Zbornik 25. mednarodne multikonference

INFORMACIJSKA DRUŽBA

Zvezek E

Proceedings of the 25th International Multiconference

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Volume E

2022

15. mednarodna konferenca o prenosu tehnologij

15th International Technology Transfer Conference

Urednika • Editors:

Špela Stres, Robert Blatnik

Ljubljana, Slovenija
10.–14. oktober
10–14 October
Ljubljana, Slovenia

http://is.ijs.si

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PREDGOVOR MULTIKONFERENCI INFORMACIJSKA DRUŽBA 2022

Petindvajseta multikonferenca *Informacijska družba* je preživela probleme zaradi korone. Zahvala za skoraj normalno delovanje konference gre predvsem tistim predsednikom konferenc, ki so kljub prvi pandemiji modernega sveta pogumno obdržali visok strokovni nivo.

Pandemija v letih 2020 do danes 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 nadaljuje razpadanje družbenih vrednot ter tragična vojna v Ukrajini, ki lahko pljuskne v Evropo. Se pa zavedanje večine ljudi, da je potrebno podpreti stroko, krepi. Konec koncev je v 2022 v veljavo stopil not raziskovalni zakon, ki bo izboljšal razmere, predvsem leto za letom povečeval sredstva za znanost.

Letos smo v multikonferenco povezali enajst odličnih neodvisnih konferenc, med njimi »Legende računalništva«, s katero postavljamo nov mehanizem promocije informacijske družbe. IS 2022 zajema okoli 200 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. Izbrani prispevki bodo izšli tudi v posebni številki revije Informatica (http://www.informatica.si/), ki se ponaša s 46-letno tradicijo odlične znanstvene revije. Multikonferenco Informacijska družba 2022 sestavljajo naslednje samostojne konference:

- Slovenska konferenca o umetni inteligenci
- Izkopavanje znanja in podatkovna skladišča
- Demografske in družinske analize
- Kognitivna znanost
- Kognitonika
- Legende računalništva
- Vseprisotne zdravstvene storitve in pametni senzorji
- Mednarodna konferenca o prenosu tehnologij
- Vzgoja in izobraževanje v informacijski družbi
- Študentska konferenca o računalniškem raziskovanju
- Matcos 2022

Soorganizatorji in podporniki konference 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. Jadran Lenarčič. Priznanje za dosežek leta pripada ekipi NIJZ za portal zVEM. »Informacijsko limono« za najmanj primerno informacijsko potezo je prejela cenzura na socialnih omrežjih, »informacijsko jagodo« kot najboljšo potezo pa nova elektronska osebna izkaznica. Čestitke nagrajencem!

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

FOREWORD - INFORMATION SOCIETY 2022

The 25th *Information Society Multiconference* (http://is.ijs.si) survived the COVID-19 problems. The multiconference survived due to the conference chairs who bravely decided to continue with their conferences despite the first pandemics in the modern era.

The COVID-19 pandemic from 2020 till now 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, the downfall of societal norms and progress seems to slowly but surely continue along with the tragical war in Ukraine. On the other hand, the awareness of the majority, that science and development are the only perspective for prosperous future, substantially grows. In 2020, a new law regulating Slovenian research was accepted promoting increase of funding year by year.

The Multiconference is running parallel sessions with 200 presentations of scientific papers at eleven conferences, many round tables, workshops and award ceremonies, and 400 attendees. Among the conferences, "Legends of computing" introduce the "Hall of fame" concept for computer science and informatics. Selected papers will be published in the Informatica journal with its 46-years tradition of excellent research publishing.

The Information Society 2022 Multiconference consists of the following conferences:

- Slovenian Conference on Artificial Intelligence
- Data Mining and Data Warehouses
- Cognitive Science
- Demographic and family analyses
- Cognitonics
- Legends of computing
- Pervasive health and smart sensing
- International technology transfer conference
- Education in information society
- Student computer science research conference 2022
- Matcos 2022

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 life-long outstanding contributions is presented in memory of Donald Michie and Alan Turing. The Michie-Turing award was given to Prof. Dr. Jadran Lenarčič for his life-long outstanding contribution to the development and promotion of information society in our country. In addition, the yearly recognition for current achievements was awarded to NIJZ for the zVEM platform. The information lemon goes to the censorship on social networks. The information strawberry as the best information service last year went to the electronic identity card. Congratulations!

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

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PREDGOVOR / FOREWORD

Spoštovani generalni direktor direktorata za znanost dr. Tomaž Boh, spoštovani direktor Instituta »Jožef Stefan«, prof. Boštjan Zalar, spoštovani udeleženci, lepo pozdravljeni in dobrodošli na 15. 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, investment managers, innovators and also representatives from governmental institutions and policy-making organizations.

Najlepše se zahvaljujemo soorganizatorjem ter drugim partnerjem, ki so podprli konferenco.

Začetni del konference s pozdravnimi nagovori bo v slovenščini, nadaljevali pa bomo v angleščini.
Part of the participants is here in the hall at the Jožef Stefan Institute, the other part is with us on Zoom.

The event, except the pitch section, is being recorded. Its parts will be made public in the next days. The welcome addresses will be held in Slovenian, later sections will be in English.
Po pozdravnih nagovorih bo spoštovani gost Michele Neu predstavil kako sodeluje s podjetji The French Alternative Energies and Atomic Energy Commission. Sledilo bo tekmovanje raziskovalno-podjetniških ekip, ki se potegujejo za naziv najboljše inovacije iz javnih raziskovanih organizacij, nato bo razglasitev nagrade Svetovne organizacije za intelektualno lastnino WIPO IP Enterprise Trophy.

Sledili bodo predstavitve odličnih projektov slovenskih znanstvenikov, razglasitev WIPO nagrade Medal for Inventors ter raziskovalni prispevki o prenosu tehnologij in intelektualni lastnini. Vzporedno bo izvedena še sekcija o povezovanju Instituta s šolstvom.

Program je, kot vidite, res bogat, saj se dotika množice aktivnosti, pri katerih smo v pisarnah za prenos tehnologij osrednjega pomena.

Organizacijski odbor 15.ITTC / Organizing Committee of the 15.ITTC

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The main organizer of the 15 ITTC Conference is Jožef Stefan Institute.

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

Prof. Alexandru Marin, University POLITEHNICA of Bucharest

Co-financing

The event is organized and co-financed in the frame of the Enterprise Europe Network (GA project number 101052776).

Collaboration

The 15th ITTC Conference is organized in collaboration with the International multiconference Information Society (IS2022).

Partners

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Lithuanian Innovation Centre

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SI-TT
Slovenian Association of Technology Transfer Professionals

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FIS Fakulteta za informacijske študije
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NIB NACIONALNI INŠTITUT ZA BIOLOGIJO
NATIONAL INSTITUTE OF BIOLOGY

University of Ljubljana

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RRA Koroška – Regionalna razvojna Agencija za Koroško

Inkubator Sežana

ZRS Bistra Ptuj

SIS EGIZ

Namaste – Centre of Excellence

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The editors and organizing committee of the Conference would like to express cordial thanks to all who helped make the 15th 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**:

- Alexandre Massart, co-founder and director, Blend Ventures,
- Jurij Giacomelli, Investment Manager, META Ingenium,
- Michel Neu, International Technology Transfer Expert, CEA Alternative Energies and Atomic Energy Commission,
- Nina Urbanič, Adviser for equity investment monitoring and reporting, Slovene Enterprise Fund,
- Vladimir Jančič, CEO, Publikum Korpfin,

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 **WIPO EVALUATION COMMISSION**:

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Special thanks go also to Slovenian intellectual property office for their help with the organisation, communication with WIPO and presence at the Award ceremony. We thank also to ARRS for their presence at the Award ceremony and WIPO for their video for the Award ceremony.

Technology transfer offices as a facilitator of knowledge triangle integration in the knowledge valorisation era: focus group discourse analysis *

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ABSTRACT / POVZETEK

Knowledge triangle integration, together with knowledge valorisation era, positions technology transfer offices (TTOs) as a central point in transforming research results into the products and solutions for the benefit of economy and society. The present study was qualitative focus group analysis to explore issues and obstacles in communication, how they network and keep relationships with different stakeholders. Analysis showed that the majority of TTOs faced similar problems when it comes to the communication and networking such as lack of resources and low interest or skipping TTOs in the innovation lifecycle. Showcasing success stories and storytelling are suggested as best tools to attract new beneficiaries in the knowledge triangle while cultural change and top-down approach are key to gaining more impact and success.

KEYWORDS / KLJUČNE BESEDE

Technology transfer office, knowledge triangle, knowledge valorization, focus group

1 INTRODUCTION

The knowledge triangle involves different stakeholders with various interests trying to cover three main missions of higher education institutions: education, research and innovation. Knowledge triangle as a concept also tackles different interconnections and relations within the knowledge triangle [1]. Finding synergies and creating new opportunities is of immense importance for the successful knowledge triangle integration [2].

Technology transfer offices (TTOs) are in the center of the knowledge triangle and therefore are in the best position to stimulate its integration. Furthermore, TTOs are in the best position when it comes to the new European commission knowledge valorisation policy aiming to transform the excellent research results and data produced in Europe into sustainable products and solutions for the benefit of society and economy. TTOs, as intermediary organizations, are in a position of creating a channel for knowledge valorisation by improving the conditions for knowledge and technology transfer and serving as the first contact point for industry and researchers in the commercialization process. Through the networking, mentoring, coaching and best practices exchange TTOs can also boost research innovation potential [3].

Information flow and good communication are one of the key enabling factors for building sustainable and long-term cooperation and achieving social and economic benefits of knowledge triangle integration [2]. However, successful and effective communication largely depends on mechanisms of information, promotion and dissemination in addition to the commercialization activities and setting ground for new collaborations [4]. Traditional activities to foster collaboration between universities and businesses are usually focused on networking and matchmaking events. Recently, an ecosystem approach including co-creation and open innovation platforms was introduced, to achieve more concrete outputs [5]. However, TTOs face the challenge of having to communicate with various audiences, which includes businesses, other research organizations, governmental bodies, external partners, NGOs and other decision makers that require distinct key messages and a different approach. TTOs should be the main contact point and the facilitators of these partnerships, however, this is not yet as relevant to the external partners. The contribution of a TTO is crucial and brings value [3].

The aim of the present study was to better explore different aspects and situations of TTO functioning, how they network and how they form and keep relationships with different stakeholders. Furthermore, the aim of the study was to detect main obstacles and opportunities for better communication within the knowledge triangle.

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

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2 METHODOLOGY

The present study was qualitative focus groups discourse analysis and was done as a part of the EIT funded project called CHIC - Creating holistic innovation capacity. Specifically, focus groups were part of the E3 initiative intending to explore issues and obstacles in communication within the knowledge triangle and empowering participating TTOs with the right communication strategies, tools, content and plan that could enhance their outreach. The three Es stand for three essential values: ENGAGE – networking and matchmaking people within the knowledge triangle by equipping TTOs with communication strategies that will; ENABLE – to raise their outreach and strength ties with stakeholders by giving them the right information and the necessary knowledge and actively participating in the knowledge triangle to EVOLVE – by facilitating interactions within the ecosystem and achieving higher engagement. The E3 initiative represents a set of activities and best practices with the main aim of driving the change for a more creative, constructive, collaborative and competitive innovation ecosystem.

Focus groups were held during the international ASTP conference in Lisbon, from 18th till 20th of May 2022. Participants were recruited through a convenient sampling, after submission of an online registration form published on the official ASTP webpage. Prior to the focus group discussion, participants were introduced to the CHIC project and the E3 initiative and were asked to anonymously answer several baseline questions using Mentimeter.com online tool.

Participants were randomly distributed in 4 groups with an even number of participants discussing one of the following topics: i) Networking and KTT ecosystem, ii) TT added value activities, iii) Communication activities, iiii) Stakeholders relationship. Each group participated in two discussions on different topics, to have the overall better input for each discussed topic. Each topic had one moderator, experienced in the tech transfer field and one volunteer reporter taking notes during the discussion. Discussions lasted about 30 minutes after which the moderator changed the table and started the same set of questions with another group.

Discussions were audio recorded and all participants were asked to sign informed consent including recording the discussions. Efforts were made to elicit responses from all participants. Recordings were transcribed for coding and all participant information were anonymized to protect confidentiality. Text analysis was done using Atlas.ti Web (version 4.0.0-2022-07-26) [6] while results were reported using COREQ 32-items checklist for qualitative studies [7].

3 RESULTS

Overall 40 participants were included in the focus groups, 27 female and 13 males, while each group had from 9 to 12 participants. Participants were from all over the world, mostly Europe, but also USA and South Africa (Table 1). Majority of participants, approximately 30% were from TTOs having between 6-10 employees, 22,5% were form TTOs having either from 3-5 or 11-15 employees, while rest were from very small TTOs (1-2 employees), or very big with more than 15 employees (Table 1).

Table 1: Baseline characteristics of included participants

Characteristic	N(%)
Gender	
Male	13 (32,5%)
Female	27 (67,5%)
Size of the TTO	
1-2 employees	5 (12,5%)
3-5 employees	9 (22,5%)
6-10 employees	12 (30%)
11-15 employees	10 (25%)
More than 15 employees	4 (10%)
Countries	**N of participants from each country**
Poland, Ireland	4
UK, Luxembourg, Estonia, Portugal, Hungary	3
USA, Czech Republic, Iceland, Austria, Romania, Netherlands	2
Chile, Sweden, Croatia, South Africa, Germany, Belgium	1

Text analysis was done separately for each of the discussed topics. Regarding the networking and KTT system participants stressed out the importance of organization of different events serving as an opportunity to include different stakeholder groups. Furthermore, showcasing the success stories and storytelling was mentioned a number of times (Table 2).

For the TTO added value services the majority of participants, no matter how big or small TTO provides networking and matchmaking activities, access to finance and having teaching activities on different topics, mostly innovation and entrepreneurship, following managing of innovation funds and organizing specialized events such as hackathons (Table 2).

When it comes to the communication activities participants were very active in terms of defining main barriers in effective communication and suggesting the best tools to overcome those barriers. Lack of resources in terms of time and people and skipping the TTOs completely in the innovation ecosystem were suggested as common barriers. Direct one on one communication, storytelling and having a system of awards or recognized individuals at the university can help in communicating TTO values (Table 2).

For the stakeholder relationship participants came up with the conclusion that TTOs usually have very little impact on the policy making and funding mechanisms unless there are joint efforts on the i.e country level. Majority of the smaller TTOs are driven bottom-up while top-down approach is needed for cultural change and success (Table 2).

Table 2: Summary of topics with examples

Topic	Sub-topics and description	Example
Networking and KTT ecosystem	type of collaborations, how collaborations are establsihed, how active is networking	*"And for the cultural change, it can help if there will be some more pressure in the programs to think about this and to accept technology transfer successes as an equivalent to academic publishing currency."*
TT added value activities	type of services provided and for whom	*"Once a year we are having showcase event where different successful technologies which are patent protected, can be offered, can also be introduced by the research itself, not only by a PD. We also offer entrepreneurial club meetings, where we are supporting and offering some discussions with investors and smaller companies, and so on..."*
Communication activities	main communication barriers, what works best in communication	*"We've created a new title to give - innovation ambassador, something like that. So, each student federation, of each academic unit, or career has a innovation manager and he's a student that goes around and helps us with all our activities, contests, whatever we do. So this ambassador system has worked really good."*
Stakeholders relationship	the position of TT, impact on policy and decision making	*"If you have if you've got an ecosystem that's not developed, you need to be going up to God, you need to all of the universities together. And that becomes a very strong lobby for government to ignore."*

4 CONCLUSION

TTOs can serve as valuable intermediaries in the knowledge valorisation era and can be a first contact in establishing networks and creating ecosystems. Showcasing success stories and storytelling are suggested as best tools to attract new beneficiaries in the knowledge triangle. However, cultural change and a top-down approach are crucial for the healthy ecosystem and success that will be to the benefit of the entire society.

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Proof of Concept typology: a method for classification of PoC activities according to a technology cycle timeframe

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ABSTRACT

The paper presents the results of an experimental study aimed at creating a typology for the Proof of Concept (PoC) activities that could be more domain-specific and help practitioners to develop more effective PoC schemes. The typology has been developed by using real cases from the sample of the European Research Council (ERC) funded PoC projects. The automated subject indexing helped to generate keywords that were matched with technology descriptors from the Gartner Hype Cycles for Emerging Technologies to identify the timeframes for the funding gap according to a Hype Cycle. Accordingly, the PoC activities have been categorized into Pathbreaking PoCs, Mature PoCs and Catching-Up PoCs. The main characteristics have been identified, and further steps for the typology validation presented.

