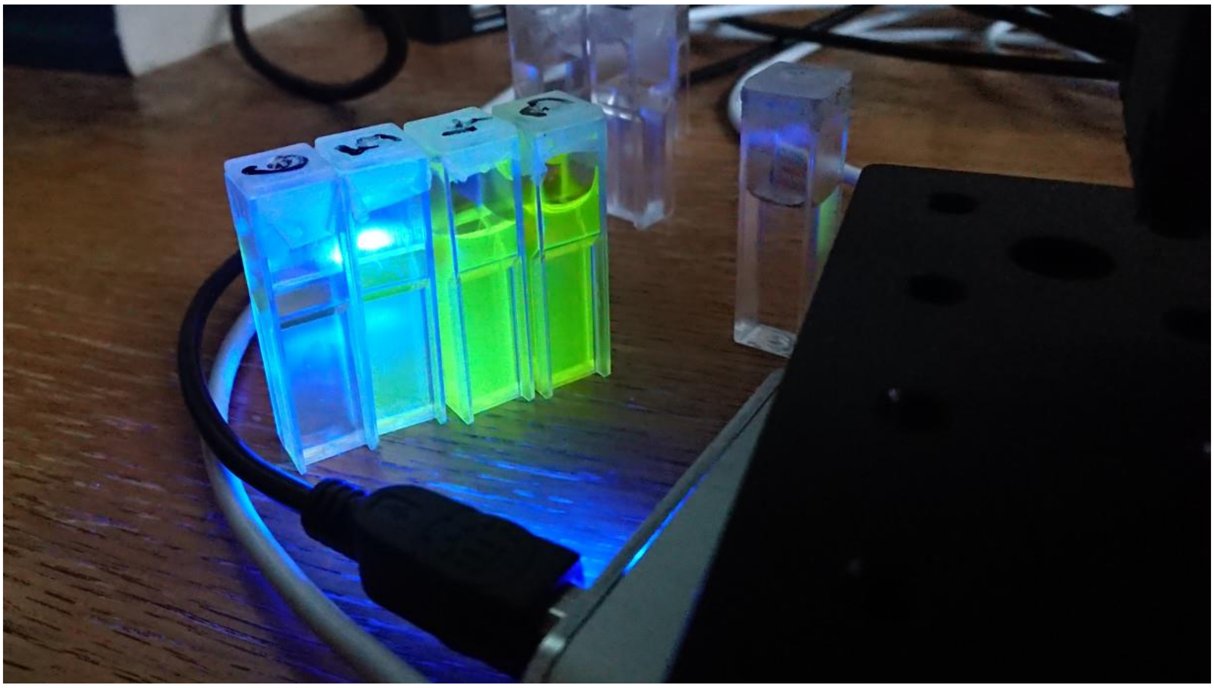

Figure 1: Fluorescence samples. Rok Dolenec. 2020.

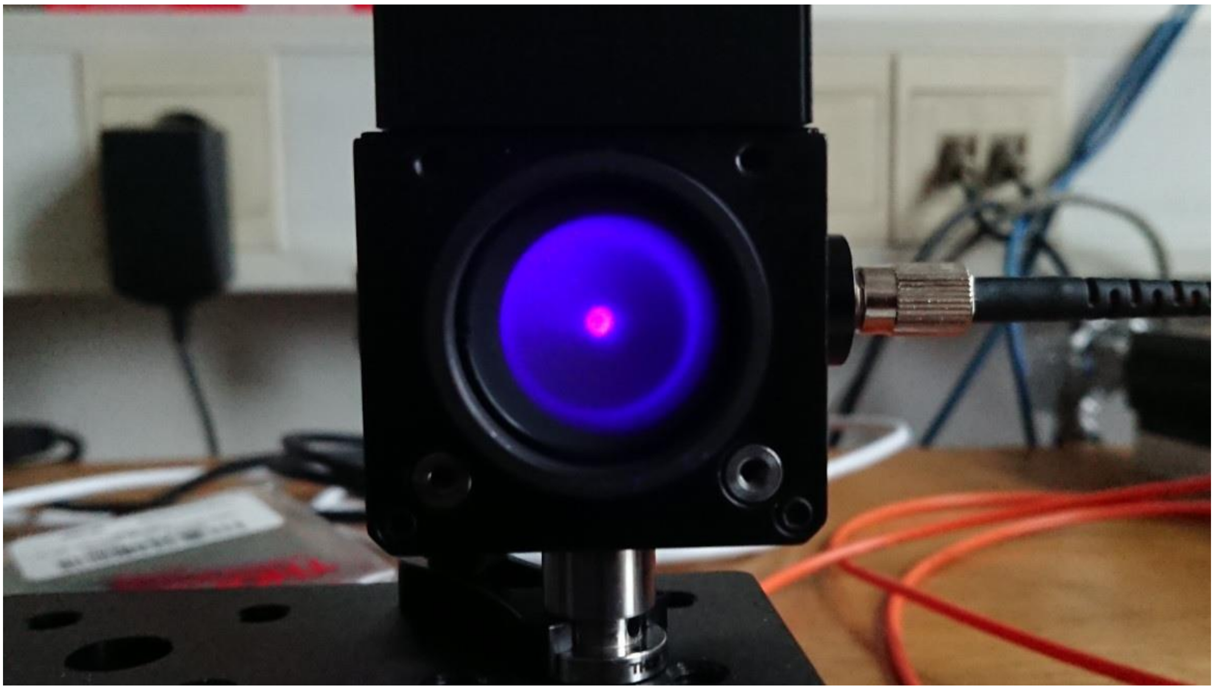

Figure 2: Cross view into sample space. Rok Dolenec. 2020.