KEYWORDS

Technology, innovations, finance, technological development, transfer of technology, typologies, research and development.

1 INTRODUCTION

The quickening pace of technology developments has created an additional impetus to make the knowledge generation and commercialization processes that lead to the creation of innovations faster, more agile and aligned with technological cycles. McKinsey predicts that more technological progress will come in the decade ahead than in a century [1], hence the urgency for assessing funding for upcoming technologies ahead of time.

It is a broad consensus among academics and practitioners [2,3,4] that the main hurdle for increasing the generation and transfer of scientific knowledge resulting in intellectual property with a potentially high value to be realized in the emerging and existing markets is a funding gap. A gap stands between the need for funding to validate inventions on one side and the lack of market demand for high-risk undertakings on the other. Both popular and academic literature often associate this gap with the term (a metaphorical expression) “Valley of Death”, which designates an initial stage in the technology life cycle where a gap between the development of new scientific knowledge and the commercial development of new products can become fatal to new ideas [5].

1.1 Study aims and research objectives

The presented study has aimed to analyse one of the funding instruments that public funding institutions and, increasingly, also research and technology organizations plan, design, and employ to help scientific research-based inventions overcome the funding gap and move closer to market. The funding scheme in question is called the PoC programme or instrument, which provides on a competitive basis a certain fixed amount of money in the form of a grant, a subsidy, or an investment for the projects that need funds to validate and commercialize new technology. The amounts can vary from ca. 20 to 60 thousand euros for initial PoC grants to more than 100 thousand for more advanced ones.

Two research objectives have been established for this study. First, to create a method that could help categorize the PoC activities according to the logic of the technological life cycles. Second, to test the approach on selected cases of the ERC PoC projects using publicly available data and create a typology of PoCs providing the basic descriptors for individual PoC types.

2 METHODOLOGY AND DATA

2.1 Research design

Any analysis of the PoC projects has a priori limitations due to the confidentiality of the source material (let alone its availability on a scale to allow a representative sample) and the complexity of the scientific, most often interdisciplinary, fields addressed. Hence, the approach adopted for this pilot study on the typology of the PoCs has been based on using the following mechanistic causal inference. If one can assume that the PoC activities can be related to a specific technology life cycle timeframe, then one could categorize PoCs against the time expectancy of that cycle.

Three subsequent tasks have been formulated to meet these objectives. The first task was to explore, using the existing literature, the relationship between time and expectations that define a funding gap and find a way of measuring a timeframe for the current or perceived gap. The second task was to analyse the actual cases of the ERC PoC projects (using the publicly available limited information about the project duration and

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scope) and categorize them according to different timeframes of the expected funding gaps in each case. The third task was to describe the categories and discuss avenues for further research in validating the proposed typology and its uses for practitioners.

2.2 Data sets

Three datasets have been compiled to complete the tasks. Below is a brief description of each. Due to the space limitation for this paper, the data has not been included in an appendix. They could be provided upon request or shared through a public repository.

Dataset 1 in an Excel file contains details about 1225 PoC projects covering the period from 2014 to 2023 [6]. The following variables in the dataset have been used for analysis: project title, a project abstract, fields of science, and project start and end dates. Dataset 2 in an Excel file contains the information about the upcoming technology areas taken from the Gartner Hype Cycles for Emerging Technologies for the period from 2011 to 2022 (altogether 425 entries, of which 134 are unique ones); all accessed through Google search. The following variables in this dataset have been used for analysis: technology descriptor, year of appearance on a Gartner hype cycle, the minimum and the maximum years remaining to reach “the Plateau” (to be referred to as a market maturity) on a hype curve.

Dataset 3 is a subset of Dataset 1 in an Excel file containing information about 10 PoCs projects covering the period from 2016 to 2022. The cases for analysis were selected from the first 300 search results filtered down by the scientific fields of “engineering and technology/electrical engineering, electronic engineering, information engineering/electronic engineering”. The following variables in the dataset have been used further: project title, URL (a reference to the project description on the Cordis website), five most relevant keywords generated from the abstract using a web-based automated subject indexing service Finto AI (see below), project start date, the matching emerging technology descriptor, the earliest and the latest year for reaching a market maturity (the latter two taken from Database 2).

3 CURRENT STATE OF RESEARCH AND DESIGN OF PoCs

The existing PoC schemes, their design and their basic characterisation, have been recently quite extensively analysed [7-11]. Bataglia et al. (2021a) analysed the operationalisation of PoC instruments in a selected higher education institution and looked at different enablers that contribute to implementing PoCs. Further, Bataglia et al. (2021b) compared different PoCs and analysed the determinants influencing commercialisation outputs in these cases. Munari and Toschi (2021) compared the valorisation outcomes of those obtained with a PoC grant to a group of projects that applied to the PoC scheme but were not funded. The authors confirmed that the instrument was effective in the early valorisation of scientific discoveries. Munari and Wessner (2017) conducted an in-depth analysis of the ERC PoC programme to understand better how well the PoC scheme contributes to maximising the value of ERC-funded research by facilitating its commercial and social potential development. These and other academic contributions helped to map out the rationale behind the PoC schemes and their current uses by institutions from the perspective of a generic approach to the R&D life cycle and innovation. The research completed to date helped to assess individual PoC instruments according to the scope and size of funding, yet did not attempt to categorize PoCs.

The academic interest in PoC schemes has mirrored the institutionalization of this public funding instrument, which has also been adopted by leading RTOs and universities. France has been the first to introduce PoC funding in its “Investing in the Future Programme” (2009-2011). The idea has been picked up by other EU Member States (e.g., EXIST programme in Germany) before being adopted EU-wide. Since 2011 the European Research Council has been running a PoC scheme as a top-up funding opportunity for the ERC grantees aiming to bring their research results closer to market. From 2011 until June 2022 ERC funded 1469 PoCs (the success rate stood at almost 30%).

At the same time, the research and technology organizations (RTO), both public and private, have started experimenting with different approaches to foster academic entrepreneurship and commercialization by adopting a mixture of traditional product development methods such as stage-gate processes and agile processes taken from lean management and startup development. CEA, TNO, SINTEF, Tecnalia and other major RTOs have set up internal PoC schemes to provide extra funding and additional support (including mentorship and guidance with industry expertise) to the selected teams of their researchers with credible ambition to create a viable commercial product or a spin-off [12].

4 ANALYSIS

4.1 Timeframes in the technology life cycles

The literature shows that a funding gap for PoC activities can be expressed and measured in terms of technology or investment readiness levels, time-to-market, person-months, and other performance indicators [7, 8]. However, for simplicity, this study uses a single indicator: a PoC timeframe. A PoC timeframe is a period from the start of the PoC activity until the market maturity of the relevant emerging technology field. A mature market is considered a stage where the growth rate slows to almost zero.

According to the generally accepted definition, a funding gap is the amount of money needed to fund the ongoing operations or future development of a business or project that is not currently funded with cash, equity, or debt [13]. Funding gaps can be covered by investment from venture capital or angel investors, equity sales, debt offerings, bank loans, and public funding programmes. Public and private investments attracted to address a particular funding gap are driven by various factors, of which the expectations about the potential of realising a substantial value out of the results of the R&D activities are of prime importance. Hence, one can argue that a funding gap is a function of the perceived and experienced trajectory of the technological cycle associated with technological breakthroughs and markets.

A hype cycle model introduced by Gartner Inc. in 1995 has become a standard approach to outline how the development of technologies is perceived [14, 15]. It plots a generally applicable path a technology takes in terms of expectations or visibility of the value of the technology (y-axis) as related to time (x-axis). The model incorporated two distinct equations/curves adopted from behavioural psychology and technology management studies, that is a hype curve shape for human expectations about any new technology and a classical technology diffusion S-curve showing the proliferation of the technology on the market [16].

Most recently, a new approach based on the insights from neuroscience has been taken into consideration when analysing the Gartner Hype Cycle [17]. The latest research has focused on exploring expectation dynamics in early-stage innovations to explain the hype cycle phenomenon that precedes innovation adoption. Different types of expectations (emotional and logical) and speed of acceptance or abandonment of new technology have been observed as being dependent upon time [17]. The faster the time-to-market, the more emotional and rapid the acceptance of technology, which creates logical expectations and drives the hype cycle of emerging technology. Hence, the duration of any technology validation is hype cycle time and domain-dependent.

Any technology development is always a design process. The philosophers of science agree that new technology becomes accepted through five types of experiments, efforts aimed at empirically demonstrating the proper development and working of technology, including feasibility experiments, trial experiments, field experiments, comparative experiments, and controlled experiments [18]. The results of individual experimentations thus lead to obtaining proof of concept, understood as an artifact that acts in this role to demonstrate the technology at a required level of complexity. The PoC activities include verification tasks and actions (evaluation of risk assessment, product and process capabilities, compliance with requirements, proof of concept through analysis, modelling and simulation, demonstrations and tests) and validation methods (prototyping, demonstration, market tests, field trials) [19].

4.2 Subject indexing and categorization of PoCs

The categorization of PoCs is an open-ended and ad hoc process. It relies on applicants' self-reporting and keyword assignment by funding agencies' staff and expert bodies. The interdisciplinary and inter-sectorial nature of the PoC projects creates difficulties in categorizing the PoCs due to their multidisciplinary, cross-sectorial and both scientific research and market-oriented nature.

Thus, for this study, the use of an automated AI-driven subject indexing tool has been sought. The used system (Finto AI) is based on the open-source AI-driven tool Annif for indexing and classification developed by a national library consortium to categorise text in several languages, including English [20]. The tool uses text classification algorithms and a neural network model based on TensorFlow trained on the General Finnish Ontology (linked to the US Library of Congress Classification).

The subject indexing was done as follows. The text of each full abstract of the project in Dataset 3 was entered into Finto AI online tool, and the obtained five most relevant keywords were added to the project entry in Dataset 3. Then the keywords were searched in Dataset 2 containing the Gartner Hype Cycle emerging technologies. The descriptor of the corresponding technology was included in Dataset 3 to identify the match. The keywords have been manually cross-checked with the emerging technology descriptors in Dataset 2, searching for matches. The matches have been identified if the wording was synonymous or related. The EuroSciVoc taxonomy has been consulted, where there was an additional need to clarify individual keywords.

The PoCs have been categorized according to the following procedure. First, the start dates of the analysed PoC projects have been correlated with the remaining years of the corresponding matching emerging technologies using the latest reported data from the annual Gartner Hype Cycles of Emerging Technologies. The PoCs have been classified according to the following principle. If the start of the year of the PoC activity was behind the estimated year for reaching the market maturity of the corresponding emerging technology, then the PoC was assigned to the category of “Catching Up PoC” (Type 3). If the start of the PoC activity was ahead of the emerging technology reaching market maturity by the earliest estimated date, then the PoC activity was assigned to the category of “Mature PoC” (Type 2). If the start of the PoC activity was ahead of the emerging technology reaching market maturity by the latest estimated date by more than ten years, then the PoC activity was assigned to the category of “Pathbreaking PoC” (Type 1).

Finally, to validate the approach, each categorized PoC activity from Dataset 3 has been additionally researched using publicly available sources, trying to find details about the follow-up activities confirming one of the patterns associated with these categories. Namely, in the cases of Pathbreaking PoCs, numerous scientific activities had to be observed, which are associated with the early stages of technology development. In the cases of Mature PoCs, more applied research activities could be expected, while in the case of Catching-up PoCs, the follow-up in terms of research activities expected to be relatively minimal. Thus, a typology of PoC has been created consisting of three categories. Table 2 summarizes their main characteristics.

Table 1: A preliminary typology of PoCs

PoC Type	Hype Cycle stage	Time to market maturity
Type 1: Pathbreaking	Innovation/Technology Trigger Peak of Inflated Expectations	7-13 years
Type 2: Mature	Peak of Inflated Expectations Trough of Disillusionment	2-8 years
Type 3: Catching Up	Trough of Disillusionment Plateau of Productivity	0-4 years

Table 2: Main details of the analysed PoCs

PoC No.	Keywords generated by Finto AI	Gartner descriptor	PoC Type
196345	EEG, brain, signal processing, diagnostics, measurement	Brain-computer interface	Type 1
200027	mobile communication networks, data communications networks, technology, product development, telecommunications technology	Machine-to-machine communication (M2M)	Type 2
202878	antibiotics, bacteria, antibiotic resistance, enterprises, pathogens	Biochips	Type 1
207634	video, content production, social media, content, YouTube	Social TV	Type 3
211122	energy consumption, high-speed technology, electronics, technology, consumption	Quantum computing	Type 1
211988	signal processing, lasers, optics, data transfer, polaritons	M2M	Type 2
216265	patients, metabolic disorders, public health service, wireless data transmission, monitoring	Home Health Monitoring	Type 3
220480	machine learning, energy efficiency, enterprises, simulation, simulators	Low-cost single-board computers on the edge	Type 1
220708	robots, robotics, automation, recycling, industrial automation	Mobile Robots	Type 2
227183	nanostructures, sensors, diodes, beamforming, light-emitting diodes	Not covered	Type 1

5 CONCLUSIONS AND LIMITATIONS

The study has helped to create a method to quickly categorize the PoC activities using the Gardner Technology Hype Cycles for Emerging Technologies. It helped to establish a typology with three possible types for classifying PoCs into Pathbreaking PoCs, Mature PoCs and Catching-Up PoCs. Those categories can provide an additional indication of the expected timeframes of PoCs and a potential funding gap ahead. Yet, they do not offer clues for assessing the potential value of the categorized PoCs. The typology could help to do a quick check on any technology-based product idea where the time prospects of the market are uncertain at a given moment of the technology development. The applicability of this typology requires validation using full details of a representative sample of PoCs. However, one can only achieve that on a limited scope due to confidentiality limitations.

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The "Incubator of Innovativeness" program driving technical readiness levels of the Cracow University of Technology Innovations

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ABSTRACT

This paper presents the implementation of the Polish governmental "Incubator of innovativeness" program at the Cracow University of Technology. It deals with the methodology of projects' selection, management of Proof-of-Concept research, intellectual property protection, and commercialization process. It presents the barriers and challenges encountered in the process and recommends the improvements for the next editions of the program.

KEYWORDS

innovation, technology, transfer, TRL, technical readiness level, Proof-of-Concept, research funding

1 BACKGROUND AND RATIONALE

One of the objectives of the Center for Technology Transfer (CTT) of the Cracow University of Technology (CUT) in Kraków, Poland, is maximizing impact of scientific research through its successful commercialization. The capability of technology to be practically implemented is highly dependent on its development stage and is measured by the TRL level (Technical Readiness Level).

The critical advancement on the way of solution development is moving from the basic technology readiness level TRL 1-2 (basic principles observed, technology concept formulated) to a higher level, preferably 5-6 (technology validated and demonstrated in relevant environment). While the former is typically financed by universities and governmental scientific and R&D funds, the latter is just the beginning of VC and industry interest in technology. This gap in funding of technology development is often referred to as a "death valley", since public institutions' funding focuses on scientific results, while business investment is justifiable only in case of technologies ripe for implementation. This is well known from the literature [1] and the tech transfer practice in various TTO environments.

The road from idea to innovation leads through Proof-of-Concept, which is TRL level 3.

As commonly defined by EU institutions [2] Proof-of-Concept (PoC) is "1. the realization of a method or idea in order to demonstrate its feasibility, or to verify that a concept or theory has practical potential; 2. evidence, typically deriving from an experiment or pilot project, which demonstrates that a design concept, business proposal, etc. is feasible; 3. a small exercise to test a design idea or assumption.

A desirable effect of PoC research is transition from prototype to a Minimum Viable Product (MVP) on the way to a fully blown commercial product.

2 InIn PROGRAM OF THE POLISH MINISTRY OF EDUCATION AND SCIENCE

Ministry of Education and Science in Poland has addressed this issue by creating and maintaining the program called "Incubator of Innovativeness" (InIn), which started in 2014 and is currently continued in the 4th edition.

The objective of the program is to support entities active in the field of commercialization of the results of scientific research and R&D, in initiating cooperation of academia with the business environment and application in the specific market solutions. The "Incubator of Innovation 4.0" program initiated in 2020 provides support to "Innovation Incubators", i.e., universities and their special purpose vehicles (SPVs) – wholly owned university companies - or consortia established by universities, SPVs, scientific institutes of the Polish Academy of Sciences, research institutes or international scientific institutions. The support is provided for the following activities:

- conducting pre-implementation (PoC) research, including additional laboratory tests or adapting the invention to the needs of the interested buyer, the cost of which may not exceed PLN 100 k;
- the analysis of the market potential of inventions and the analysis of their readiness for implementation, as well as the valuation of intellectual property rights (IPR management);
- identifying entities interested in implementing the research results and development works;

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- technology portfolio management.

In 2014 Center for Technology Transfer of CUT created a consortium with the SPV of CUT Intech PK (Intech) and since then has successfully applied for the governmental funding in all 4 editions of the InIn program.
In 4 editions of the InIn program CTT has received 85 applications from the CUT research teams, out of which 43 have been granted research funding up to 100 k PLN (Eur 25k). Total program budget per edition at CUT was 2 MM PLN (Eur 500k) on average.

3 IMPLEMENTATION OF THE InIn 4.0 PROGRAM AT THE CRACOW UNIVERSITY OF TECHNOLOGY

3.1 PoC projects selection

The PoC projects applications have been received and selected by the Selection Committee, which comprised of the 4 external (non-CUT) members of the University Council (the controlling body approving the university budget and discharging the Rector for his term), Vice-Rector for Science, CTT Director, SPV President, Head of Commercialization and Head of the Academic Innovation Incubator. As one of the important InIn project indicators was successful direct and indirect commercialization of the technologies, the selection criteria were not only the uniqueness, novelty and feasibility of the proposed research idea, but also its commercialization potential. Out of 35 applications in the 4th edition 14 PoC research proposal have granted funding in the range of PLN 65-90 k (Eur 15-20 k). As a rule, the Committee did not grant the full amount applied for, but typically 90% of it, which allowed to accommodate more PoC projects.

3.2 Research management

Within the course of the project, it was critical that research work has been carried out according to the planned schedule and at the steady pace. This allowed for the uniform money spending throughout the project term, which in turn guaranteed timely payments of installments by the Ministry, which were only made upon reaching the research spending milestones. Thus the CTT job was not only responsiveness to the researchers needs and requirements, but also exercising some discipline in money spending by the scientists. This was of special importance due to the fact that not only research cost, but also project management remuneration was financed from the fund. Consequently, timely salary payments of CTT employees were dependent on regular researchers' spending.

3.3 Intellectual property rights

One of the critical issues was assuring timely protection of the intellectual property of the university, According to Polish law all IP resulting from employees' work belong to the university (no "professor's privilege"). Here the conundrum was applying for protection at the Polish Patent Office at the right time, i.e., when all the important attributes of the technology have been already discovered, but early enough to be able to start commercialization work before the deadline. CTT has been working closely with the Patent Attorneys Office at CUT to assure timely and effective IP protection. Potential international patent extensions (PCT and protection in particular countries) will be considered at the later stage depending on commercialization results.

3.4 Brokers and commercialization

Apart from increasing the TRL level of the university technologies, the InIn program's objective was improving the effectiveness of the activities of TTOs and SPVs in research organizations in the field of cooperation with business, including commercialization of the results of R&D works. This involved also investing in Technology Brokers by their high-quality training and by hiring the new ones.

Broker's major task in the InIn project successful direct and indirect commercialization of the technologies Already at the stage of PoC proposals selection by the Committee has been looking for the potential spin-off (start-ups with university/SPV co-ownership) and spin-out (start-ups with university/SPV co-ownership) founders. Among 14 technologies we have identified 2, which were showing the industrial potential of the solution and interest of scientists in running the business. The Ministry accepted our proposal and our project indicators became 12 direct and 2 indirect commercializations.
Currently the technology transfer process is underway and we are considering applying all forms of commercialization, including licensing, sale of patents and know-how as well as creating start-ups. The tangible results of the InIn project at CUT have been so far 4 spin-offs founded and 2 licenses granted. It is a lengthy and unpredictable process and it may (and certainly will) extend beyond the projects' end.

3.5 Barriers and challenges

3.5.1. Barriers

In the course of the project, we have encountered the following barriers, that we were not able to break:

- Researchers' conflict between fundamental science and applied research – publish or patent
- Scientists' lack of understanding of technology transfer – its objectives and methods; much training needed
- Purchasing procedures in public institutions – slow, restrictive and complicated
- Reporting – too detailed, too bureaucratic, too time consuming
- Funding - the limit of Eur 20-25 k was in many cases too low. While in some disciplines this may be enough (SSHA – Social Sciences, Humanities and Arts) in some technical disciplines it does not allow for the fulfillment of the research plan. More flexible spending limits should be considered.

3.5.2. Challenges

In the course of the project, we have encountered the following challenges, which have been mitigated partially or in full:

- Different or opposed interests of the consortium members – internal competition
- Focus on customers and their needs - the concept not liked by scientists, who value freedom of research.
- Know-how vs. patent - the nuances often disregarded by scientists
- International IP protection – PCT procedures are rigid and costly.

The legal regulations at the different levels are generating most of the barriers and we are not able to change them without legislative initiatives. As far as challenges, we have mitigated or even liquidated some of them thanks to tech transfer education and training of scientists.

4 RECOMMENDATIONS FOR THE NEXT EDITIONS OF THE PROGRAM

Based on the experience and results of the 4 editions of the InIn program Polish Ministry of Science and Education came up with the proposal of the new program called "Development Incubator" (DI), which is an extension and expansion of the existing InIn program [4].

Its objective is support for the management of commercialization of R&D results in research organizations. The project will consist of 2 modules:

1. CTT and SPV direct support module - program implemented in partnership – "Development Incubator" (DI);
2. Training module - E-learning platform prepared by the Ministry, customized training program.

The main tasks under the project have been formulated as follows:

1. Initiating and strengthening cooperation between the scientific community and the economic environment, including searching for entities interested in joint implementation of research projects and implementation of the results of scientific research and development works,
2. Mapping the potential of research organizations to conduct joint research projects in industrial and scientific consortia.
3. Promotion of research organization services aimed at the economic sector
4. Preparation of commercialization projects for the results of scientific research and development works, including in particular the valuation of industrial property rights, analysis of the market potential of inventions and analysis of their readiness for implementation.
5. Substantive preparation to conduct independent activity for research teams whose optimal commercialization path is the establishment of a spin-off company
6. Managing the R&D portfolio of a given research organization, including in particular:

• maintaining a database on ongoing research projects, including monitoring and analysis of the results of scientific research or development works in terms of their practical usefulness,
• analyzes of market needs to select topics of research or development work and research on the state of the art before starting research or work,
• analysis of the possibility of obtaining patent protection and the possibility of commercializing the results of scientific research and development works before their publication
• targeted analyzes and business plans for a potential investor (up to 50% of costs)

7. Conducting PoC works, including additional laboratory tests or adapting the invention to the needs of the interested buyer, the cost of which may not exceed PLN 100 k.

This proposal has been a subject of discussion within the Polish technology transfer organization PACTT, whose member is CTT of CUT.

PACTT is an association of 82 major universities in Poland, including technology and medical universities. It gathers together representatives of tech transfer offices (TTOs) responsible for protection, management and commercialization of universities intellectual protection. PACTT is the voice of technology transfer community in Poland.

As a result of internal discussion, the comments and recommendations to the Ministry of Science and Education have been formulated by PACTT, which are currently being considered.

Our major stipulations pertained to:

- Unit finding in excess of PLN 100k (Eur 25 k) per technology
- Spending allowed at any given moment of the project
- Simplified reporting
- Increased funding for training of brokers
- PCT patents financing allowed from grant money.

The current InIn 4.0 project ends April 30, 2023 and we expect the new edition, called "Development Incubator", to start May 1, 2023.

This governmental program has proven to be very effective in supporting the Proof-of-Concept research at the Polish universities and became a major instrument in financing commercialization of the university technologies.

ACKNOWLEDGMENTS

The comments of Ms. Marlena Marek and Ms. Joanna Szypułka as well as assistance of Dr. Irena Śliwińska are greatly appreciated.

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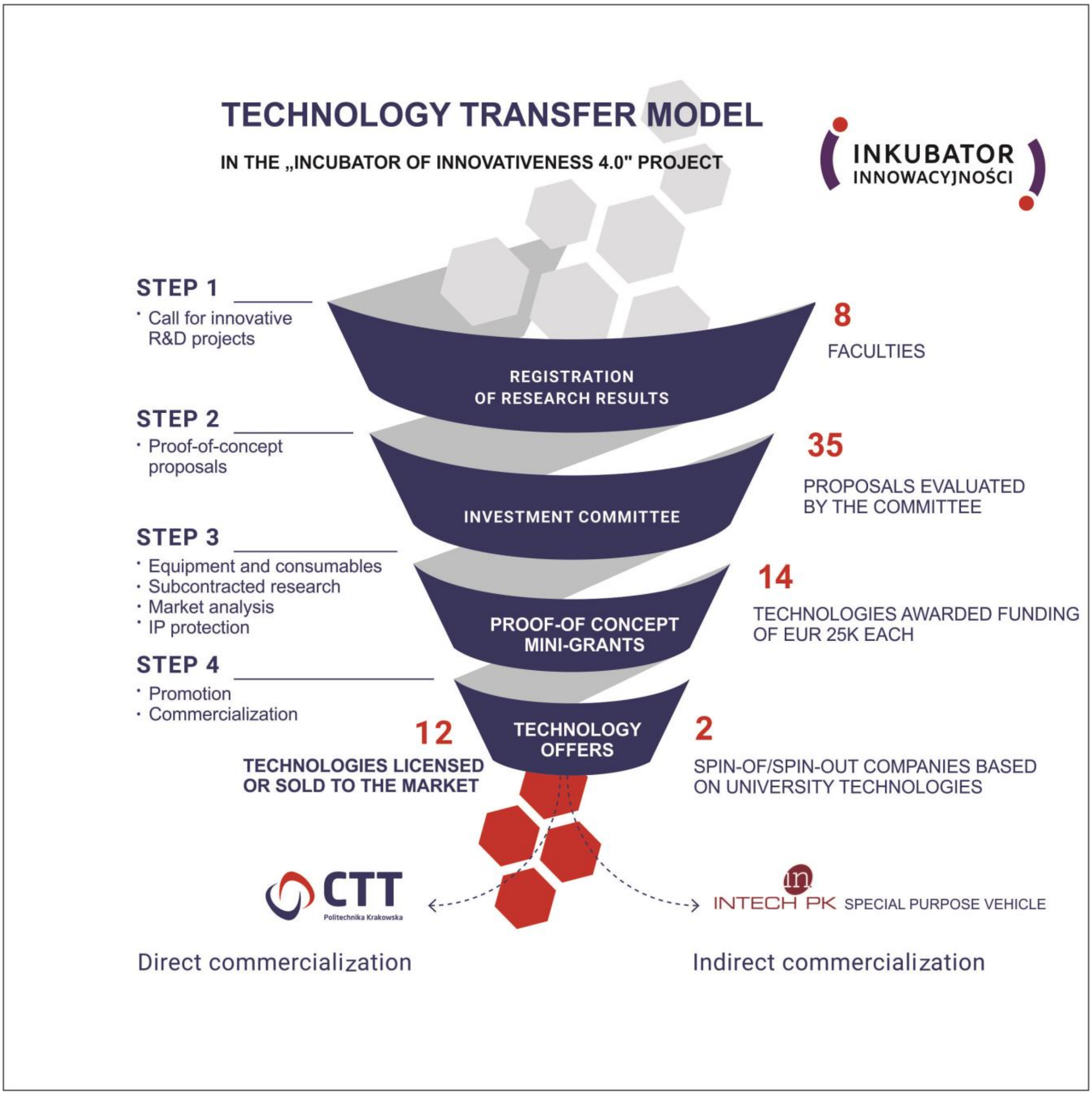
Figure 1: Technology Transfer Model in the "Incubator of Innovativeness 4.0" project at the Cracow University of Technology


TECHNOLOGY TRANSFER MODEL
IN THE „INCUBATOR OF INNOVATIVENESS 4.0" PROJECT
INKUBATOR INNOWACYJNOŚCI
STEP 1
Call for innovative R&D projects
REGISTRATION OF RESEARCH RESULTS
8
FACULTIES
STEP 2
Proof-of-concept proposals
INVESTMENT COMMITTEE
35
PROPOSALS EVALUATED BY THE COMMITTEE
STEP 3
Equipment and consumables
Subcontracted research
Market analysis
IP protection
PROOF-OF CONCEPT MINI-GRANTS
14
TECHNOLOGIES AWARDED FUNDING OF EUR 25K EACH
STEP 4
Promotion
Commercialization
TECHNOLOGY OFFERS
12
TECHNOLOGIES LICENSED OR SOLD TO THE MARKET
2
SPIN-OF/SPIN-OUT COMPANIES BASED ON UNIVERSITY TECHNOLOGIES
CTT Politechnika Krakowska
INTECH PK SPECIAL PURPOSE VEHICLE
Direct commercialization
Indirect commercialization

Science meeting the needs of entrepreneurs

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ABSTRACT

The rapid development of new technologies and innovations that we are seeing today means that it is most important that inventions meet the long-term needs of industry. Without this, there is a little chance for the successful commercialisation and appearance of the innovation on the market. Research to Business meetings and interviews are good practice for allowing the representatives of companies and universities to fully discuss inventions and commercially interesting technologies. The innovations dedicated to industrial partners, together with interesting financial tools that enable higher TRLs for inventions and technologies to be achieved, ensure an excellent basis for the development of future research cooperation and business synergy.

The aim of this paper is to discuss the relationship between science and enterprise in respect of science's response to the needs of industry, and is presented in the form of a case study of a project by scientists from Gdynia Maritime University (Poland). All the innovations within the framework of this project concern equipment for a mobile diving base, in particular, the flexible diving bell Batychron and the mobile electromagnetic mooring system.

KEYWORDS

needs of industry, research to business, relationship between science and enterprise, knowledge & technology transfer activities

1 INTRODUCTION

It is often claimed that it is the idea behind an invention that is the most important, however, there is a long road from the initial conception of an idea to its implementation. Creating new, innovative inventions almost always involves investment and inextricably requires the involvement of an inventor. To obtain funds for the implementation of any project, scientists often use various grant competitions. The idea itself is not enough to obtain such a grant, but a thoroughly prepared action plan and, more often than not, an industry partner are crucial. In other cases, some entrepreneurs have the required financial means but lack ideas to bring their business to the next level. Companies are often in the market for new ideas or for the scientists who will develop a given concept. This is where the relationship between science and enterprise comes in, like a system of connected vessels, supported by Technology Transfer Offices together with innovation brokers. It is crucial to ensure that the core values of both organizations promote the types of behaviour that strengthen and not hinder the development of trust-based relationships. It is worth highlighting that all research, technology, and product development as well as professional staff are becoming an element of competitiveness and competence building enterprises oriented for innovation [1, 2].

The European Innovation Council (EIC) Advisory Board said that researchers must work closely with entrepreneurs to make breakthrough research in Europe successful business opportunities [3]. If so, the innovations coming from science will not only meet the needs here and now, but also those in the future, which are more important for business from the economic point of view.

Great innovation should respond to the entrepreneurial need so that it can be successfully commercialised. Furthermore, Aliasghar et al. highlighted that the entrepreneurs are really looking for both knowledge and innovation in science [4]. Therefore, scientific research must respond to the needs of enterprises. The development of mutual benefits which facilitates scientific knowledge commercialisation is absolutely crucial [5] (Figure 1).

A World of Knowledge Transfer is an international knowledge transfer community gathering organization. In July 2022, the latest ASTP 2021 Survey Report on Knowledge Transfer Activities in Europe was published [6]. The data source for the report was 519 Knowledge Transfer Offices (KTOs) from 26 countries for the financial year 2019. The ASTP 2020 Survey Report on Knowledge Transfer Activities in Europe from 512 KTOs (from 27 countries) for the financial year 2018 was presented [7]. The main conclusions are presented in Figure 2

[†]Author Footnote to be captured as Author Note

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[6, 7]. The headline numbers from the ASTP 2021 Report are promising [6].