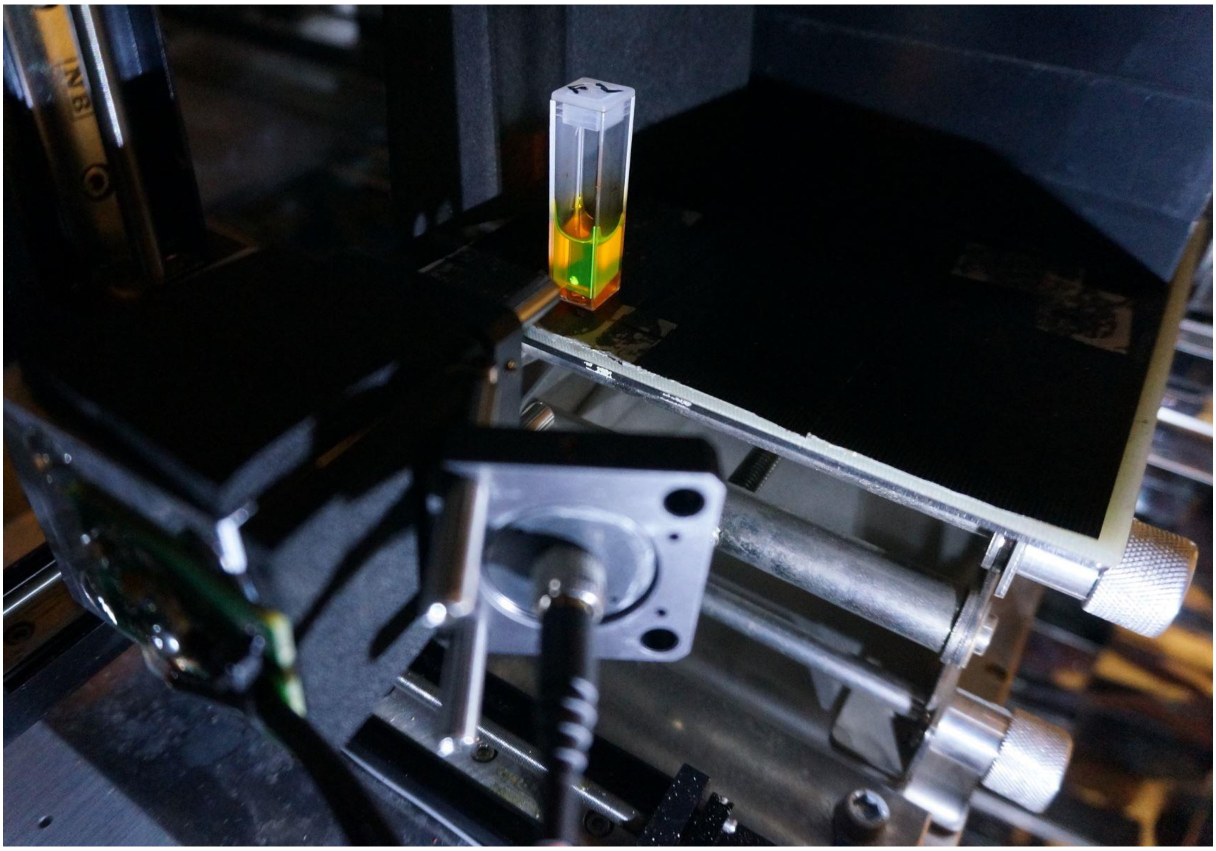
Figure 3: Device in operation. Rok Dolenec. 2020.

Tomappo OptiGarden – healthy, sustainable and nutritious vegetable garden planned in a few clicks

Authors/inventors: Bojan Blažica, Andrejaana Andova, Barbara Koroušić Seljak, Bogdan Filipič.

PRO: Jožef Stefan Institute

Industrial partner: Proventus, d.o.o.

Abstract:

Vegetable gardening is gaining popularity among the younger generation as growing your own local food and taking care of a healthy nutrition is increasingly trendy. Gardening is a rewarding and relaxing hobby, but can also be daunting as there is much knowledge to be considered when planning a healthy, nutritious garden. Considering gardening best practices such as crop-rotation and companion planning, data about vegetables and climate, yield estimation, nutritional contents and the needs and tastes of the gardener can be treated as an optimization problem and thus solved automatically with an algorithm with little effort by the user.

Automatic garden planning can be used to develop solutions in the home and garden market. From powering a mobile application for gardeners (B2C, approx. 5 million potential users in main EU markets, 44 million in the US) to advanced lead generation and e-marketing solutions addressing the need of garden centers and gardening brands to connect to a younger generation of gardeners and digitalize their operations both online and in-store.

A team of researchers with backgrounds in AI, optimisation, meteorology and human-computer interaction, who are keen gardeners themselves, is devoted to bring the benefits of gardening just a click away to all expert and aspiring gardeners. Teaming up with Proventus, the start-up developing the gardening platform Tomappo, ensures market uptake in both B2B and B2C segments and much needed business development experience.

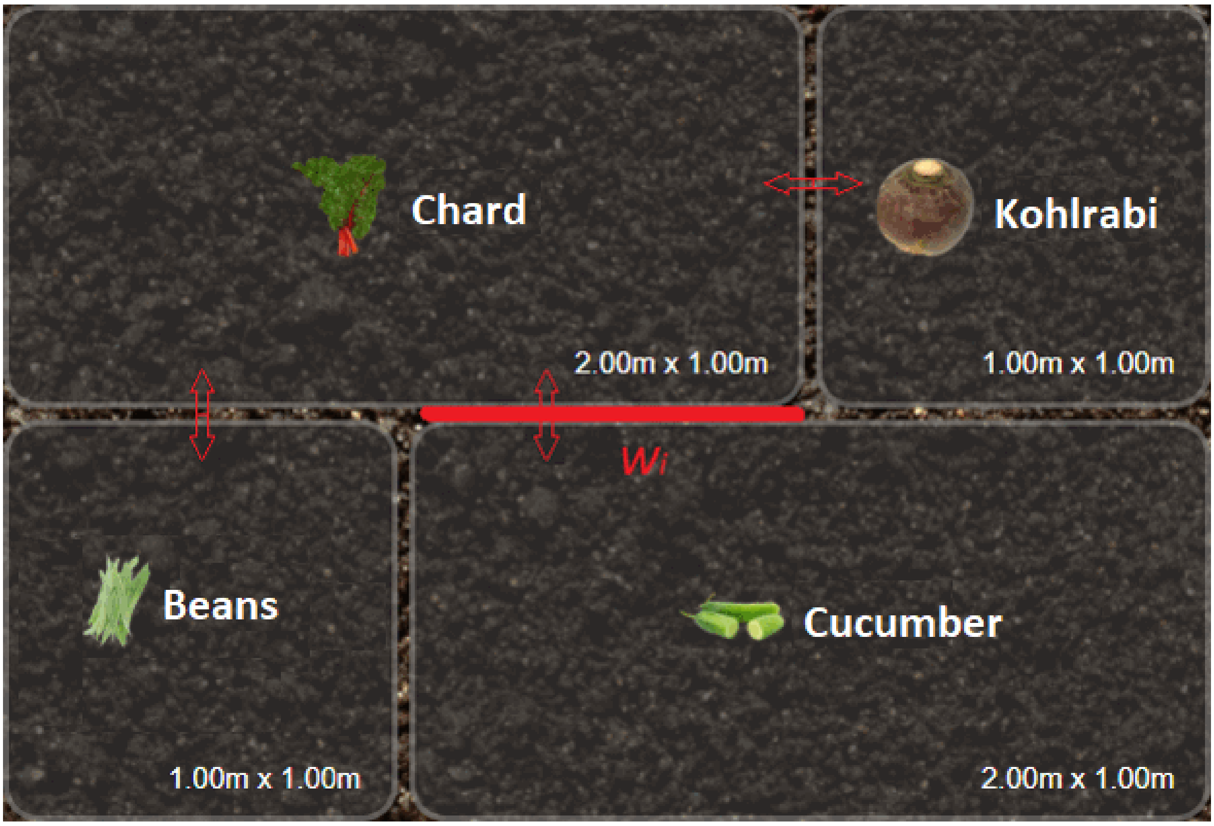

Figure 1: A segment of a vegetable garden illustrating the concepts to be considered in garden planning. Andrejaana Andova and Bogdan Filipič. 2021.

Figure 2: Testing the interactive kiosk in garden centre Kalia, Ljubljana. Bojan Blažica. 2021.