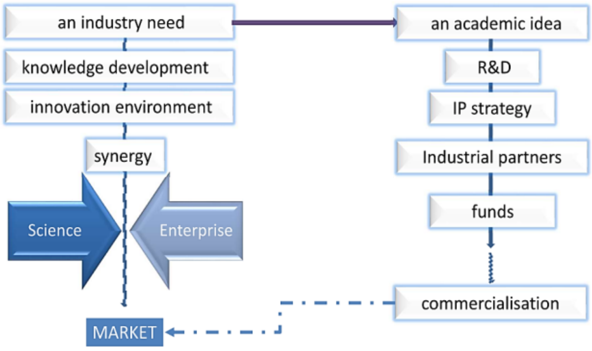

Figure 1: The diagram presents the innovation occurs directly as an industry need

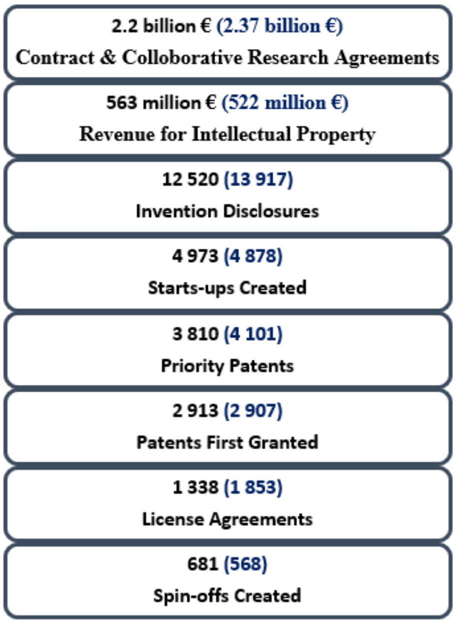

Figure 2: Overview of Survey Main Outputs and Findings for the financial year 2019 [6] – the black font (in compared to the financial year 2018 [7] – the navy font)

In general, a cooperation between companies and universities should generate economic activities such as purchasing or licensing research results, patents, etc. [1].

The KTOs' staff in the financial year 2019 performed mainly functions such as research support (31%), commercialisation (24%), others (24%), entrepreneurship support (11%), and business development (10%) [6]. This sees a change from the financial year 2018 when KTO's staff was more focused on commercialisation (31%) than research support (24%) [5]. This reverse relationship could be the result of the COVID-19 crisis. Additionally, the observation also confirmed the importance of Technology Transfer Offices in creating and maintaining relationships between science and entrepreneurs.

The total number of contract & collaborative research agreements and the total number of revenues for intellectual property has grown with time [6, 7]. The result is inspiring for the future.

European KTOs indicated a total of 177, 784 agreements with the industry of which 69% were Consultancy Agreements, 21% Contract Research Agreements, and 10% Collaborative Research Agreements [6]. The total number of agreements in the financial year 2019 was slightly higher than in 2018 at about 7 020 agreements [6, 7]. In the financial year 2018, the distribution of the number of agreements was similar: 70% Consultancy Agreements, 21% Contract Research Agreements, and 9% Collaborative Research Agreements [7].

Among commercial contracts, KTOs reported more licenses, options, and assignments in the financial year 2018 [6, 7]. The biggest difference was in the case licenses (1, 853 in 2018 [7] and 1, 338 in 2019 [6]). This fact could be the result of global economic uncertainty.

These observations confirmed the effective cooperation between industry and academic centers in commercialisation.

However, in relation to the intellectual property aspect in the financial year 2019, the results were a bit worse. The total number of invention disclosures and the total number of priority patent applications had decreased [6, 7]. This trend may be due to the coronavirus pandemic, but innovation brokers from technology transfer offices are taking an increasing number of different steps to promote science in the economy and to encourage entrepreneurs to cooperate with universities [1].

Last year, the same innovation brokers from the Technology Transfer Office of Gdynia Maritime University as part of creating a network of relations between science and enterprises were actively involved in activities aimed at recognizing the needs of the industry environment. This action was carried out on various issues as part of:

1. Invitation to a meeting of companies from the database of companies run by Technology Transfer Office of Gdynia Maritime University.
2. Cooperation with the "Instytut Autostrada Technologii i Innowacji" consortium, which brings together scientific entities and entrepreneurs.
3. Launch of a new initiative of Pomeranian academic centers under the name "Discovering needs for innovation" carried out in cooperation with different companies.

As part of the third initiative, eight science and enterprise meetings were held with micro, small and medium-sized companies, in particular from the Pomeranian region.

The undertaken new action was to serve the development of cooperation in the local innovation ecosystem. The main proposal of the action was to understand the needs of the Pomeranian enterprises, identify their innovation potential, and assess the barriers that prevent the growth of this potential. Additionally, the opening of companies to the Pomeranian academic centers is a new kind of communication between business and science.

In the next section of this paper, an example of increased cooperation science-enterprise will be described in more detail.

2 A CASE STUDY

This section presents a case study of a project by scientists from Gdynia Maritime University (GMU) (Poland). Innovations within the framework of this project concern the equipment of a mobile diving base, in particular, the flexible diving bell Batychron and the Mobile Electromagnetic Mooring System (MEMS).

In December 2020, a micro company from Gdansk (Poland) was looking for a scientific unit to prepare an R&D report on technological innovation for the contracting authority on its Mobile Base of the Marine Emergency Diving Service (MoB MEDS) project. Under the assumption, the MoB MEDS have to enable diving teams to quickly reach the vessel in danger, as a result of various random maritime accidents (e.g., collision, contact, grounding). Without performing effective repairs related to the need to carry out control inspections of the underwater part of the hull, and quick protection of the water area against potential oil and/or chemical spillage, a high-speed boat could seriously endanger the safety of human life, the environment, or marine navigation [8]. The research group from the Navigational Department of the GMU, along with members of the Student Special Interest Group of Underwater Research "Sea Quest" undertook the task of creating the report.

The research group proposed two solutions as innovative equipment for MoB MEDS. The company expressed its interest in implementing these systems in its newly built watercraft, which resulted in the signing of a letter of intent.

As a consequence of acquiring a business partner, in April 2021, the GMU Research Group applied and was accepted into a grant programme called "Innovation Incubator 4.0″, implemented under the programme of the Ministry of National Education of the Republic of Poland (earlier the Ministry of Science and Higher Education of the Republic of Poland) as part of the non-competition project entitled „Support for scientific research management and commercialisation of the R&D work results in scientific units and enterprises" under the Intelligent Development Operational Programme 2014-2020 (measure 4.4). The project reference number for the pre-implementation work is UMG-03. The project name is The Innovative Equipment of the Mobile Intervention Unit and contains two inventions the Batychron flexible diving bell and the Mobile Electromagnetic Mooring System.

Batychron is a flexible underwater bell patented by Gdynia Maritime University as a device applicable in hydro-technics for underwater transport and diving while maintaining the safety of human life [9]. There are several solutions for diving bells in hydroengineering [10], however, the disadvantage of the known solutions is the large construction of the bell and the weight. These devices were very heavy and needed to be moved together with the vessel, which required several people to be serviced. Under this assumption, the Batychron should be light, handy, and portable. One of the goals of the above-mentioned project was to build a new device called the Batychron in a modular form with the new materials (Figure 3). The utility model for this device was submitted to the Polish Patent Office (No. W.130766) on 05/05/2022. As a result of the research, it was confirmed that the Batychron device can be used not only as the equipment for intervention units but also to secure and make all kindsof training, tourist, internship, recreational, and sports dives more attractive.

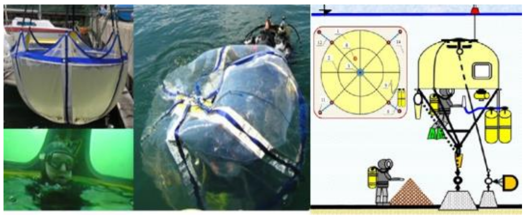

Figure 3: a Batychron

The second invention proposed in the mentioned project is the MEMS. The MEMS is an innovative mooring system designed to fit a small intervention/service vessel that moors to the sides of larger vessels requiring intervention for repair, servicing, or the transfer of cargo or people, without the need to involve a large number of crew members during mooring operations (Figure 4).

The main disadvantages of the known electromagnetic or vacuum mooring systems are, on the one hand, their extensive dimensions, which prevent them from being used on smaller vessels and, on the other hand, the inability to move the moored vessel horizontally along the other vessel. The MEMS solution, using a system of electromagnetic grippers with a unique set of mooring lifts ensuring constant rope tension, tackles the problems and requirements of small intervention/service watercraft, including working dive boats, during mooring to a larger serviced unit. The key elements in this solution are not only mobility, time, and lower energy consumption but, above all, safety - the risk of an accident with ropes on a serviced vessel is reduced.

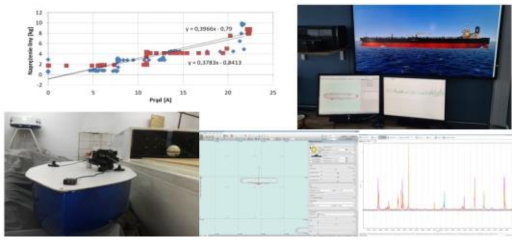

Figure 4: a MEMS

The application to the Polish Patent Office was filed by GMU (No. P.437572) on 13/04/2021. In April 2022, the European application number EP22000102 was filed. Currently, as part of the project, the simulation and laboratory/model tests are carried out to develop a plan for the construction of a demonstration model.

Both inventions have been promoted externally at several trade exhibitions and industry shows (e.g., at the 14th International Conference on Marine Navigation and Safety of Sea Transportation Gdynia 16-18/06/2021, XXI International Maritime Exhibition and Conference BALTEXPO 2021, Gdansk 6-8/09/2021). At the 15th Edition of International Invention and Innovation Show INTARG® 2022 Katowice 11-12/05/2022, the GMU Research Group presented 'Innovative Floating Intervention Unit Equipment: A Mobile Electromagnetic Mooring System and a Batychron for which they were awarded a silver medal in the category Transport and Logistics.

At the same time, one of the small local companies from Gdynia offered to cooperate with GMU by offering apprenticeships. The company was also looking for a wider cooperation related to R&D projects in their field. The company's marine automation department is involved in wide-ranging cooperation with shipyards and directly with shipowners around the world. They design and manufacture their systems in the field of power engineering and ship automation, as well as in servicing existing systems. Once acquainted with the Mobile Electromagnetic Mooring System, the company had no doubt that this was a project closely related to their industry, and one in which they wanted to be involved. The cooperation agreement was signed as part of the R&D activities. Currently, the level of technological maturity was determined as 5 – validation of the technology was performed in a near real-world environment (prototype) thanks to support from the "Innovation Incubator 4.0" grant programme. The small local company specializing in marine automation in order to scale the solution and demonstrate the willingness to conduct joint implementation works as part of applying for external funds. GMU extensively work together with Gdynia company to obtain funding to carry out an R&D project, as a consequence of which a fully certified MEMS device is to be created.

As shown in this case study, ideas for technological solutions can be developed and realized by effective cooperation between science and enterprises. Such a relationship is a win-win situation - the scientists from the University can conduct scientific research and realize their ideas, the entrepreneurs can generate income and develop their brand, and in this case, a Gdynia-based construction company can be the first to build the invention, and the previously mentioned company can use it. Working together they can offer a new technology to the market. The enterprises have noticed that those ground-breaking solutions have a global reach. Both devices can be used in sectors such as marine services, repair interventions of other marine vessels, diving services – recreational, training, repair or excavation work, underwater transport, cargo, and people transfer in the offshore area.

The GMU Research Group is still working, gaining momentum, and creating new ideas based on the needs of entrepreneurs. In April 2022, the members of the Student Special Interest Group of Underwater Research "Sea Quest" operating at the GMU would like to continue their research at the Batychron installation. For this purpose, they applied to the Ministry of Science and Higher Education for funding for a new project called the MUDS Base, the Mobile Underwater Diving Support Base. This project was submitted as part of a scientific competition organized by the Ministry of Science and Higher Education in October 2021 as a new initiative: "Student Circles Create Innovations". The project has been accepted and is under realisation. All the activities of the GMU Research Group are supported by innovation brokers from the GMU Technology Transfer Office. In line with the new trends, innovation brokers involve students in designing innovative solutions. This corresponds to increasing the awareness of both scientists and entrepreneurs that the new programs also offer the possibility of carrying out research in young research teams.

3 CONCLUSIONS

Creating new and innovative solutions is always associated with financial investment and building interdisciplinary research teams ready to take on the difficult challenges of the current economy. In this respect, the relationship between science and enterprise is of prime importance. Science is important to meet the needs of entrepreneurs because it is precisely this that stimulates their interest in the development of new technologies. These dependencies are crucial to conducting R&D focused on the needs of entrepreneurs.

A good example of cooperation between science and enterprises. is the project referred to in this paper involving GMU scientists. Innovations within the framework of this project concern the equipment of the mobile diving base, in particular, the flexible diving bell Batychron and MEMS. The cooperation between science and enterprise contributed to the creation of new innovations, their protection by patents, and further plans for their commercialisation. This case study highlights the importance of scientific work that corresponds to the needs of industry.

ACKNOWLEDGMENTS

Research financed by the "Innovation Incubator 4.0″ grant programme implemented under the programme of the Ministry of National Education of the Republic of Poland (earlier the Ministry of Science and Higher Education of the Republic of Poland) as part of the non-competition project entitled "Support for scientific research management and commercialisation of the R&D work results in scientific units and enterprises" under the Intelligent Development Operational Programme 2014-2020 (measure 4.4).

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Commercialization of R&D results created with public funds in the National Academy of Sciences of Belarus

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ABSTRACT

The paper informs on organizational structure, the current state of commercialization of R&D results created with public funds in the National Academy of Sciences of Belarus (NASB), difficulties to involve private capital in the process of commercialization and proposes ways to address these problems.

KEYWORDS

Technology transfer (TT), legislation, intellectual property rights (IPR), spin-off, start-ups, R&D contracts

1 INTRODUCTION

Founded in 1922, the NASB is the primary state scientific institution and the leading R&D center of Belarus. It incorporates over 110 organizations (incl. production, design, and 80 R&D institutions), and employs about 14 000 persons (incl. 5 000 researchers, 100 academicians, 120 corresponding members, 400 doctors of sciences and 1 600 candidates of sciences) [1, 2].

Between 1993–2020 the NASB registered nationally and internationally over 8 800 objects of industrial property rights: inventions (66,3%), utility models (25,2%), plant varieties (4,6%), trademarks (3%), industrial designs (0,7%). At the end of 2020, only 558 objects remained in force [3].

NASB ranks first by the number of national patents (table 1) and the number of registered license agreements (table 2) [3].

NASB licensing income for 12 years (2009–2020) amounted to 6 mln USD or about 500 000 USD per year, and as shown in table 3, the plant variety is licensed the most – 59%. In recent years, NASB exported annually ca. 50 mln USD of goods and services, which means that licensing revenue amounts to 1% of total export [3].

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Table 1 – Obtained national patents in 1993–2020

Establishment	No. of patents	Pct., %
NASB	5 132	34,0
Ministry of Education	4 600	30,5
Ministry of Health	2 763	18,3
Ministry of Industry	1 520	10,1
Ministry of Agriculture and Food	1 057	7,0
Total:	15 072	100

Table 2 – Registered with the National Center of Intellectual Property license agreements in 1993–2020

Establishment	No. of agreements	Pct., %
NASB	550	19,8
Ministry of Industry	501	18,0
Ministry of Agriculture and Food	499	18,0
Food industry concern "Belgospishcheprom"	468	16,8
Ministry of Transport and Communications	71	2,6
Ministry of Education	66	2,4
Light industry concern "Bellegprom"	60	2,2
Other state bodies and state-owned enterprises	563	20,3
Total:	2 778	100

Table 3 – Number of license agreements in NASB organizations in 1994–2020

Licensed IP	No. of agreements	Pct. , %
Inventions	52	9,5
Utility models	41	7,5
Industrial designs	5	0,9
Trademarks	28	5,1
Plant varieties	328	59,6
Know-how (until 2013)	96	17,5
Total:	550	100

The reason for such low licensing income is that the results of scientific and technological activities (STA), created with government funding, de facto belong to the state, and not to organizations of the NASB [4, 5]. This is also the reason why the NASB does not create spin-off and start-up companies.

The best results of the NASB in patenting and licensing activities is due to the organizational structure of the intellectual property (IP) management system in the NASB.

2 ORGANIZATONAL STRUCTURE OF IP MANAGEMENT SYSTEM

Organizational structure of IP management, technology transfer and commercialization of STA results in the NASB consist of four levels (see figure 1):

- Top management level is the Chairman of the Presidium of NASB and the Deputy Chairman, supervising IP matters;
- Regulation and coordination performs Expert council on IP management;
- Management and control is carried out by the Main department of scientific, scientific-technical, and innovative-production activities, the Main department of international scientific and technical cooperation, the State scientific institution "Centre for System Analysis and Strategic Research" (CSASR), which includes the division "Republican Centre for Technology transfer" (RCTT), the Departments of sciences (7) and the Departments of the NASB apparatus;
- Execution level includes organizations of the NASB.