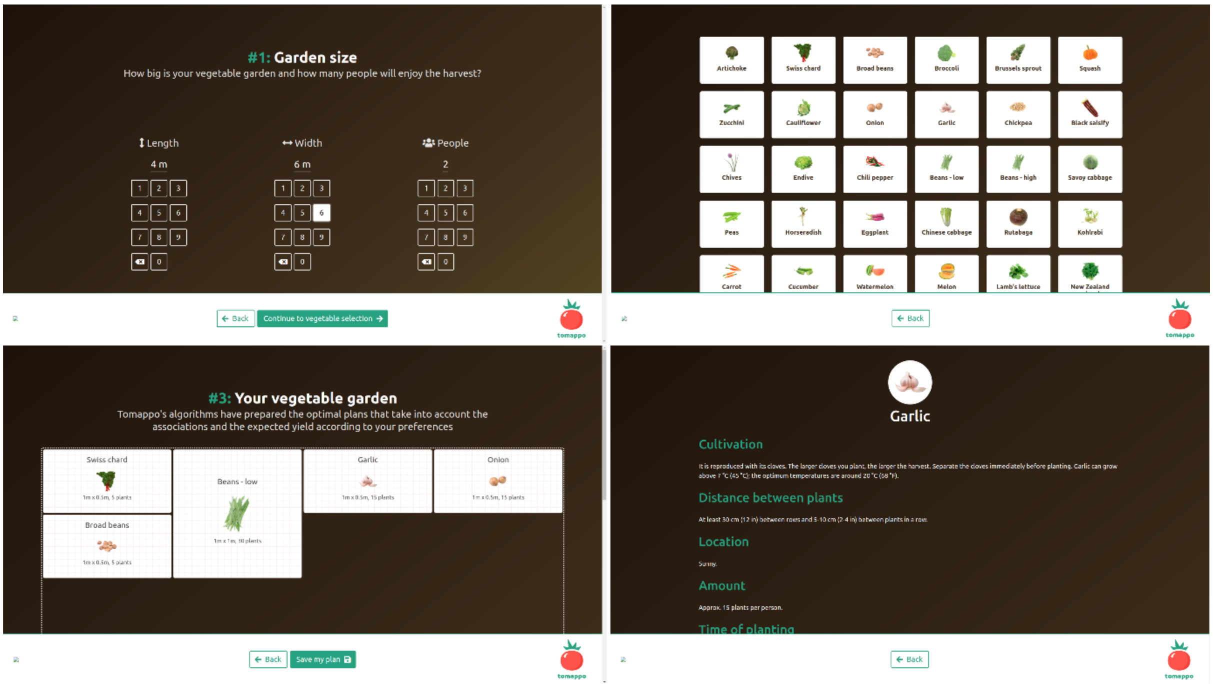

Figure 3: Automatic garden planning on interactive kiosk: input of basic parameters, selection of vegetables, display of different optimal layouts, info about vegetables. Bojan Blažica. 2021.

Novel surface finishing procedures for medical devices, especially vascular stents

Authors/inventors: Ita Junkar, Metka Benčina, Rok Zaplotnik, Matic Resnik

PRO: Jožef Stefan Institute

Abstract:

Cardiovascular diseases cause millions of deaths all over the world and present a serious health care burden. The minimally invasive way to treat diseased blood vessels is by insertion of expandable tubular stent. Currently three types of stents are available on the market; the bare metal stents (BMS), drug eluting stents (DES), and the bioabsorbable stents (BAS). According to Market Data Forecast the European Coronary stents market is estimated to grow to reach 3.64 billion by 2026. Vascular stents have already saved countless lives, but unfortunately their surface properties, which significantly affect biocompatibility, are still far from optimal and there is a huge demand to develop vascular stents with superior properties. The main issues are the stent induced thrombosis (blot clotting) and restenosis (narrowing of blood vessel wall), which are linked with health complications, high health care costs, high demand for medication, and revision surgeries, which can be even fatal for the patient. Numerous approaches have been proposed to improve coronary stent surface mainly by developing various types of coatings, however so far improvements have been only incremental. Our interdisciplinary team (chemical and mechanical engineers, plasma scientists, microbiologist) developed plasma-based approaches for surface modification of biomaterials, especially vascular stents. The novel approach is based on one step plasma treatment, which enables fabrication of multifunctional surface that; prevents platelet adhesion and smooth muscle cell proliferation, promotes proliferation of endothelial cells and reduces bacterial adhesion. By relatively fast and environmentally friendly treatment at optimized plasma conditions it is possible to fabricate nanostructured stent surface with specific surface chemistry, that are mechanically stable, anti-corrosive and can prevent undesired release of toxic ions like Ni in case of NiTi implants.

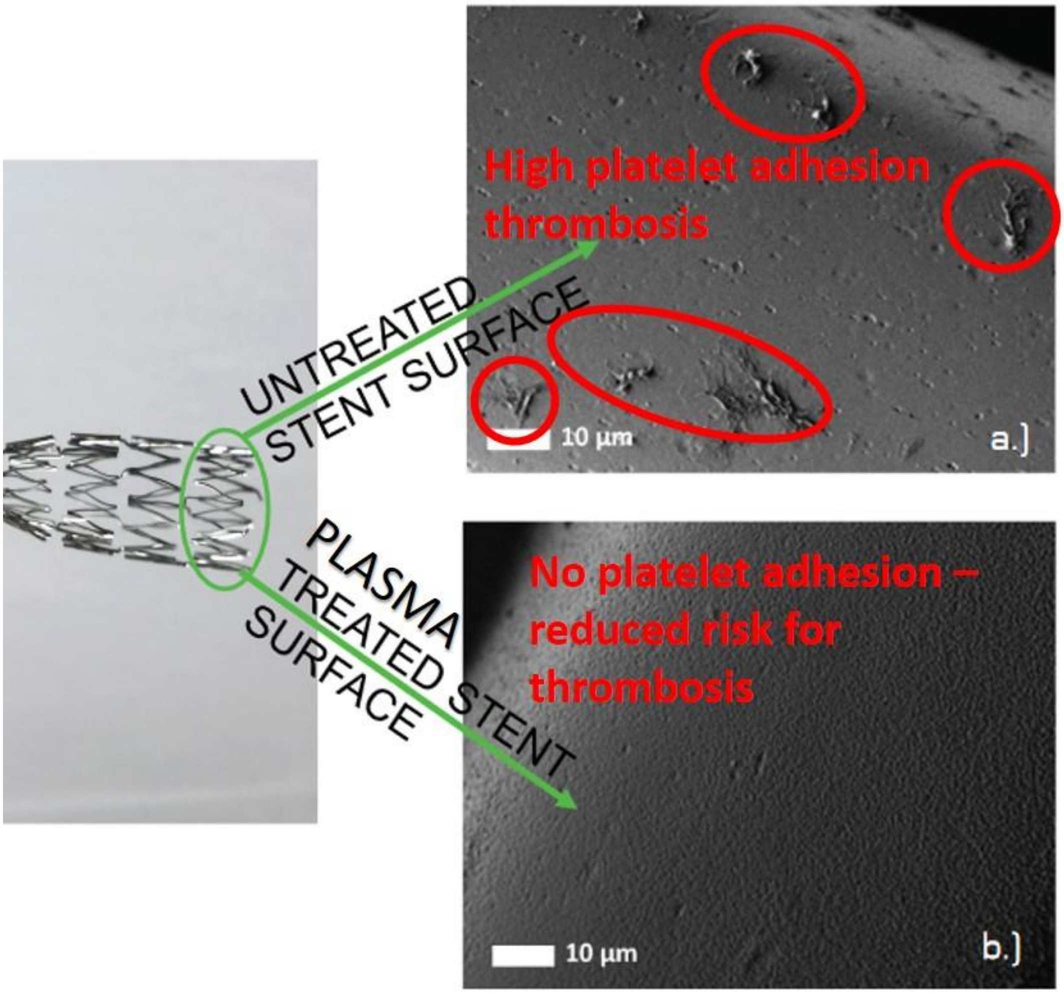

Figure 1: On the left-hand side bare metal vascular stent from NiTi alloy (Kindly donated by Rontis AG) is shown, while stent surface after incubation with whole blood is presented on the right-hand side. Interaction of platelets with the surface of commercial and plasma-treated vascular stent (images obtained from scanning electron microscopy) is shown. Ita Junkar. 2021.