The Expert council on IP management exists since 2010. Its main activities, specified by the Regulations on the Council (approved in 2014) are to:

- develop and update IP management strategy of the NASB;
- coordinate organization's activities in the field of IP protection and management;
- considerate proposals by NASB organizations to improve legal mechanisms for IP protection and management;
- examine issues related to acquisition of IP rights, and the disposal of those rights;
- approve payment of remuneration to the heads of organizations;
- contemplate other IP issues that require collegial decision-making.

The structure also includes:

- two WIPO Technology and Innovation Support Centers (TISC): on the basis of Yakub Kolas Central Scientific Library of the NASB (since 18 Nov 2021) and on the basis of RCTT (since 31 Jan 2022) [6, 7];
- specialized structural divisions in organizations (patent service, scientific and innovation division, marketing division);
- specialists of non-specialized structural divisions with advanced professional training in the field of IP and technology transfer.

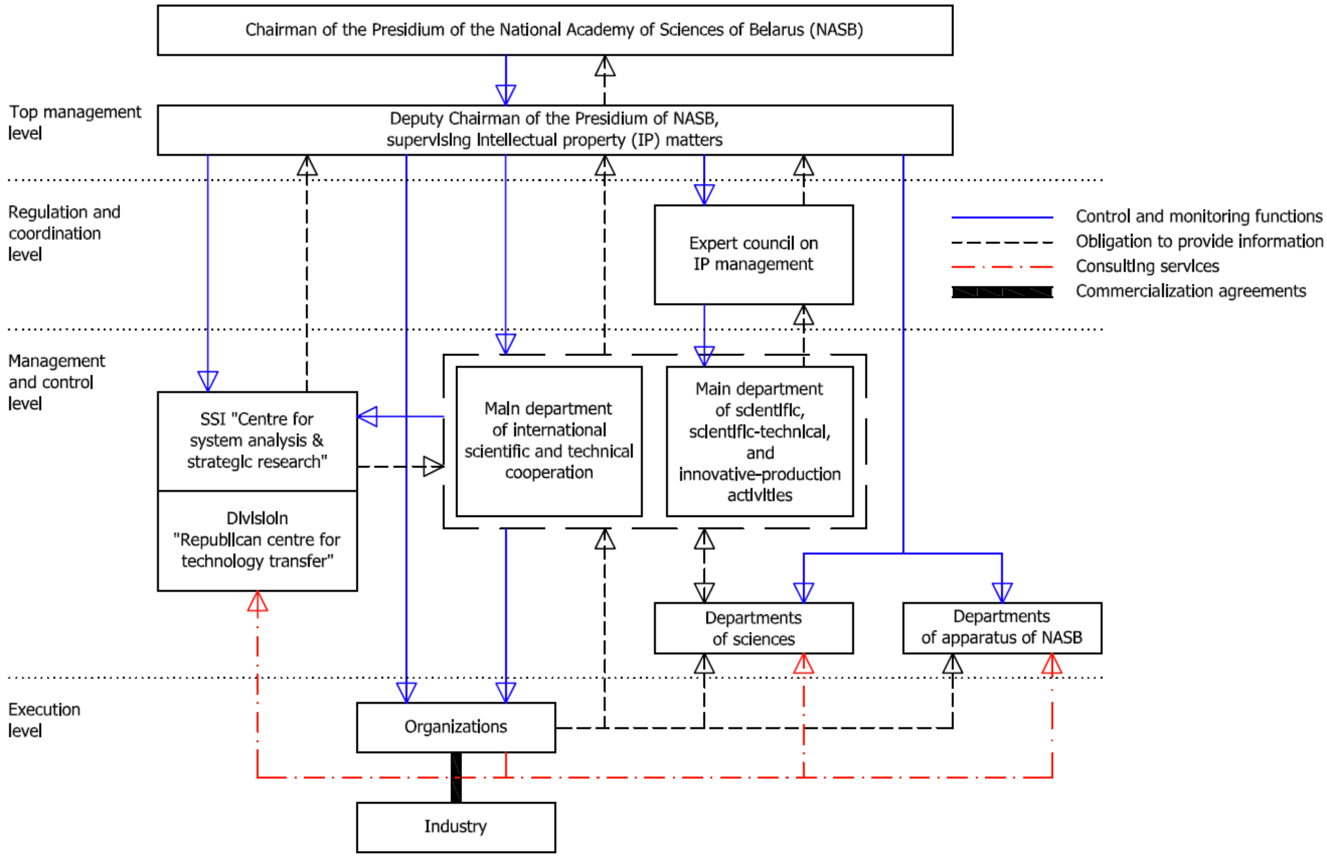

Figure 1: Organizational structure of IP management, technology transfer and commercialization of STA results in the NASB

Services offered by the TISC based on RCTT include:

- access to online patent and non-patent (scientific and technical) resources and IP-related publications;
- assistance in searching and retrieving technology information;
- training in database search;
- on-demand searches (novelty, state-of-the-art and infringement);
- monitoring technology and competitors;
- basic information on industrial property laws, management and strategy, and technology commercialization and marketing;
- support of training seminars on TISC activities organized by NCIP, WIPO, European IP Helpdesk and others, including assistance in the appointment of external speakers from the network of European IP Helpdesk partners (for example, the European Network of National Intellectual Property Offices – INNOVACCESS, European Patent Office / Academy) for specific activities in the field of intellectual property.

3 COMMERCIALIZATION ISSUES

When commercializing the STA results the NASB organizations follow:

1. Regulation on the commercialization of the results of scientific and technical activities created at the expense of state funds (approved by the Presidential Decree No. 59 on 5 Feb. 2013, amended in 2018);
2. Strategy of the Republic of Belarus in the field of intellectual property until 2030 (approved by the Decree of the Council of Ministers No. 672 on 24 Nov. 2021). The Strategy specifies main directions for improving the national IP system, the goals and objectives of the state policy in this area, which provide for the transformation of IP into an effective tool for innovative and socio-cultural development of the Republic of Belarus.

The Regulation defines commercialization as "introduction into civil circulation and (or) use for own needs of the results of scientific and technical activity or goods (services) created (performed, rendered) using these results, ensuring the achievement of economic and (or) social effects". The Regulation stipulates strict deadlines for the commercialization of STA results (created with public funds) subject to mandatory commercialization, i.e. within three years after the creation. Failure to commercialize means violation of budget legislation, and so received public funds should be recovered from legal entities in an indisputable manner to the budget with interest that equals to refinancing rate of the National Bank set on the date of collection.

To keep the list of IP rights on STA results subject to mandatory commercialization and its outcomes the State Committee on Science and Technology (SCST) and the subordinate organization – Belarusian Institute of System Analysis and Information Support for Scientific and Technical Sphere (BelISA) – maintain the State register of rights to the results of scientific and scientific and technical activities. State customers supervise the commercialization and maintain local registers of STA results.

Committee, created by order of organization's head, carries out annual inventory of SDA results in the NASB in 1st quarter (according to internal regulation approved in 2014). Organizations, not later than 15th April, provide the results of inventory to NASB apparatus on five sheets:

- Sheet No. 1 "Sole rights on objects of industrial property";
- Sheet No. 2 "Sole rights on objects of copyright";
- Sheet No. 3 "Organization's rights on STA results obtained via agreements";
- Sheet No. 4 "Organization's rights on potentially patentable STA results";
- Sheet No. 5 "Organization's rights on STA results, which are not objects of exclusive rights" (know-how).

After the adoption of Presidential Decree No. 59 in 2013, almost all STA results subject to mandatory commercialization are commercialized at state enterprises. After mandatory commercialization for STA results begins period of indefinite use – organization does not know when and who will show interest in created technology, and for what amount the organization will be able to sell it. From accounting point of view the STA results represent intangible assets. Putting STA results on accounting can proof that they belong to organization. This procedure is described in the Law of the Republic of Belarus "On accounting and reporting" No. 57-Z from 12 Jul 2013 and in National standard of accounting and reporting "Individual Accounting Statements" (approved by Decree of the Ministry of Finances No. 104 from 12 Dec 2016). The above documents do not allow putting the STA results (intangible assets with an indefinite useful life) on accounting with zero value, and if any private organization wants to purchase the technology, then the minimal license cost should be the sum of all expenses for creation and patenting the technology. As a result, organizations have no interest putting STA results on accounting and concluding license agreements. Technology transfer with private enterprises and foreign companies occurs under commercial agreements with technical assistance, technical cooperation agreements, R&D agreements, and joint ventures. Belarusian legislation also does not allow "gratuitous" transfer of technologies created with public funds to SMEs to attract private investments.

4 FURTHER DEVELOPMENT

In order to proper and on-time implement the Strategy of the Republic of Belarus in the field of intellectual property until 2030, the NASB approved "Plan of the National Academy of Sciences on the execution of priority measures in 2022–2023 for Strategy's implementation" (NASB Order No. 18 from 19 Jan. 2022). The Plan contains actions directed at the:

- development of institutional system in the field of IP;
- development of IP infrastructure;
- improvement of incentive mechanisms for the creation, legal protection and use of IP;
- development of IP management system;
- improvement of legal culture and education in the field of IP.

The improvement of IP management system, in particular, provide for "Development and adoption of institutional IP policies in scientific organizations of the NASB". According to Plan's schedule, all 80 R&D institutions should adopt IP policies: 24 in 2022, 18 in 2023, 17 in 2024, and 21 in 2025.

5 CONCLUSIONS

After the adoption of Presidential Decree No. 59 in 2013 in Belarus, almost all STA results subject to mandatory commercialization are commercialized at state enterprises. After mandatory commercialization for STA results begins period of indefinite use – organization does not know when and who will show interest in created technology, and for what amount the organization will be able to sell it.

To allow de facto access of private SMEs to technologies developed with public funds, after their mandatory commercialization at state enterprises, and attract private capital to adoption of such technologies in SMEs, it is necessary, in addition to recommendation given in [4], to enact legislation that:

1. allows putting the STA results (intangible assets with an indefinite useful life) on accounting with zero value, similar to Generally Accepted Accounting Principles (GAAP) and International Financial Reporting Standards (IFRS);
2. gives the contractor-organization the right to independently determine the cost of license agreements based on the market value of the created technologies;
3. stimulates the involvement of private capital to commercialization of technologies in SMEs.

ACKNOWLEDGMENTS

We would like to thank the National Academy of Sciences of Belarus and the State Committee on Science and Technology of the Republic of Belarus for their constant support of RCTT activities and express gratitude to all our colleagues who work in technology transfer for their help and advice.

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Selection and evaluation of technologies for the transfer to the industry

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ABSTRACT

The paper refers to the study of the issue of selection and evaluation of technologies for their transfer to the industry. For low-income countries such as the Republic of Moldova, where the potential for technology generation is low, it is very important to create policies for selecting and evaluating technologies that would facilitate the transfer of technologies that can be assimilated in that country, taking into account human resources and existing technological and financial potential.

This article highlights 27 methods used to select and evaluate technologies, the decision-making issues for which those methods are applied, and the strengths and weaknesses of some methods. Some challenges arise in the process, because the available methods are usually too simple or too elaborate for most managers and companies to be systematically understood and applied. To continue the research, there is a need to combine methods or develop a new method.

KEYWORDS

Innovation, technology transfer, methodology, criteria, descriptors of performance

1 INTRODUCTION

The process of selecting and evaluating technologies is an indispensable component of technology transfer and responds to the issue of identifying the most optimal technologies proposed for transfer within enterprises and industries. This statement is made by the author of this article based on his experience in technology selection and evaluation for at least 10 years.

Various methods of selecting and evaluating technologies from simple ones, such as financial methods, to the most complex ones, such as mathematical programming, have been developed and used to address this issue.

The methods are used to extract and process relevant information about a problem, because the reality is also too complex to manage in its entirety. Therefore, any method, no matter how sophisticated, will always be only a part of the reality it intends to reflect and can only produce an optimal result in its own particular framework.

A technology screening method can thus be a valuable tool for an organization to help choose technologies, especially if it can generate useful information in a timely manner and at an acceptable cost. There are various concerns to consider when selecting a method, as well as several different types, which are discussed below.

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2 CHARACTERISTICS AND PRINCIPLES OF TECHNOLOGY SELECTION AND EVALUATION METHODS

After studying the literature presented in references, the following five aspects are considered the most important in a method of selection and evaluation of technologies, which propose the following characteristics and definitions:

Table 1: Characteristics and definitions of technology selection and evaluation methods

Characteristics	Definitions
Realism	*The accuracy of the representation of the real world and in the reflection of the company's decision on the situation, objectives, limitations, risks, etc.*
Capacity	*Ability to analyze different types of decision variables and deal with several factors (multiple time periods, changes in interest rates, etc.)*
Flexibility	*Applicability to different types of technologies and issues and ease of change in response to changes in the business environment*
Use	*Ease of understanding and application of the method. Clear, easy to understand by all members of the organization and executed quickly*
Cost	*The costs of setting up and using the method should be less than the potential benefits of the technology and relatively low in the cost of the technology*

Easy computerization	*Easy collection, storage and handling of information with readily available software (such as Excel®)*

In the literature there is an extensive list of "good practice" principles for technology management tools observed by several authors, some of which apply in particular to technology selection and evaluation tools, such as:

- Robust (theoretically possible and reliable)
- Economical, simple and practical to implement
- Integrated in other business processes and tools
- Flexible (adaptable to suit the particular context of the business and its environment)

There are a wide range of methods that have been used to select and evaluate technologies, from simple cost analysis to full and linear programming or more flexible methods such as fuzzy mathematical programming.

Research on the selection and evaluation of technologies dating back to 1959, where several criteria and methods of mathematical programming were already used. Reference is made to works that use the following methods: scoring, ranking, decision trees, theoretical approach to the game, Delphi technique, fuzzy logic, hierarchical analytical process (AHP), goal programming, dynamic programming, linear programming 0-1, programming quadratic and nonlinear programming. Some methods can even be used together, which further increases the number of possible techniques to be used for the selection and evaluation of technologies.

The table below shows several methods for selecting and evaluating technologies, which have been used in various decision-making issues, such as evaluating technology offerings, information systems, and research and development.

Table 2: Various types of technology selection and evaluation methods for certain decision-making issues

Technology selection and evaluation method	The decision-making problem
Net present value method	Programming the selection of investments in technologies
Cost analysis (e.g. VNV, DCF and reimbursement)	Technology selection and evaluation
Unweighted ranking and model	Decision to select and evaluate investments in technologies
The analytical ranking process (AHP)	Selection and evaluation of industrial technologies
Multiatributive utility theory in combination with PRICE	Technology selection and evaluation
Linear and full programming	Technology selection and evaluation
Utility method-theory	Bidding decisions
The fuzzy overtaking method	Technology evaluation
Competitive bidding strategy model	Technology selection and evaluation
Multiatributive analysis in combination with regression models	Selection and evaluation of technologies for the public sector
Multicriteria selection and evaluation	Aggregation of expert judgments
The method of fuzzy preferences	Technology selection and evaluation
Fuzzy logic	Selection and evaluation of software technologies
Mathematical programming	The decision to select and evaluate the technology provider
Gray	Selection and evaluation of the technology offer
TOPSIS	Decision making for tenders
Fuzzy stochastic	Technology selection and evaluation
ELECTRE I	Technology selection and evaluation
The theory of possibility	Technology investment decision
Mathematical programming	Selection and evaluation of research and development technologies
Network Analytical Process (ANP)	Selection and evaluation of research and development technologies
Fuzzy-logic	Selection and evaluation of new product development technologies
ANP	Technology selection and evaluation
Packing method - several boxes	Selection and evaluation of research and development technologies
AHP and multi-attribute decision making technique	Selection and evaluation of industrial technologies
Mixed integrated programming method	Optimal selection and evaluation of the research and development portfolio
Zero-one integer programming methods with limited chance	Random selection and evaluation of technologies

As can be seen, there are different methods that are used for different decision issues. Therefore, it can be concluded that there is no specific method for a particular situation, but rather that there is a wide range of possibilities and applications. The advantages and disadvantages of the methods must be weighed against the particular issue of the available decision, in order to choose the most appropriate method. The table below explains some of the above methods, the corresponding advantages and disadvantages.