Superhydrophobic coatings with dual action: corrosion and antibacterial/antiviral protection

Authors/inventors: Peter Rodič, Ana Kraš, Barbara Kapun, Chris Černe, Ingrid Milošev, Veronika Bračič

PROs: Jožef Stefan Institute

Abstract:

The innovation is the synthesis and preparation of superhydrophobic coating, which can be deposited on various metal surfaces. The superhydrophobic surface has two principal roles: (i) it repels the solution droplets from the surface and thus acts as corrosion protection since it prevents a corrosive solution to reach the underlying metal substrate and initiate the corrosion process, and (ii) it prevents, or diminishes, the attachment of pathogens (bacteria and viruses) or biofilm (microorganisms) to the surface and thus acts as antimicrobial/antiviral protection.

The development of superhydrophobic coating as corrosion protection responds to the need to extend the lifetime of devices/constructions made of metals. Superhydrophobic coating as antimicrobial protection is required in various critical applications such as hospitals and health care facilities, where microorganisms can be easily spread. Contaminated surfaces such as doorknobs, tables, and utensils used in hospitals/restaurants/hotels/apartment blocks can facilitate the viral transfer. Although surfaces can be sanitised with a variety of household cleaners, sterilising all the surfaces after each use is challenging to maintain. Further, by using disinfectants, the corrosion protection of the metals can be reduced because disinfectants solutions are usually chlorine- or alcohol-based and highly alkaline or acidic. Consequently, they are harsh for many metals such as copper, zinc, steel and aluminium. Therefore, the metal surfaces must be additionally protected against corrosion.

Our innovation can be applied in all the applications where the needs exist to preserve metal surfaces from corrosion and to protect them from the action of microorganisms. Compared to the competition, the main advantage of this coating synthesis is an easy and innovative preparation with desirable superhydrophobic properties.

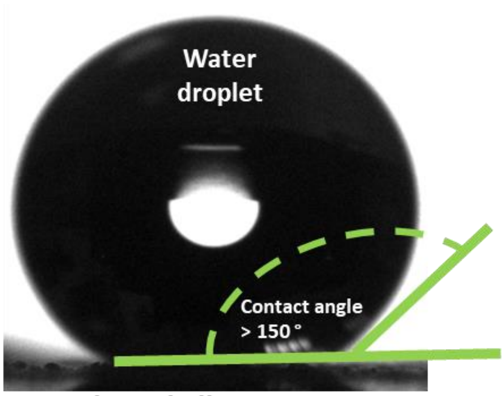

Figure 1: Water droplet on the superhydrophobic surface with contact angle above 150°

Cutting Tool Life Estimator

Authors/inventors: Anže Marinko, Jože Ravničan, Matjaž Gams

PRO: Jožef Stefan Institute, Jožef Stefan International Postgraduate School

Industrial partner: Unior, d.d.

Abstract:

In mechanical engineering, a lot of work is performed on lathes, where the cutting tools wear out over time. Replacing cutting tools is expensive and time consuming so it should be delayed if possible. On the other hand, costs and customer dissatisfaction may be caused by products not performing well if cutting tools are worn out. To avoid non-quality products, replacement of the cutting tool should be performed at optimal time.

Currently, most of cutting-tool replacement if performed by human operators using either human or specialized sensors for inputs. With our Cutting Tool Life Estimator (CTLE), the human operator relies on CTLE sensors detecting 3D accelerations, and the CTLE artificial intelligence (AI) proposing replacement when needed. The role of the human operator changes from the one getting input information and making subjective decision into a second-opinion generator and supervisor since the CTLE system objectively proposes a decision on its own. Compared to human-only decision making, the new approach enables use of more sensors and combining human with artificial intelligence, which in recent years progressed substantially in performing real-life problems based on complex input signals.

The use of CTLE therefore enables better timing of the replacement of the cutting tools. As a consequence, the production is cheaper and of better quality, thus providing an important advantage over competitors in the mature automotive, tool and other mechanical industries. In the future, the CTLE could become more independent, as the program would eventually learn more to predict the time of excessive tool wear and would propose changing the cutting tool at the closer-to-optimal time. Machine learning models in general improve over time when more data are provided.

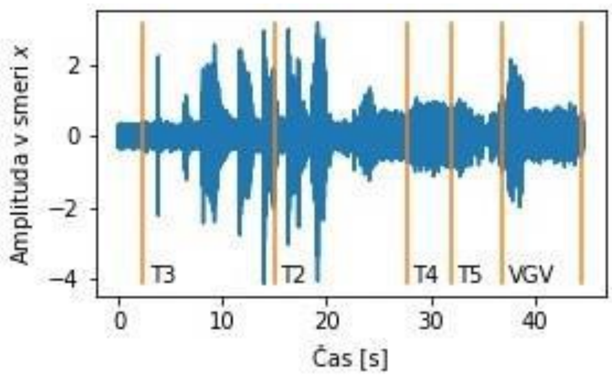

Figure 1: Amplitudes of vibrations in time of one machining cycle. Anže Marinko. 2021.

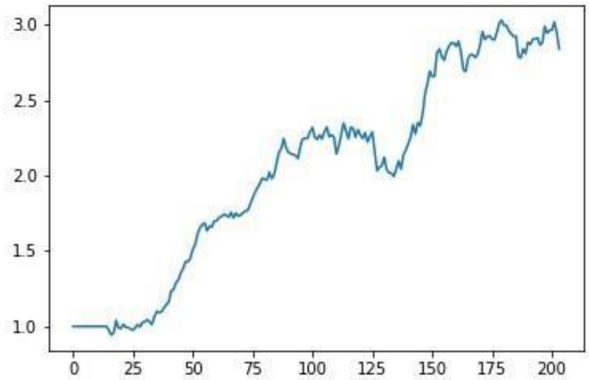

Figure 2: Estimated cutting tool wear during cycles until the cutting tool replacement. Anže Marinko. 2021.

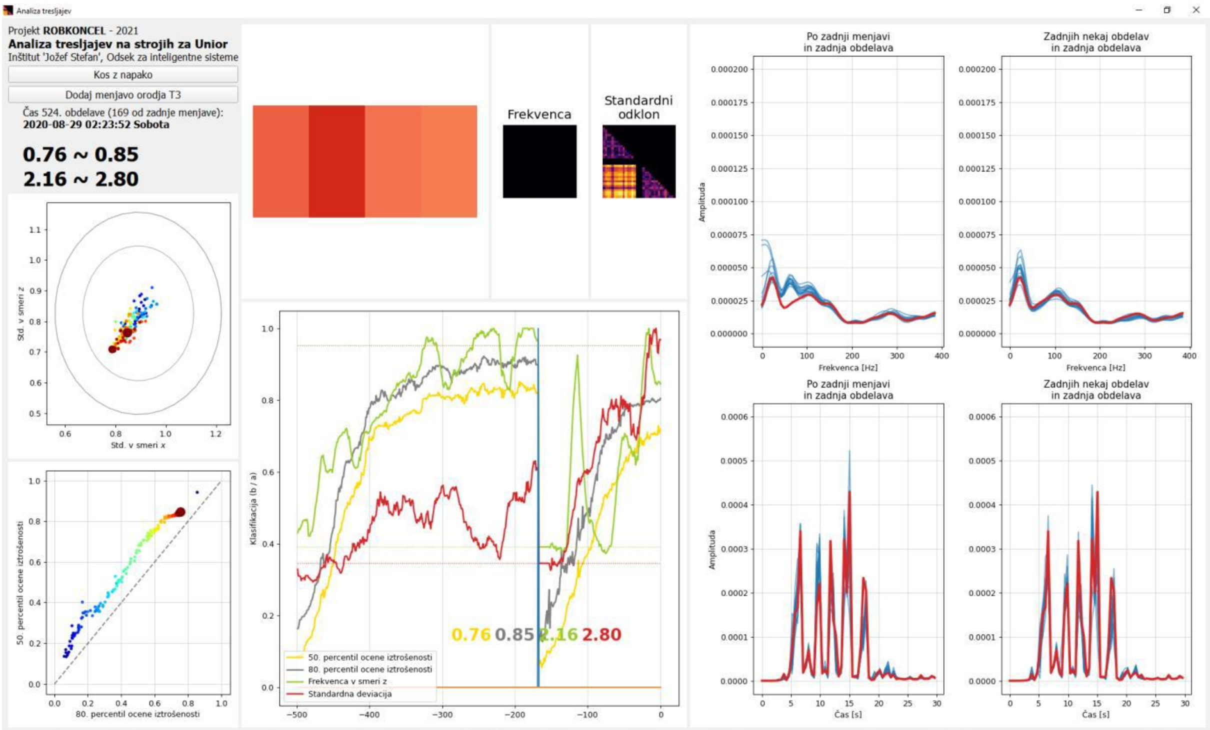

Figure 3: User interface of the program. Anže Marinko. 2021.

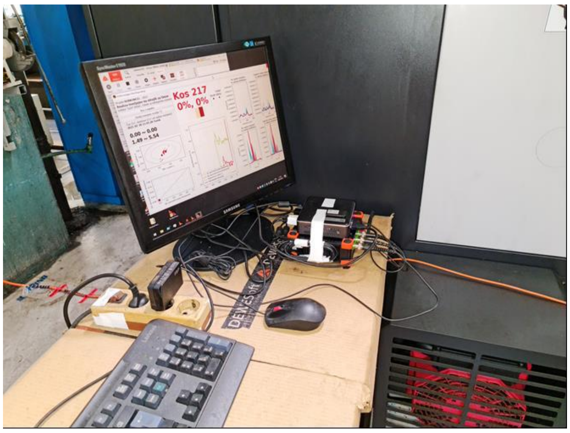

Figure 4: The CTLE systems runs on a PC connected to sensors on a lathe. Application in the UNIOR company. Anže Marinko. 2021.

Award announcement Best innovation with commercial potential

13:00 to 13:10

Moderator:

Robert Blatnik, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Evaluation commission members:

Dr. Jon Wulff Petersen, Plougmann Vingtoft

Matthias Keckl, Fraunhofer Technologie-Transfer Fonds (FTTF)

Nina Urbanič, Slovene Enterprise Fund

Gregor Klemenčič, Deep Innovations

ANNOUNCEMENT OF THE WINNERS

The evaluation commission weighed all the criteria in the evaluation process and selected two equally ranked winning teams.

The award of 1250 Euro goes to the team members:

Andrej Seljak, Rok Dolenec, Rok Pestotnik, Matija Milanič, Peter Križan and Samo Korpar, Jožef Stefan Institute for Real-time fluorescence lifetime acquisition system – RfLAS.

The award of 1250 Euro goes to the team members:

Ita Junkar, Metka Benčina, Rok Zaplotnik and Matic Resnik, Jožef Stefan Institute for Novel surface finishing procedures for medical devices, especially vascular stents.

Congratulations!

Award announcement: WIPO IP Enterprise Trophy

From 13:10 to 13:20

Moderator:

Marjeta Trobec, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Evaluation commission members:

Alojz Barlič, Slovenian Intellectual Property Office (SIPO)

Matthias Keckl, Fraunhofer Technologie-Transfer Fonds (FTTF) GmbH

Nina Urbanič, Slovene Enterprise Fund

ANNOUNCEMENT OF THE WINNER WIPO IP ENTERPRISE TROPHY

Dear Ladies and Gentlemen,

It's a big honour for us to have the World Intellectual Property Organisation and Slovenian Intellectual Property Office among the co-organisers of this conference.

By celebrating the achievements of inventors, creators and innovative companies around the world, the WIPO Awards aim to foster a culture in which innovation and creativity are encouraged and appreciated at every level of society.

Last year at the 13^{th} International Technology Transfer Conference the WIPO awards were given in Slovenia for the first time.

Today we will announce the recipients of two WIPO awards. The awards will be given tomorrow at the conference ceremony between noon and one o'clock and will be accessible via live streaming on the institutes' TV channel.

The selection committee consisting of Mrs. Nina Urbanič, Slovene Enterprise Fund and Mr. Matthias Keckl, Fraunhofer Technologie-Transfer Fonds who you already know, were joined by Mr. Alojz Barlič from the Slovenian Intellectual Property Office.

The WIPO Medal for Inventors will be announced just before the end of the conference.

The WIPO IP Enterprise Trophy is awarding a Slovenian enterprise for its good practice in constant and methodological use of the IP system in its business activities.

The main criteria for the selection were the following:

- the number of cooperations with public research organisations,
- no. of employments of your PhDs from public research organisations,
- new products or services launched to the market based on TT and IP protected,
- public campaigns to promote the appreciation of companies' IP assets,
- encouragements for creative and inventive activity among staff,
- programs to use the IP-based business also for public goals and
- commercial/marketing strategies based on effective use of the IP system.

May I use the words from a member of the selection committee: I am very impressed with the applications, and I think there are a lot of passionate and great people behind the technologies and companies.

Among the applications, the jury has decided to give the IP Enterprise Trophy to GEM Motors.

Short justification: GEM Motors is actively cooperating with several public-research organisations. They have a clear IP strategy with patents in EU, India, USA, Russia, Japan, China and S. Korea and that is essential for B2B business. Their in-wheel patented technology has been presented at several fairs and conferences. Through the social responsibility programs by promoting the urban e-mobility different project partners, other companies and schools are included. And finally, they constantly and methodologically encourage the creativity and innovativeness among their staff and encourage PhD employments.

Congratulations!