Table 3: Comparison of technology selection and evaluation methods

Decision method	Description of the method	Advantage	Disadvantage
Cost analysis (eg VNV, DCF and return on investment)	Use accounting data and other relevant information to identify ways to reduce costs and then choose the technology that works best	Controls costs and prevents waste and losses Easy for decision makers	It focuses only on costs and ignores the cost-benefit principle
Linear programming	Linear programming is a technique for optimizing an objective linear function, subject to linear equality and inequality constraints	Get the best result in a mathematical model, give a list of requirements represented as linear equations	An optimal solution may not be found
Integrated programming	Type of mathematical programming whose variables are (in whole or in part) integers in the problem	It greatly reduces time and space for solution	More difficult to solve than linear programming
Fuzzy logic	Fuzzy logic is a form of multivalent logic derived from fuzzy theory, it deals with reasoning that is approximate rather than accurate	It is a powerful tool for managing inaccurate data	Fuzzy logic difficult to achieve on a large scale
AHP	A mathematical decision-making technique that allows the qualitative and quantitative aspects of decisions to be taken into account	Reduce complex decisions in a series of individual comparisons and then summarize the results	It depends on the experience of the expert The comparison and the trial process is harsh, which cannot be used for high precision in decision making
ANP	It is a mathematical decision-making technique similar to AHP	It can deal with technology evaluation issues	It requires large amounts of data and the decision depends on the experience of the experts
Gray Target decision	Gray Target decisionhas some original effect on the problem of recognizing the model with small samples, insufficient information and data and in uncertain conditions	It does not need a large number of samples and the samples do not need to be regularly distributed It can describe in more depth the nature of things with low computational load The results of the quantitative and qualitative analysis will be more consistent It can be used for short and long term predictions and is highly accurate	The optimal solution may not be a global optimization situation

While return on investment (ROI) is one of the primary factors for prioritizing technology, other issues should be considered, such as alignment with strategy, balance between maintenance technologies and technology investments, allocation efficient use of resources and other non-financial benefits.

It is impossible to define a set of criteria suitable for all circumstances, as they will differ greatly from one another in different companies and technologies. As a result, there are an endless number of criteria mentioned in the technology selection and evaluation literature, which vary depending on the type of technology and methods used for selection and evaluation, where scoring methods present the most extensive and extensive set of criteria, including more than just financial and strategic issues. There are also different ways in which criteria can be organized, such as by the type of criterion, which is the most common.

3 CONCLUSIONS

Studying the literature has allowed us to understand the importance of selecting and evaluating technologies for the success of innovation and technology transfer in companies, but also the decision-making issues they face in applying the methods of selection and evaluation of technologies. The challenges arise because the methods available are usually too simple or too elaborate for most managers and companies to be systematically understood and applied. In order to tackle these challenges, the author developed a proprietary method, that includes criteria divided into several groups like financial, strategical, technological, marketing, and external factors, which could be adjusted for a concrete case. Due to the multicriteria evaluation and selection approach, the new method permits to obtain of complex results with fewer efforts and special skills from the company technology managers.

To avoid further selection of technologies "Losers", the key lies in the objectivity of the selection and evaluation process, through a method that incorporates both financial and non-financial criteria and by the awareness that each method may be appropriate in certain situations for a particular company and for the circumstances of the technology. Such a method is proposed in the research conducted by the author of this article in his PhD Thesis „Selection and evaluation of technology for the technological transfer".

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Subsidizing Knowledge Transfer with Public Funds

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ABSTRACT

European state aid law is an important cornerstone enabling the functioning of the European single market and thus the realization of the four basic European freedoms (the movement of goods, persons, services, and capital within the EU). At the same time, as the EU strives to stay competitive in the globalized world ruled by rapid technological advancements, it needs to find ways of facilitating interactions between traditionally publicly funded research and the private sector, which could accelerate our economy and fuel it with new inventions and technologies. This, of course, invokes the 'specter of state aid' as the typically non-profit organizations start to enter the market, albeit only offering their knowledge as a product. To balance these forces, a complex system of rules and exemptions is emerging. In this paper I argue that sometimes the 'spectre' is being summoned by the research organizations themselves and that the current rules of state aid law regulating the field of research, development and innovation do not present a major obstacle in knowledge transfer efforts of the European public research sector.

KEYWORDS

state aid, research, development, innovation, European union, competition law, European single market, public subsidies, knowledge transfer, effective collaboration, contract research, licensing

1 INTRODUCTION

The aim of this paper is to bring the regulation of state aid in the European Union closer to readers working in the field of publicly funded research and knowledge transfer. In addition to the introductory general interpretation of the law of state aid, the paper focuses on the issue of state aid of research organizations, especially in connection with their interactions with companies, particularly when dealing with intellectual property belonging to these organizations. These issues raise a number of practical problems that are relevant for research organizations, especially from the point of view of fulfilling their role in the dissemination of knowledge[1]. These problems also affect those corporations and entities that seek to collaborate with research organizations in the area of knowledge dissemination or transfer. I plan to address this subject in relative detail in this paper and subsequent work. In the field of knowledge transfer, at least in Czechia, the European regulation of state aid is perceived as an obstacle to the effective transfer of knowledge from public research organizations to society. I believe that this obstacle is mostly superficial, and the aim of my paper is to convince the reader of this as well.

I suggest the main aim of the paper is to contribute to understanding the reality of the state aid law of the European Union. This issue is already, in my opinion, sufficiently elaborated in the works of other authors like Wendland, Nicolaides and Schwendinger[2]. This paper may conversly serve as a state aid reference intended for experts in the field of knowledge transfer and management of public research institutions, but also for experts oriented to the issue of industrial property within the academia and also for patent representatives and lawyers whose professional activity falls in this area.

2 STATE AID

Many authors consider the doctrine of neoclassical political economy to be the fundamental ideological source of state aid law [1]. A fundamental place in this ideology is occupied by the phenomenon of a self-regulating market, which should be protected from the efforts of states to intervene in it with public subsidies. Such interventions are justified only in borderline cases, such as market failure or the pressing need to level certain geographical and especially social inequalities.

The first and arguably most important arena in which the negative externalities of selective favoring of international competitors are manifested is the global trade. For this reason, state aid is regulated in relative detail by the World Trade Organization, particularly on the basis of the Agreement on Subsidies and Compensatory Measures, which deals on the one hand with the rules governing the provision of subsidies, i.e. state aid, and on the other hand with the application of so-called compensatory measures to compensate for the damage caused subsidized imports, both in order to maintain healthy international competition.

The European Union ('Union'), unlike the World Trade Organization, has more effective tools for enforcing its standards and similarly uses state aid regulation as a tool to protect the health of economic competition. Articles 107 and 108 of the Treaty on the Functioning of the European Union ('TFEU') governing the provision of state aid by member states can be found in the chapter dedicated to the competition law. Those subsidies that bring negative externalities manifested in the property right of competitors from other member countries are identified as problematic. The main goal here is the protection of the European single market.

[1] Knowledge dissemination, according to Framework, means to widely disseminate the results of research activities by way of teaching, publication or knowledge transfer.

[2] See references below.

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The European single market is based on four fundamental freedoms that enable the free movement of people, goods, services and capital. It is precisely the above-mentioned Article 107 and 108 of the TFEU which, through the prohibition of state aid, creates the environment for its unobtrusive operation. For example, the realization of the free movement of goods will not be quite possible in a situation where the goods in question are competing with an alternative that the subsidized entrepreneur can afford to sell at prices that do not reflect the costs of its production.

On the other hand, there is a need to clearly define the rules applicable to all (member states) for exceptions to the above state aid ban. This happens, for example, in areas where there is an obvious market failure, i.e. for example when supporting the so-called Services of General Economic Interest (SGEI). In connection with the system of exceptions to the prohibition of public aid, this area of legal regulation is thus enriched by an essentially political aspect. These aspects appear both at the level of the Union (for example, the exception for significant projects of common European interest listed in Article 107(3)(b) of the TFEU) and at the level of the Member States.

3 STATE AID OF R&D&I

The European Union generally favors research, development and innovation ('R&D&I'). In its Article 179, the TFEU contains a provision according to which the Union aims to "strengthen its scientific and technological foundations by creating a European research area in which scientists, scientific knowledge and technology move freely". For this purpose, according to this article, it is necessary to support businesses and research organizations in their efforts to cooperate. However, this objective may be in conflict with another important objective of the Union. It is the above-mentioned effort to build and protect the health of the European single market, protected from the negative impact of state or public subsidies.

R&D&I subsidies can therefore potentially distort competition in the European single market. This happens especially in cases where the state aid does not induce additional activities on the part of the beneficiaries beyond those that the recipient would have carried out even if such aid did not exist. The effect of state aid can thus be perceived as an increase on the input side (i.e. supported companies invest more of their own resources in R&D&I as a result of state aid) or an increase on the output side (i.e. more outputs or R&D&I results are created precisely as a result of state aid). Regulation of state aid can ensure its increased effectiveness by requiring providers to focus state aid on projects that would not have occurred in the absence of their state aid[1].

According to the Commission[3], State aid of R&D&I is enabled by the wording of the TFEU itself, specifically in two places. State aid of European R&D&I is enabled by Article 107 paragraph 3 letter b), according to which aid intended to help the implementation of a significant project of common European interest can be considered compatible with the European single market. This fact is also reflected in the wording of the old framework for state aid for research and development and innovation, or its point 4, regulating the compatibility of support according to Article 87 paragraph 3 letter b) of the EC Treaty (today's Article 107 paragraph 3 letter b) of the TFEU). Typically, however, state aid for R&D&I will be evidenced by an exception pursuant to Article 107 paragraph 3 letter b), according to which aid intended to facilitate the development of certain economic activities or economic areas can be considered compatible with the European single market, if they do not change the conditions of trade to such an extent that it would be contrary to the common interest.

The beginnings of state aid regulation of R&D&I go back to the 1980s, when the Commission issued the first framework defining the conditions for the compatibility of public R&D&I support with the common market. The importance of research and development as a general interest of the Union has also been enhanced by the revision of the founding treaties, the consequence of which is the above-mentioned wording of Article 179 of the TFEU. The political dimension of the importance of R&D&I is the reason for the Commission's favorable approach to authorizing public subsidies in this area. This is manifested on the one hand within the current Framework for State aid for R&D&I ('Framework')[4] which represents and examplary of soft-law instrument, in which the Comission reveals its opinions regarding the interpretation and application of R&D&I state aid law. According to the current wording of the Framework, state support for R&D&I can thus be compatible with the European single market if it can be expected to mitigate market failure by supporting an important project of common European interest or by facilitating the development of certain economic activities, and if the subsequent distortion of economic competition and trade is not contrary to the common interest [2].

In 2012, the Commission also decided to modernize state aid law. The aim of this modernization was to regulate those state and public aids, that have the greatest impact on the European single market, so that even after limiting the negative effects of aid, it is still possible to achieve the main priorities of the Union, which are the growth and competitiveness of the Union. At the same time, the new rules were supposed to be "streamlined". The logic behind this justification is that the regulation of state aid can help the efficiency of public budgets and correct the so-called market failure. The process of revising the existing rules lasted almost two and a half years, from the first public consultations at the end of 2011 until the adoption of the new rules in May 2014.

Recently, Commission launched a public consultation inviting all interested parties to comment on a proposed targeted revision of the Framework. Interested parties were called to participate in a public consultation which lasted eight weeks (until 3. June 2021). The goal of this new revision is, according Vice-President Margrethe Vestager, further simplyfication of existeing State aid rules. New framework, which shall be the result of this latest modernization effort, shall concern itsfef with the following:

[3] The European Commission is the executive of the European Union. This text uses the abbreviation "Commission" hereinafter.

[4] Framework for State aid for research and development and innovation was published by the Commission in the Official Journal of the European Union (2014/C 198/01) on
27.6.2014.

- Clarification of definitions, particulary
  - **innovation clusters**,
  - **industrial research** and **experimental development** as well as organizational innovation,
  - innovation activities of **SMEs**.
- Compatibility criteria to allow support for **technology infrastructures** to reflect market and technology evolution and to incentivize research, development and innovation investments [3].

4 RESEARCH ORGANIZATION AND KNOWLEDGE TRANSFER

Accordign to EU law a 'research and knowledge-dissemination organisation' ('RO') means an entity (such as universities or research institutes, but also technology transfer agencies or othe innovation intermediaries, etc.), irrespective of its legal status (organised under public or private law) or way of financing, whose primary goal is to independently conduct R&D&I or to disseminate the results of such activities (e.g. by teaching, publications or knowledge transfer activities) [4]. As stated above, these can be private organizations as well. Nevertheless, companies that can exert a decisive influence upon a private RO, in the quality of, for example, shareholders or members, shall not enjoy preferential access to the results generated by it [4].

In addition to the primary activities of the RO (education, basic research, etc.), according to the Commission, the public dissemination of research results (typically in the form of publications, open access databases, or open software) also has a non-economic nature and can be thus subsidised [2]. Part of knowledge dissemination activities are activities in knowledge transfer ('KT'). However, according to the Framework, KT activities are considere non-economic, only if the profit from these activities is reinvested in the primary activities of the ROs.

Knolwedge transfer is definied in the Framework very extensively as any process which has the aim of acquiring, collecting and sharing explicit and tacit knowledge, including skills and competence in both economic and non-economic activities such as research collaborations, consultancy, licensing, spin-off creation, publication and mobility of researchers and other personnel involved in those activities. Besides scientific and technological knowledge, it includes other kinds of knowledge such as knowledge on the use of standards and regulations embedding them and on conditions of real life operating environments and methods for organisational innovation, as well as management of knowledge related to identifying, acquiring, protecting, defending and exploiting intangible assets [2].

The most important takeaway here is that ROs meeting the conditions set out in the GBER and the Framework are, de-facto, outside of the scope of state aid law regulation. However, the conditions here are, (1) the above mentioned reinvestment and (2) no cross-susidization of their economic activities. Even this rule though, has its exemptions. Under certain circumstances public financing of RO's economic activities can also be allowed. These are cases where the economic activity is purely secondary (ancillary). According to the Commission, such secondary economic activity is an activity that meets the following conditions:

- the same inputs (e.g. material, equipment, labor and fixed capital) used for this economic activity are used for other non-economic activities,
- the economic activity in question is directly related to the operation of the research organization and
  - is necessary for its operation or
  - is inextricably linked to its main non-economic use,
- the scope of this activity will not exceed 20% of the total annual capacity of the given entity.

According to Wendland, we can classify the above criteria into qualitative criteria and quantitative criteria [5]. The result of the qualitative view is thus the answer to the question whether the research organization is really used almost exclusively for non-economic activity and the economic activity is directly related to and necessary for the operation of the research organization, or it is intrinsically linked with its main non-economic use. Based on a quantitative perspective, we then determine whether economic activities consume exactly the same inputs (such as material, equipment, labor and fixed capital) as non-economic activities and the capacity allocated each year to economic activity does not exceed the above-mentioned 20% of total capacities.

In this context, however, Wendland, in my opinion, rightly reminds us that it is necessary to assess quantitative and qualitative criteria cumulatively and that the 20% limit has no support in the decision-making activities of the Commission or the EU courts[5]. In the end, the qualitative criteria mentioned above will always be decisive.

5 (NON) ECONOMIC INTERACTIONS OF ROs AND COMPANIES

According to the Framework, independent research conducted with the aim of obtaining new knowledge and a better understanding of a given topic is the primary activity of a research organization, which is considered non-economic. However, according to the Framework, under certain circumstances it is considered permissible that even research that is financed by private means is not considered an economic activity in the sense of the state aid rules. Such situations are in the case of research that takes place within the framework of **effective collaboration** between a research organization and a company or companies (i.e. in the words of the Comission "undertakings").

In such **research cooperation**, both partners contribute to the success of a joint research project. Both partners in these projects also share the risks and subsequently also the outputs (i.e. project results). Compared to the above, **contract research** is characterized by the fact that the industrial partner (undertaking) unilaterally assigns research tasks to the RO and bears the full costs of this activity, including the usual margin.

[5] Court of Justice of the European Union (CJEU) consists of two separate courts: the Court of Justice and the General Court. Hence the abbreviation "EU courts" is used.

Collaboration is considered to be ‘effective’ if at least two independent parties cooperate:

- for the purpose of exchanging knowledge or technology or
- to achieve a common goal.

In order for the qualitative sign of effectiveness according to the Framework to be fulfilled, the above-mentioned purpose should be achieved on the basis of the division of labor between the parties involved. Collaborating parties should jointly determine the scope of the joint research project, jointly contribute to its implementation and share not only its results, but also the associated risks. On the other hand, according to the Commission, the collaboration is effective even if the costs of the aforementioned research project are borne in full by only one or more parties, thus effectively relieving the other parties of their financial risks. Contractual research and the provision of research services are not considered forms of cooperation.

In contrast to effective collaboration, research carried out on behalf of a company is usually carried out on the basis of an assignment, or contractual conditions set by the company, or by the customer. The company also owns the results of research activities and bears the risk of the potential failure of the research or the possibility of non-application of the results. Such research will therefore be the economic activity of the RO and its, even partial financing from public budgets (typically in connection with the use of equipment or employees' working time), is only possible if it is a purely anciliary activity (see above). Otherwise the status of an RO (i.e. non-undertaking, exempted from the state aid rules) could not be maintained.