Keynote speech: PoC funding of research spin-offs

From 13:20 to 13:40

Matthias Keckl, Managing Partner, Fraunhofer Technologie-Transfer Fonds (FTTF) GmbH

ABSTRACT OF THE KEYNOTE SPEECH

Matthias Keckl is a Managing Partner of the FTTF - Fraunhofer Technologie Transfer Fonds GmbH, an independent Venture Capital unit and financing partner for Deep Tech Start-Ups using Fraunhofer technologies with an investing volume of € 60 million.

FTTF invests exclusively in starts-up using Fraunhofer technologies.

As a strong entrepreneurial partner with 30+ years of experiences in supporting Fraunhofer start-ups, FTTF offers financing in their pre-seed phase with up to 250.000 euros, and in further funding rounds with additional investments of up to five million euros.

FTTF provides fast investments process and on-site support. Moreover, the fund supports entrepreneurs with comprehensive founding experience and a broad network of investors in order to realize the full potential of their companies. FTTF is backed by Fraunhofer-Gesellschaft and the European Investment Fund (EIF).

FTTF focuses on bridging the gap – from tech to market - in close collaboration with internal Fraunhofer tech-transfer and incubation programs, like AHEAD and CoLab.

FTTF has access to German innovation hubs whilst bridging the gap between scientists as founders and investors.

FTTF ensures optimal and efficient setup/ structure of the start-up right from the beginning and provides runway 12 to 18 months.

FTTF begins investing in the very early PoC stage of the start-up (pre-seed) giving researchers the opportunity to start the business.

FTTF invests in the VC start-ups with growth and exit potential as well as funding requirement. FTTF doesn’t invest only in founded companies that are also in pre-revenue phase – start-ups have already started pilot projects but usually do not yet have revenues.

FTTF requirements for a PoC (pre-seed) investment:

- Start-up has to have access to technology:
  - Freedom to operate
  - Acceptable license fees
  - Call option to take over IP, or at least option to start negotiations
- Founding team is the core of any FTTF investment. Investor has to know and understand the people behind the start-up, drivers of the team and their long-term entrepreneurship. FTTF strictly insists that tech competence is part of start-up and the founders are 100% committed to the start-up.

- Business Model characteristics are:
  - Market entry in attractive niche
  - Scalable products
  - Deep understanding of the market environment and problem/ solution fit

FTTF standard investment approach focuses on investing 250k EUR as a convertible loan for the 7,5% shares in the start-up equity. FTTF is usually the first investors whilst other investors may also join PoC investments – excluding strategic investors or non-profit organizations.

Keynote speech: CEETT Platform – Central Eastern European Technology Transfer Platform

From 13:40 to 14:00

Natalija Stošicki, Director, Investments and EU Programmes Department, SID Bank / SID – Slovenska izvozna in razvojna banka

ABSTRACT OF THE KEYNOTE SPEECH

In 2017 and 2018 Slovene Equity Growth Investment Program (SEGIP) with EUR 100m and Croatian Growth Investment Program (CROGIP) with EUR 80m were launched in cooperation between European Investment Fund (EIF) and SID Banka and Croatian Bank for Reconstruction and Development (HBOR), respectively, with the aim to support the growth segment of the private equity market in the two countries.

All available funds were transferred to the private equity funds for further equity and quasi equity funding of Slovene and Croatian companies in growth stage. SEGIP and CROGIP deployment exceeded initial expectations, prompting the parties to enhance the collaboration by expanding the scope of the respective program to the next level - Central Eastern European Technology Transfer (CEETT platform) that is based on the ITA Tech best practices.

The resulting joint initiative is the first investment program under the Central and Eastern European Technology Transfer (CEETT) initiative, to which SID Banka contributed an additional EUR 10 million to SEGIP, HBOR contributed additional EUR 10m to CROGIP and the EIF made further EUR 20 million available for investment. Thus, the total available funding amount indicatively represents EUR 40 million.

CEETT platform will support the most promising technology transfer projects originated at public research organizations in Slovenia and Croatia that would otherwise be considered not mature enough for traditional Venture Capital funds and thus trapped in so called "Valley of Death".

CEETT platform shall actually close two financial gaps (two Valleys of Death) in the TRL ranges 4-9 that are: transition from laboratory to company and scale-up for high-risk innovative start-ups.

Existing grants that are dedicated to fund the TRL phases 1-7 are not big enough and not regularly available. Therefore, Tech Transfer Fund (VC TT Fund) that will address financing to the projects at lower TRL, would be established.

The fund will be focused on technology transfer activities across various fields providing financing primarily to university and research center spin-offs and to projects at the proof-of-concept stage, also providing follow-on financing to these projects at a later stage.

It is expected that projects in the proof-of-concept phase (pre-seed), in terms of the number of investments, will represent a majority focus of the Fund's investments.

Beneficiaries, the enterprises, must be in the seed, start-up or later stage venture investment phase and must originate from a university or research institute.

Fund Manager will be looking for investments in collaboration with public research organizations, academia and industry partners on a contract and NDA basis. Fund manager will

be looking for private co-investors in projects and spin-outs, but also for private investors on the level of the Fund.

Investment program size is for both countries EUR 40m. SID Banka, Croatian Bank for Reconstruction and Development and EIF can invest additional funds in the platform it has promising pipe-line of projects and start-ups. We hope that Republic of Slovenia will complement the CEETT support of technology transfer also with grants for the TRL phases 1-7 taking part of the risk of closing two valleys of death gap, which will additionally incentivise transfer of research achievements and innovations into economy.

Paper presentations: scientific papers on technology transfer and intellectual property

From 14:00 to 15:30

Moderator:

Tomaž Lutman, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Title	Authors
Technology Transfer Fund - Central Eastern European Technology Transfer (CEETT) platform	Marijan Leban Špela Stres
Software Protection and Licensing Challenges in Europe: An Overview	Urška Fric Špela Stres Robert Blatnik
European Guiding principles for knowledge valorisation: An assessment of essential topics to be addressed	Špela Stres Levin Pal Marjeta Trobec
Digital Innovation Hubs and Regional Development: Empirical Evidence from the Western Balkan countries	Bojan Ćudić Špela Stres
Technology Transfer as a Unifying Element in EU Projects of the Center for Technology Transfer and Innovation	Duško Odić Špela Stres
Proof of Concept cases at the Jožef Stefan Institute in 2020 and 2021	Marjeta Trobec Špela Stres
European Industrial Strategy - a great opportunity to strengthen the role of technology transfer offices	Levin Pal France Podobnik Špela Stres
Knowledge generation in citizen science project using on-line tools: CitieS-Health Ljubljana Pilot	Jure Ftičar Miha Pratneker David Kocman
Overview of National Sources of Finance and Supports Available to Spin-Out Companies from Public Research Organizations	Vojka Žunič Marta Klanjšek Gunde
Application of 3D printing, reverse engineering and metrology	Remzo Dedić

	Željko Stojkič Igor Bošnjak
Towards the Market: Novel Antimicrobial Material	Tomaž Lutman Marija Vukomanović
Technology Transfer in Belarus	Alexander Uspenskiy Aliaksei Uspenski Maxim Prybylski

Opportunities arising from publicly funded research projects / presentations of successful scientific projects

From 15:30 to 16:40 (in Slovene and English languages)

Moderators:

dr. Vojka Žunič, National Institute of Chemistry, Knowledge Transfer Office, mag. Jure Vindišar, National Institute of Biology, Technology Transfer Office, Tomaž Lutman, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Title	**Presenter(s)**	**Organization**
Vloga glukagonu podobnega peptida-1 v reprodukciji / The role of GLP-1 in Reproduction	Prof. Dr. Mojca Jensterle Sever	University medical center Ljubljana
Does relatedness matter for bacterial interactions?	Prof. Dr. Ines Mandić-Mulec	Biotechnical faculty, University of Ljubljana
Kanabinoidni receptorji in zdravljenje hormonsko odvisnega raka dojke	Prof. Dr. Nataša Debeljak, Dr. Luka Dobovišek	Faculty of Medicine, University of Ljubljana, Institute of Oncology Ljubljana
6600 years of human and climate impacts on the environment, recorded in the lacustrine sediments of Lake Bohinj	Doc. Dr. Maja Andrič	Slovenian Academy of Sciences and Arts Research done in cooperation with Prof. Andrej Šmuc, University of Ljubljana and Prof. Nives Ogrinc, Jožef Stefan Institute.
COVID-19: Razvoj postopka za testiranje zaščitnih mask	Dr. Polona Kogovšek	National Institute of Biology
How we developed a living coating	Doc. Dr. Aleš Lapanje	Jožef Stefan Institute

DNA technologies and seafood / DNA tehnologije in hrana iz morja	Doc. Dr. Andreja Ramšak	National Institute of Biology

Award announcement: WIPO Medal For Inventors

From 16:40 to 16:50

Moderator:

Marjeta Trobec, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

Evaluation commission members:

Alojz Barlič, Slovenian Intellectual Property Office (SIPO)

Matthias Keckl, Fraunhofer Technologie-Transfer Fonds (FTTF) GmbH

Nina Urbanič, Slovene Enterprise Fund

ANNOUNCEMENT OF THE WINNER WIPO IP MEDAL FOR INVENTORS

Dear Ladies and Gentlemen,

With the World Intellectual Property Organisation and the Slovenian Intellectual Property Office on-board as co-organisers we wish to announce the second WIPO award recipient today.

The WIPO IP Enterprise Trophy is awarding Slovenian enterprises for their good practice in constant and methodological usage of the IP system in their business activities.

That award went to GEM Motors. GEM Motors is actively cooperating with several public-research organisations. They have a clear IP strategy with patents in EU, India, USA, Russia, Japan, China and S. Korea and that is essential for B2B business. Their in-wheel patented technology has been presented at several fairs and conferences. Through the social responsibility programs by promoting the urban e-mobility different project partners, other companies and schools are included. And finally, they constantly and methodologically encourage the creativity and innovativeness among their staff and encourage PhD employments.

On the other hand, the WIPO Medal for Inventors is awarding a Slovenian public researcher for her contribution to the national wealth and development.

The awards will be given tomorrow at the conference ceremony between noon and one o'clock and will be accessible via live streaming on the institutes' TV channel.

The selection committee members were Mrs. Nina Urbanič, Slovene Enterprise Fund, Mr Matthias Keckl, Fraunhofer Technologie-Transfer Fonds and Mr. Alojz Barlič from the Slovenian Intellectual Property Office.

The entry criteria for the selection were granted patents or utility models in the last 10 years. Further the patented invention had to show a significant economic and technological impact in Slovenia via:

- creation of a new company or
- creation of new jobs in the companies that cooperate with the researcher or
- the number of new products and services launched to the market.

May I use the words from a member of the selection committee: I am very impressed with the applications, and I think there are a lot of passionate and great people behind the technologies and companies.

They carefully ranked at all applications and decided that the "WIPO Medal for Inventors" goes to assoc. prof. Marta Klanjšek Gunde, researcher at the National Institute of Chemistry, innovator and a co-founder of a start-up.

Short justification: based on a patented invention, prof. Gunde has established a start-up company MyCol. In the company the licensed technology is a base for developing smart labels with temperature-sensitive ink, which permanently color when heated above a predetermined temperature. The invention resulted also in 5 new jobs created in the company.

Congratulations!

Research2Business meetings (R2B meetings)

Parallel session from 10:00 – 13:20

France Podobnik, Robert Premk, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

One of parallel sessions of *14. International Technology Transfer Conference* were bilateral meetings between researchers and companies (Research-2-Business, R2B). They took place once again in a virtual form due to COVID-19 restrictions, but also because of good experience from 2020 and how well accepted they were last year.

Registration period started already in May 2021 and lasted until the event. In this time 63 participants from 9 countries registered to the event – Slovenia, Belarus, India, Italy, Netherlands, Romania, Serbia, Spain and Turkey. International component of the meetings was also achieved with active support of Enterprise Europe Network members from Italy, Spain, Serbia, North Macedonia, Serbia, Netherlands and Turkey.

Main aim of the meetings was to promote knowledge exchange between academia and companies, especially in terms of cooperation between researchers and company representatives to overcome technology challenges, to discuss available commercially interesting technologies, to find options of cooperation in forthcoming European and other international projects, to get acquainted with experts on specific fields of interest and with the current trends, while also to get familiar with the topics, that might be relevant for companies/researchers in the near future …

Participants were in advance informed about the format of the meetings and how the concept of virtual meetings works in practice to avoid any technical issues at the time of the event. During the meetings main organizer was also available for support to the participants via phone and mail.

At the meetings participated 27 researchers, company representatives and other stakeholders. Their fields of expertise were diverse and covered robotics, artificial intelligence, new materials, (bio)chemistry, biotechnologies, environment, physics, etc. In total 31 meetings took place between 10:00 and 13:00 (CEST).

Virtual concept of meetings allowed participants to attend the meetings from any place at the pre-scheduled time. While the expected time for each conversation was set at 20 minutes, the average length of 31 meeting was around 15 minutes. The shortest meeting lasted 7 minutes, while the longest almost 26 minutes.

As results and feedback from the previous years show, we can expect in the following months that established contacts between participants from the industry and research community will lead to cooperation between them.

Connecting high-school education system with academia: Presentations of selected research topics from Jožef Stefan Institute and proposals for cooperation

Parallel session from 13:20 – 15:20

Moderator:

Urška Mrgole, Jožef Stefan Institute, Center for Technology Transfer and Innovation

About

In accordance with the Jožef Stefan Institute's mission, the Center for Technology Transfer and Innovation promotes scientific work and research accomplishments among young people and the rest of the interested public.

The event

At the 14th International Technology Transfer Conference a parallel section "Connecting the education system with academia: Presentations of selected research topics from the Jožef Stefan Institute and proposals for cooperation" took place. The section was aimed at primary and high school teachers where selected research topics from the Jožef Stefan Institute (JSI) and proposals for cooperation were presented.