The Issue Paper to the Framework also brings a more detailed consideration to the topic of the definition of collaborative research. According to the Commission, effective cooperation does not happen in cases where clearly defined tasks are performed within the framework of a contract. Collaborative research is usually of a long-term nature. It is an "open-ended" collaboration. The Commission emphasizes that it is practically impossible to talk about collaborative research in cases where it was not preceded by a proper contract. Otherwise, the risk or, conversely, the benefit of the given cooperation could be retroactively allocated to the more powerful of the cooperating partners [6].

In my view, the key feature of contract researsch is that, unlike in research collaboration, the company solely determines the research assignment. The fact that the ownership of the results remains with the research organization and the company was "only" granted access rights does not deprive such cooperation of the character of contractual research, but on the other hand justifies the reduction of its price. The same is true in cases of co-ownership of results. These considerations flow from the text of the Framework, which in point 26, within the chapter dedicated to research on behalf of businesses (and in this context, contract research or research services), deals with issues of retention of ownership rights to intellectual property. The Framework literally states that "if the research organization or research infrastructure retains ownership of the intellectual property rights or the relevant access rights, their market value may be deducted from the price to be paid for the services concerned".

The Commission also suggests that for the interpretation, or the definition of the term "effective collaboration in research" it may consider documents that were created (and are being created) within the professional circles of organizations dealing with the cultivation of relations between the academic and private sectors. As an example, the Commission's recommendation of 10 April 2008 on the management of intellectual property in knowledge transfer activities and on the code of good practice for universities and other public research organizations (notified under number K (2008) 1329) is given, as well as the recommendation entitled "Responsible partnerships ” published by European associations of universities (EIRMA and EUA), non-university research organizations (EARTO) and knowledge transfer professionals (ASTP – Proton).

Another example of non-economic interaction of RO and business (i.e. undertakings) is **knowledge transfer**. Knowledge transfer in its current form is closely related to the adoption of the so-called Bayh-Dole Act in 1980 in the United States of America. For the first time in that environment, this law allowed universities to own the results of state-funded research and development. The transfer of knowledge thus resulted from the obligation of proper management of the newly acquired property. The passage of this law was part of a long-term vision of the United States government, in addition to the Bayh-Dole Act, a number of new laws were adopted (for example, the Stewenson-Wydler Act on Technological Innovation), and the goal of this reform was to increase the rate of use of publicly funded research and their transfer to the private sector.

The aim of knowledge transfer activities is to convey knowledge, ideally protected by some sort of intellectual property, into new or improved products and services. Schematically, the above-described path from an idea to a real innovation can be described, for example, using the well-known Technology Readiness Level ('TRL') scheme. Following this scheme, it could be said that the mission of knowledge transfer is the transformation of knowledge into technologies and/or products and the subsequent increase of their technological (and market) maturity.

Pracitically, most of the knowledge trasnfer deals are enabled by some sort of a license agreement in which the RO grants the business partner rights, enabling it to use the knowledge generated by the RO legally. Especially with regard to the provision of licenses, the Commission's statement contained in the so-called Issues Paper on the Framework can be considered slightly confusing. According to the paper, the transfer of knowledge should primarily take place on a non-exclusive basis. Non-exclusive licensing is, or should most certainly be the research organization's preferred way of commercializing intellectual property. Especially when this type of licensing has the potential to maximize the economic benefits. In practice, however, the situation where several partners are willing to compete with each other as non-excklusive licensees occurs only rarely. In addition, it follows from the above consideration contained in the explanatory report that the non-exclusivity of the transfer is meant in relation to the primary activity, or the mission of the research organization, which is the public dissemination of research results on a non-exclusive and non-discriminatory basis - for example through teaching, open access databases, publicly accessible publications or open software.

6 CONCLUSION

The enforcement of the european definition of RO and the emphasis on compliance with the state aid rules brought with it an interesting benefit (at least in Czech Republic where the author is based) in that the organizations are forced to prove the existence of their IPR norms and processes, which typically also deal with the application of rights to inventions. However, the state aid law continues to remain a scarecrow that keeps domestic research organizations in uncertainty regarding the acceptable level of their knowledge transfer and application-oriented activities.

Public dissemination of R&D&I results is the mission of a research organization. Therefore, the goal of knowledge transfer cannot be only the achievement of profit, but a wider, societal effect. In-house lawyers of universities, but also lawyers and legal proffesionals working for ROs, as well as in-house lawyers and representatives of the industry, should thus honor this higher goal and allow modern technology and new knowledge to reach places neglected by the market. These activities should certainly not be hindered by the bureaucracy (whether European or domestic), especially through the formalistic interpretation of competition law.

Non-exclusive licensing is, or should most certainly be the research organization's preferred way of commercializing intellectual property. In my view though, an exclusive patent license which resulted from 'arm's length' negotiation, i.e. the transaction between the contracting parties does not differ from those which would be concluded between independent enterprises and with no element of collusionm, is perfectly non-economic in nature. As mentioned above, all profits from such activities need to be reinvested in the primary activities of the RO.

Finally, it can be recommended that the RO should always reserve at least the right to use licensed invetions for its internal ,non-commercial research and educational activities. Licensing should also not jeopardize the fulfillment of the primary mission of RO's, which is the dissemination of knowledge in the true sense of the word, i.e. to the general public.

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Effective collaboration and IP management

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ABSTRACT

This article summarizes the main findings of the national project entitled "Evaluation of IP as a basis for proposing a long-term sustainable state aid model to promote science-business cooperation" (project V7-2145 of the targeted development programme - CRP 2021) supported by the Slovenian Research Agency and the Slovenian Ministry of Education, Science and Sport) [1].

The research was focused to the situations related to the Intellectual Property (IP) management in collaborative projects of the following characteristics:

(i) effective collaboration between undertakings and RKDOs takes place and;

(ii) the project is financed by the state (e.g. cohesion funds through ministries, agencies etc.) and;

(iii) the results of project are expected to contain IP that due to possible commercial interest may or may not be published and widely disseminated, but rather protected (e.g. as a business secret, patent application or other form of IP).The aim of this study was to determine (i) meaningful guidelines for intellectual property (IP) management in collaborative projects and (ii) the most typical way of assessing the market price of IP for the case of licensing or selling IP to third parties interested in using it for commercial purposes.

KEYWORDS

Effective collaboration, collaborative projects, IP - Intellectual Property, Background IP, Results, Foreground IP, State Aid, Undertaking, RKDO - Research and Knowledge Dissemination Organization, GBER - General Block Exemption Regulation [2], R&D&I - Research & Development & Innovation framework [3]

1. INTRODUCTION

The General Block Exception Regulation (GBER) of EC [2] declares certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty on the Functioning of the European Union (TFEU). Aid for research and development and innovation is one of the GBER categories and the principles of its proper implementation are explained in Framework for State aid for research and development and innovation (R&D&I) [3], which has a status of EC communication and as such does not have a direct legal impact. As the content of the R&D&I framework is based on the GBER, it makes sense to consider the points of the R&D&I framework as if they were legally binding in practice.

According to the terminology of GBER [2] and R&D&I [3] the term *"undertaking"* is used describing an entity carrying out an economic activity consisting of offering products or services on a given market (point 17 in R&D&I [3]) such as small, medium-sized and large enterprise (point 15 in R&D&I [3]).

The abbreviation *"RKDO"* stands for "Research and Knowledge Dissemination Organization or Research Organization" as defined in article 2, paragraph 83 of GBER [2] and point 15 (ee) of R&D&I [3].

The phrase *"collaborative project"* means the project carried out through *"effective collaboration"* as defined in point 27 of R&D&I [3] (see the full definition in the following text).

The *"aid intensity"* is the maximum gross amount of state aid that can be granted per beneficiary (undertaking or RKDO), expressed as a percentage of eligible costs, before any deduction of tax or other charge (point 15 c in R&D&I [3]).

For the purpose of this article the term *"consortium"* means a group consisting of at least one or more undertakings and one or more RKDOs that "effectively collaborate" among each other in the framework of national collaborative project funded to certain extent by the state (the type of collaboration as described in article 25, paragraph 6 (b) (i) in GBER [2]).

2. RESULTS AND DISCUSSION

Key characteristics of collaborative projects taking place through effective collaboration between research and knowledge dissemination organizations (RKDO) and companies (undertakings) associated to the maximum allowed intensities of state aid funding were followed by general guidelines regarding management of IP in such projects and more detailed description referring to the management of Background IP – owned by one or more project partners before the beginning of collaborative project; and Foreground IP – jointly created by the partners in the course of the collaborative project. Typical and less common ways of IP commercialization in accordance with the state aid rules were schematically represented along with the types of recommended agreements at individual steps of commercialization. Different options are further described regarding the IP transfer and market price determination.

3. CONCLUSIONS

The most important findings are: (i) the relations between the partners regarding the ownership and access of Background IP

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have to be well regulated in advance prior to the start of the collaborative project; (ii) the typical and most useful path for the transfer of IP includes the following steps: valuation of IP, effective negotiations; determination of the IP market price and conclusion of IP license or IP sales and/or IP exploitation and/or new collaborative project consortium agreement.

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LEGAL DISCLAIMER:

The authors of this paper used reasonable efforts to include accurate information on the state aid rules related to the collaborative projects, but we, however, make no warranties as to the accuracy of the content and statements and assume no liability or responsibility for an error or omission in the content of this article.

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Project support services of a technology transfer office

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ABSTRACT

The Center for Technology Transfer and Innovation (CTT) at the Jožef Stefan Institute (JSI) offers not only services related to technology transfer, but also project support services. Database of project calls established by CTT serves as an important tool to inform researchers about relevant calls. Establishing a consortium of project partners or joining one that is already established is also an important step in project work. Further support such as writing of project proposals, identifying and planning impact of the project, managing data, providing gender equality, management, financial, legal and administrative support is crucial for successfully acquiring and running a project. In June 2022 we performed a survey which targeted researchers at the institute. It provided quantitative and qualitative analysis of project support services available at the JSI.

KEYWORDS

project support services, management, technology transfer, project's impact, public funding

POVZETEK

Center za prenos tehnologij in inovacij (CTT) na Institutu Jožef Stefan (IJS) poleg storitev, povezanih s prenosom tehnologij, ponuja tudi storitve za podporo projektom. Baza projektnih razpisov, ki jo je vzpostavil CTT, je pomembno orodje za obveščanje raziskovalcev o relevantnih razpisih. Pomemben korak pri projektnem delu je tudi vzpostavitev konzorcija ali pridružitev k že vzpostavljenemu konzorciju. Nadaljnja podpora, kot je pisanje projektne prijave, prepoznavanje in načrtovanje vpliva projekta, upravljanje s podatki, zagotavljanje enakosti spolov, upravljanje, finančna, pravna in administrativna podpora, je ključnega pomena za uspešno pridobitev in izvedbo projekta. Junija 2022 smo izvedli anketo, ki je bila namenjena raziskovalcem inštituta. Z njo smo pridobili kvantitativno in kvalitativno analizo storitev projektne podpore, ki so na voljo na IJS.

KLJUČNE BESEDE

storitve projektne podpore, upravljanje, prenos tehnologij, vpliv projekta, javno financiranje

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1 INTRODUCTION

Technology transfer offices and project support offices at the public research organizations are sometimes two units (i.e. National Institute of Chemistry, Slovenia) and sometimes merged in one unit (i.e. KU Leuven, Belgium). Experience in creating impact, management with intellectual property, technical background and good connections with researchers should be values of each technology transfer unit. These kinds of expertise are useful also in preparing R&D project proposals and management of the project consortia. Using national/regional funding is also one of the most common pathways to raise Technology Readiness Level and transfer technology to industry. If technology transfer support and project services are carried out at one unit, a one-stop-shop service can be offered to researchers, which we see as an advantage. Further specialized knowledge in project management is needed, such as legal, financial and other expertise.

2 PROJECT SUPPORT SERVICES

The following project support services are offered at the CTT, JSI.

2.1 Finding right call

Getting a project can result from two options. In the first option the organisation identifies a call, suitable for its expertise and builds a project idea and project partner consortium based on guidelines in the call. The second option occurs when a consortium is already established and the project prepared. In that case the consortium looks for a call that would fit their consortium and project proposal. Often modifications are made in order to correspond to the call.

In both cases a good overview of published and forthcoming calls as well as their conditions and deadlines is needed. This can be delivered to researchers in different ways – using internal database, newsletters, direct communication, etc.

In 2017 CTT established database of research and innovation calls, which is still active [1]. The database is searchable and different filters such as technical field, financer, deadline, opening data, can be applied in order to optimize the set of calls a user is looking for. The database includes calls which are directly relevant for JSI which means that JSI can apply as an applicant. Furthermore, indirectly relevant calls where JSI's role could be in subcontracting are included in the database. The database contains calls published by Slovenian, European and other authorities and bodies. It is designed in a way that calls are automatically archived when the deadline passes. In order to keep the database up to date, once per month relevant sources are reviewed and new calls inserted in the database. It is offered only to JSI's employees, which is arranged by limited access with institutional Internet Protocol address.

Beside the infrastructure (database) relevant information about the suitable calls should be delivered to researchers. This is done in different ways – through more systematic way using newsletter and mailing lists or for specific technology.

It is necessary that conditions of the calls are studied and most suitable are identified. It is also advisable to establish a link with a contact person or national contact point (usually ministries and agencies) in order to discuss the compatibility of expertise, organisation status and other characteristics with the call. For example, the Horizon Europe programme has a helpful and well organized network of National Contact Points. This is useful for companies as well as research organizations. Usually it is crucial for small companies without experience in project proposals and dedicated units.

2.2 Establishing partnership

Most of the research and innovation projects are done in cooperation with more partners. Sometimes JSI is in position to coordinate the project and in other cases its role is more suitable as a partner, associated partner or subcontractor. The partnership for project proposals can be established with existing partners from past projects or other types of cooperation. It is also good to look for new partners in order to bring new ideas to the project. This can be done in different ways.

Enterprise Europe Network is the largest European network that connects industry with research organizations, operated by the chambers of commerce, technology transfer offices, innovation agencies and similar nodes [1]. Its main tool is a publicly available anonymized brokerage database with business/technology offers/requests as well as partner search publications. Specific guidelines must be followed in order to prepare such publications. This results in well prepared publications so dissemination activities are normally easy and suitable companies, research institutions and other organizations across Europe are quickly informed. CTT-JSI is a member of Enterprise Europe Network and it represents an important tool for establishing partnerships.

Partners can be found also by several other means such as other networks, platforms and communities, brokerage events, direct contact by email/phone – targeted or by e-blast – and other.

Once contacts between possible partners are established, video-call or personal meeting is advised to be organized in order to establish personal relationship and discuss cooperation directly.

The further discussions can require concluding written agreements such as non-disclosure agreements, letters of intent, material transfer agreements etc. which requires legal support in drafting, negotiating and signing such contracts.

2.3 Writing the project proposal

Public authorities expect very well prepared project proposals for published calls. One of the reason is that a financer doesn't want to take the risk of financing unclear and not well planned projects.

A project proposal can be defined in different ways. It can be:

- A document which includes all the information needed by relevant stakeholders to make management decisions.
- A document that transforms an "idea" or "policy" into an effective/doable project.
- A document used to convince a "sponsor" to finance a project or to let you implement it.
- A document which serves as a key management tool ("road-map") for the implementation of a project.

Project proposals of Horizon Europe and other research and innovation funding calls normally consist of three parts: 1) Excellence; 2) Impact; and 3) Quality and efficiency of the implementation. As a rule, researchers prepare scientific parts of the proposal in part 1) and 3). In part 1) it is usually expected to explain also how the data will be managed and how gender equality will be provided. Sometimes also some other non-technical content is expected such as interaction with initiatives, living lab concepts etc. Researchers are often not familiar with these parts. This is usually the case also with chapter 2) Impact.