At the beginning, activities for the promotion of science and research work, which Center for Technology Transfer and Innovation at the Jožef Stefan Institute carries out independently or in collaboration with the research departments at JSI, were presented. School visits: every Thursday during the school year, the Center for Technology Transfer and Innovation, with the help of other JSI departments, organizes visits to the Institute that are intended for primary and high schools, faculties and everyone else from the school sphere. Open day at JSI: each year at the end of March, traditional Stefan's Days take place at the Institute, marking the birthday (24 March) of the great Slovenian scientist, Jožef Stefan. In the scope of Stefan's Days, the Center for Technology Transfer and Innovation, in cooperation with the JSI research departments, organizes the Open Day at JSI. Visitors can choose from a number of visit programmes and look at the laboratories at Jamova cesta in Ljubljana and at the Reactor Center near Ljubljana. Open Week at JSI: In the scope of Stefan's Days an open week at JSI is organized, where every day of the week one school is welcomed to JSI for a visit. Preparation and implementation of lectures for teachers and principals: for closed groups of professors the Center for Technology Transfer and Innovation can organize trainings and lectures from the Jožef Stefan Institute's field of work with the aim of implementing new in-depth knowledge in classrooms. Mentorships for research assignments of high school students: The researchers from the Jožef Stefan Institute offer mentorships for research assignments for high school students. Participation in various European projects and initiatives such as "Science with and for Society": the Center for transfer technology and innovation at the Jožef Stefan Institute enthusiastically participates in various European projects and initiatives with the aim of promoting science and research work among Youth, e.g. the research festival Znanstival, the European Researchers' Night, and European projects such as STEM4Youth and SciChallenge. Within the STEM4Youth project nine modules in the field of chemistry were prepared and implemented in 19 Slovenian primary and secondary schools, with 20 mentors and over 500 elementary and high school students participating.

In the second part researchers from various research departments presented their work. Dr. Janja Vidmar, Department of Environmental Sciences, O2: The multidisciplinary research of the Department of Environmental Sciences focuses on the combination of physical, chemical and biological processes that influence the environment, man and human activities. One of the recent research projects was related to the investigation of drug abuse in educational institutions using wastewater analysis. Matej Kolarič, mag. biochem., Department of Biochemistry, Molecular and Structural Biology, B1: The mission of the department is related to enzyme analysis, molecular mechanisms of programmed cell death, and the immune response. Areas of research focus on proteolytic enzymes with the aim of treating and detecting diseases and improving the quality of life of patients. At the department the identification and quantification of different proteins, for example in human blood, is done via mass spectrometry. Assist. prof. dr. Peter Rodič, Department of Physical and Organic Chemistry, K3: The department is focused on the investigation of physicochemical processes on the surfaces of solids, such as corrosion and heterogeneous catalysis, as well as the synthesis of new compounds. The goal is to gain new insights and understanding of mechanisms of protection and degradation of materials in different environments. The activities of the department are also related to a phenomenon we all encounter every winter: what is the impact of road salting on corrosion. Sebastjan Nemec, mag. pharm., Department for Materials Synthesis, K8: The research at the Department is devoted to the development of advanced materials. Their main focus of the research are nanoparticles, especially magnetic nanoparticles which can be easily influenced from a distance with a magnet. Mark Zver, M. Sc., Department of Surface Engineering and Optoelectronics, F4: the main activities are focused on plasma generation, sustenance and characterization of the plasma which is later used for tailoring surface properties of various materials. Plasma is the most common state of matter in the visible universe. Low-temperature plasmas are usable for substance removal, surface cleaning, compound application, etc. Erik Novak, mag. prof. mat., Artificial Intelligence Laboratory, E3: The Department for Artificial Intelligence is concerned mainly with research and development in information technologies with an emphasis on artificial intelligence. Their main focus is development of practical solutions useful in the public and private sector. The department cooperates with videolectures.net which is an online repository of lectures from prestigious conferences and events. Dr. Živa Stepančič, Laboratory for Open Systems and Networks, E5: The focus of the laboratory is on research and development of next generation networks, telecommunication technologies, components and integrated systems, information society services and applications etc. The laboratory participated in the SI-PASS project, where hub (network) was established and the national e-services are integrated.

Center for Technology Transfer and Innovation at Jožef Stefan Institute wishes to bring the scientific work and accomplishments as close to the youth, teachers and other interested public as possible, believing that nothing can beat the personal experience and direct contact with the laboratories and top-level researchers. The event proved to be very useful and instructive for teachers who gained new ideas for the implementation of lessons at schools and learned new opportunities to cooperate with the Jožef Stefan Institute.

The Conference closing

From 16:50 to 17:00

Moderator:

Robert Blatnik, Jožef Stefan Institute, Center for Technology Transfer and Innovation (CTT)

It is time to close this year's conference. The topic of the conference was how to bridge the valley of death – and we received some answers to that question today.

While listening to the presentations I will quote dr. Spela Stres from the last year Conference closing: Water dripping day by day wears the hardest rock away (»Tiha voda bregove dere«). Tech transfer is always going to be the silent water almost going unnoticed. But that is how you maximise the impact of tech transfer: by being persistent and persistently professional.

But I would like to add also this, that many small springs of water coming together could bring strong river which is irrigating the deserts.

From the perspective of the Conference organizing committee we can say that this year's conference has been professional in every aspect. We are happy, though, that the conference is behind us, because there is a lot of work put into it every year, and we would like to thank all our colleagues here at the Center for Technology Transfer and Innovation at the Jožef Stefan Institute who worked tirelessly for the conference to take place in such a diverse format and with such perfect execution.

But what actually mattered today was that everyone who followed this conference was able to feel how far we can go with the collective spirit of the researchers from all public research organisations in Slovenia, and we have high hopes that all tech transfer offices are going to join in to that spirit as well. This has been a lovely event, despite the covid-19 situation.

We now feel this has been again the best conference we have ever had. Thank you all and see you soon!

Day 2

CONFERENCE CEREMONY

Overview of the Conference Ceremony

8 October 2021

Jožef Stefan Institute, Ljubljana, Slovenia

Location: Main Lecture room at the Jožef Stefan Institute (A-building)

12:00 – 12:05	Musical performance / Glasbena točka
12:05 – 12:10	**Welcome speech** Prof. Dr. Boštjan Zalar Director of Jožef Stefan Institute
12:10 – 12:20	**Opening speech** Mark Boris Andrijanič Minister za digitalno preobrazbo Republike Slovenije Minister for Digital Transformation
11:20 – 12:25	**Greetings** Prof. Dr. Mojca Ciglarič Chair of the Programme Committee of IS2020 Dean of Faculty of Computer and Information Science
12:25 – 12:55	**Awards of IS2021** prof. dr. Mojca Ciglarič, IS Programme Chair prof. dr. Matjaž Gams, IS Organization Chair prof. dr. Sašo Džeroski, SLAIS President Niko Schlamberger, President of Slovenian Society Informatika prof. dr. Andrej Brodnik, President of ACM Slovenia dr. Mark Pleško, President of Slovenian Academy of Engineering 14. ITTC: Awards ceremony – competition for the best innovation with commercial potential in the year 2021, WIPO Medal for Inventors and WIPO IP Enterprise Trophy 14. ITTC Organising Committee World Intellectual Property Organisation representative / Slovenian Intellectual Property Office representative Awards “Pioneers of computer education in high-schools”
12:55 – 13:00	Musical performance

Indeks avtorjev / Author index

14. mednarodna konferenca o prenosu tehnologij

14th International Technology Transfer Conference

Špela Stres, Robert Blatnik