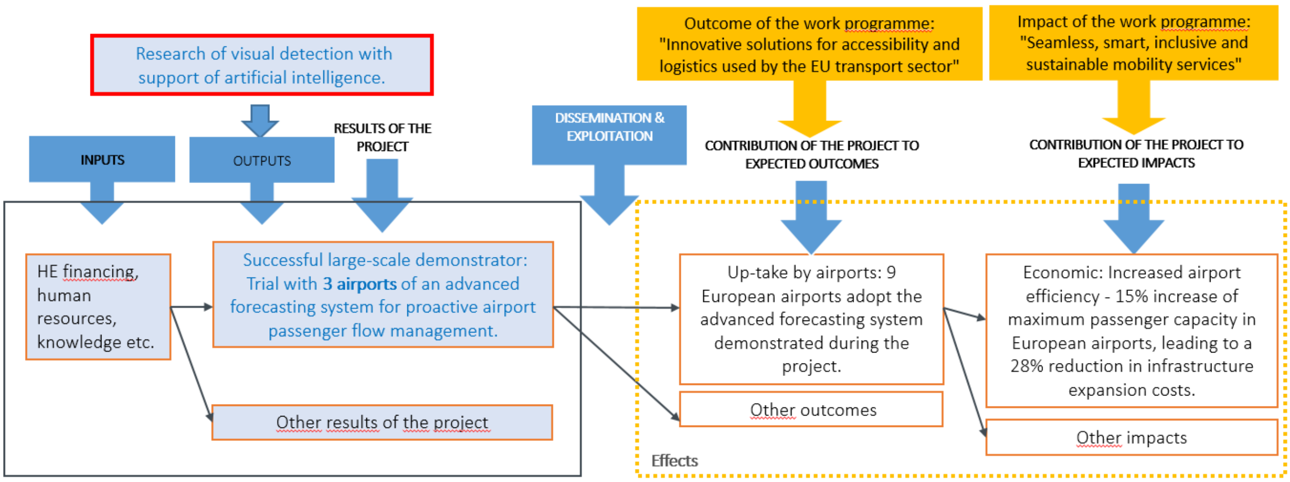

Figure 1: Pathway to impact, example by European Commission [3]

A one-stop-shop service to support these sections of the project is needed. It should be noted that there is no single standardized way/text suitable for all projects. In order to prepare these parts to fit well into the project, suitable partners with relevant expertise should be found and the strategy prepared with effective communication. For a successful project proposal different analysis such as state-of-the art and market analysis should be prepared. Often a research group already has a lot of important information gathered, so having an interview with them is a good start.

2.4 Impact

Generally, a project applicant should describe the qualitative and quantitative impact of the project as well as what measures will be implemented to reach it.

The term impact describes all the changes which are expected to happen due to the implementation and application of a given intervention. Such impacts may occur over different timescales, affect different actors and be relevant at different scales (local, national, etc.). Impact is the last link in the results chain according to the theory of change: inputs–>activities–>outputs(results)–>outcomes–>impact. An illustrative example with artificial intelligence for a forecasting system in airports is shown in Figure 1.

Project proposals usually include scientific, economical, societal, and environmental impacts. Scientific impact includes creating quality new knowledge, strengthening human capital in research and development, and encouraging the spread of knowledge and open science. In EU projects, societal and environmental impacts are expected to be reached by addressing EU policy priorities and global challenges through research and innovation as well as strengthening the acceptance of research and innovation in society. Economic impact involves creating growth based on innovation, creating more and better jobs, and utilization of investments in R&I.

In order to achieve expected impact, suitable measures must be taken. Dissemination, communication and exploitation must be effective and well coordinated. Public dissemination and communication is normally an obligation in publicly funded projects. This request is reasonable, since the public (including relevant stakeholders) funds the research and development activities and should be informed about them. The Open Science principles are gaining on importance. Not just publications about research, but also related data that was acquired during the project is expected to be published. With the help of open science, all stakeholders in society will gain important access to knowledge.

Communication activities are constantly changing and adapting to new trends. In the past, physical promotion materials such as flyers and brochures were more significant. Nowadays, social networks, new internet platforms and other forms are gaining importance. This trend was accelerated during the COVID19 pandemic.

Although dissemination is expected from project partners, suitable protection of intellectual property (IP) and exploitation of results should also be accomplished. In order to accomplish both dissemination and protection of IP, the best way is to file patent applications for developed inventions. Sometimes the generated knowledge is not patentable or patent protection is not reasonable. In case such know-how has a big commercial value or is expected to have one, it should be protected as a secret know-how. Important part of exploitation activities is to have a suitable business model, partners and end-users which are interested in accepting new technologies.

2.5 Data management

In comparison with Horizon 2020 projects, it is expected to better manage data in Horizon Europe projects. The data management should follow FAIR (Findable, Accessible, Interoperable, Reusable) principle. Already in the project proposal, the project consortium should have a good picture of what type and size of

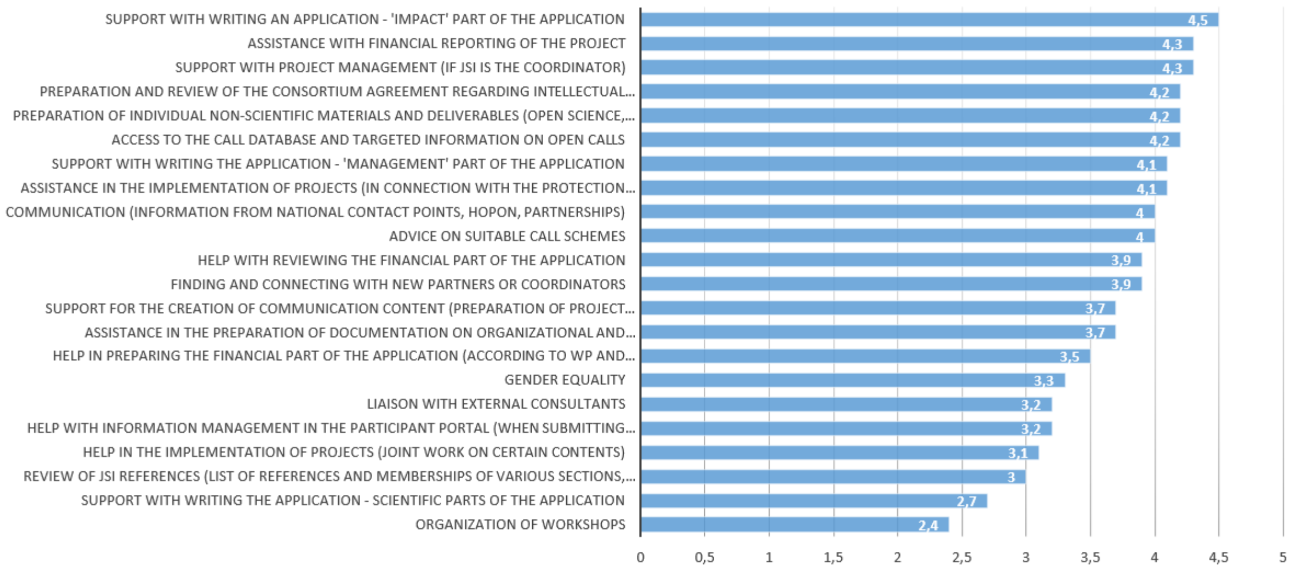

Figure 2. Need for project support service by JSI researchers according to internal survey

data will be generated in the project. The data generated in laboratories and other locations should be well structured and labelled. Metadata should be generated. An appropriate trustworthy repository with possibility to assign persistent identifiers should be chosen and used to upload the data. Good practices for these activities are advised to be reviewed and followed. By consistent upload of data to repository, an effective dissemination is accomplished. These activities should be well aligned with IP protection strategy. An important aspect is also safety which has to be assured in order to protect sensible data including personal data from cyber attacks.

2.6 Gender equality

Articles 2 & 3 of the Treaty of Amsterdam (1997) and other EU policy directives (i.e. COM (96) 67 final) foresee principles of gender mainstreaming which should be incorporated in every project [4], [5]. Gender equality in projects is targeted in two ways. Firstly, the consortium team is expected to be gender balanced in the terms of equal number of women and men. Secondly, the content of the project must take into account gender balance. An example is assuring gender balance of tested persons in clinical trials during validation of a new drug. Another example would be to design an algorithm for car safety which corresponds to a man and woman driver. Gender equality is also empowered by stimulation to establish a gender equality plan. Beginning with Horizon Europe calls in 2022, public bodies, research organisations or higher education establishments (including private research organisations and higher education establishments) must have an established gender equality plan [6]. Different projects, initiatives and platforms such as ATHENA, RePower Women are established to promote gender equality [6], [8].

2.7 Management, financial and administrative support

Management of the project is an important task in performing the project, especially for a coordinator. Planning, monitoring, executing and reporting are activities which should be mastered by a good manager. In case of bigger projects, tasks should be divided and researchers should be supported with management. Different IT tools can be used for the management such as Microsoft Project. Finances should be well planned and expenditure tracked.

3 DEMAND FOR SERVICE, SURVEY AT THE JSI

In June 2022 we performed a survey, in which we asked JSI researchers which project support services they use and by which JSI's unit, which services are important to them and what improvements do they suggest for the future. 44 researchers have filled out the survey. 90% of them expressed their need for support and 95% said that they would like to have an overview of services available at the JSI.

Figure 2 shows the rate of importance of each service for researchers on scale 1-5, where 1 is not important and 5 is very important. As most important the researchers have identified support with the writing section 'impact', assistance with financial reporting and support with project management when JSI is coordinator.

Table 1. Project support of different units at the JSI. Service providers at the JSI in the survey were as follows: U1 - Director's Office; U6 - International Project Office; CTT; SRIP TOP - Strategic Research & Innovation Partnership Factories of the Future; SRIP PMiS - Strategic Research & Innovation Partnership Smart Cities and Communities. Other*: 1) They haven't needed help so far. 2) They were not aware of the possibility of internal assistance. 3) Help from external consultants. 4) They did not apply to this group of calls. ERC - European Research Council; EIC - European Innovation Council; MSCA - Marie Skłodowska-Curie Actions; ESA - European Space Agency; ARRS - Slovenian Research Agency; MIZŠ - Ministry of Education, Science and Sport; MGRT - Ministry of Economic Development and Technology.

	TOP 3 service providers at the JSI			Other*
ERC calls	U1	U6	CTT	
	26%	19%	7%	48%
Horizon Europe Pillar 2	CTT	U6		
	30%	22%		48%
Horizon Europe Pillar 3 (EIC, Pathfinder, ...)	CTT	U6		
	32%	5%		63%
MSCA scheme	CTT	U6	U1	
	24%	13%	3%	60%
Other schemes (ESA, Hop on, ...)	CTT	U6	SRIP TOP	
	31%	6%	3%	60%
ARRS calls	CTT	U1		
	21%	3%		76%
Calls of MIZŠ/MGRT and other Slovenian agencies and ministries	CTT	SRIP TOP		
	32%	3%		65%
Calls of other agencies	CTT	U6	SRIP TOP	
	21%	13%	5%	64%

We were also interested to get feedback from surveyees, from which units at the JSI they get most support for a specific group of projects. The results are shown in Table 1. Based on the survey, major project support providers are CTT, U6 and U1 and in a smaller portion SRIP TOP. The notable results not shown in Table 1 are following: There is no need for support within the JSI: most prominently in ARRS calls (49%), MIZŠ/MGRT calls and other Slovenian agencies and ministries (39%), and projects from other agencies (21%). Researchers are familiar with the possibility to turn to someone within the JSI for help: between 93% (ERC calls) and 77% (ARRS calls). Use of external consultants' services is following: a) mostly for Horizon Europe 3rd pillar (EIC, Pathfinder) and the ARRS scheme (8%) b) rarely for MIZŠ/MGRT calls and other Slovenian agencies and ministries (3%). When external consultants were sought, researchers used different approaches to find them (Figure 3).

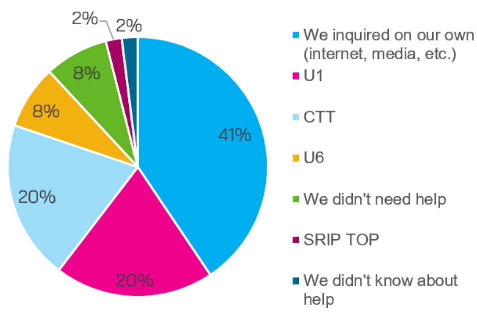

Figure 3. Looking for external consultants to prepare the project application

44% of researchers expressed their willingness to participate in the design of future project support at the JSI. They also proposed some suggestions for improvements:

- Better definition of the services of individual providers of project support services at the JSI.

- Providing comprehensive support in the "non-scientific" parts of the application (impact, finance, GEP, promotion) and faster response regarding contracts (e.g. NDA).
- Possibility of internal review of the entire project application and advice for improvements by a person with experience in EU project reviews. List/analysis of the most common reasons for project rejection.
- Better support in the financial part of the project, review of finances, consulting for certain types of projects
- Support in finding suitable calls (which are more suitable, in what composition of consortia, which are the priority topics).

Main findings of the survey are that (i) researchers need support with project management, (ii) CTT is recognized as the main service provider, but also other units at the JSI are very important, (iii) project support services of JSI's units should be better represented and communicated.

The pre-grant project support services provided by CTT are currently not charged to researchers. Financing of this is not adequately addressed and is expected to be properly resolved. In October 2022 Slovenian Ministry of Education, Science and Sport published a call for project support service, which is a good start to improve this field.

ACKNOWLEDGMENTS / ZAHVALA

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Challenges of Legal and Regulatory Framework for Blockchain Technology in the EU

Izzivi zaščite tehnologije veriženja podatkovnih blokov v EU

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ABSTRACT

While blockchain is one of the crucial emerging technologies shaping Europe's digital future, blockchain protection in the domain of IPR is not clearly defined. This status quo, therefore, necessitates an examination of this field – to arrive at a clear legal basis which would regulate blockchain technology protection it is necessary to define and address the crucial points. The following paper presents the challenges of blockchain protection in the EU. It starts by introducing blockchain technology from theory to practice, followed by the existing conditions of the current legal and regulatory framework and the most common challenges for blockchain technology protection, and concludes with proposals for further research in this field.

KEYWORDS

Blockchain Technology, Intellectual Property Rights (IPR), Protection, Challenges, EU

POVZETEK

Četudi je blockchain tehnologija oz. tehnologija veriženja podatkovnih blokov na eni strani ena izmed ključnih (še vedno nastajajočih) tehnologij, ki oblikuje digitalno prihodnost Evrope, na drugi strani njena zaščita na področju pravic intelektualne lastnine še vedno ni povsem jasno opredeljena. Da bi v prihodnosti prišli do vsem deležnikom jasne pravne podlage, ki bi urejala zaščito tehnologije veriženja podatkovnih blokov, je zato treba opredeliti in obravnavati najpomembnejše kritične točke. V prispevku predstavljamo izzive na področju zaščite tehnologije veriženja podatkovnih blokov, ki jo predvideva trenutni pravno-formalni okvir EU. Najprej se osredotočamo na tehnologijo veriženja podatkovnih blokov od teorije do prakse, nato na obstoječe pogoje veljavnega pravno-formalnega okvira ter najpogostejše izzive pri zaščiti, na koncu pa podajamo predloge za nadaljnje kritične točke, ki zahtevajo raziskave tega področja.

KLJUČNE BESEDE

Tehnologija veriženja podatkovnih blokov, pravice intelektualne lastine, zaščita, izzivi, EU

1 INTRODUCTION

Blockchain technology as one of the technologies of Industry 4.0 significantly affects how businesses operate while revolutionizing numerous innovation ecosystems[1] [1].

In 2018, 21 Member States and Norway agreed to sign a declaration to establish a *European Blockchain Partnership* (EBP) and to work together to establish a *European Blockchain Service Infrastructure* (EBSI) to support the delivery of cross-border digital public services with the highest standards of security and privacy. Since then, eight more countries have joined the partnership [3]. EBP nowadays consists of the EU 27 Member States, Liechtenstein, and Norway.

The European Union (EU) and Europe have taken a step forward in balancing the legal, regulatory and policy frameworks of the EU Member States in crypto assets [4]. In 2020, the European Commission (EC) has published a new proposal for "*Regulation of the European Parliament and the Council on markets in crypto assets*" [5]. This proposal is part of the *Digital Finance Package*, a comprehensive package of measures to further enable and support the potential of digital finance in terms of innovation and competition while mitigating risks [6]. In addition to the proposal, the *Digital Finance Package* also includes a proposal to pilot the regulation of market infrastructures using "*Distributed Ledger Technology*" (DLT), a proposal for digital operational resilience and a proposal to clarify or amend specific related EU financial services rules. The EC's priorities ensure that the EU regulatory framework for financial services is innovation-friendly and does not produce barriers to use of new technologies. The proposal to pilot DLT regulation represents the first concrete action in this field. [4]

The World Intellectual Property Organization (WIPO) points out that blockchain technology affects all industries and it is in the interest of the intellectual property (IP)

[1] Given that this paper is written in the context of the innovation ecosystem it should be understood as the evolving set of actors, activities, and artifacts, the institutions and relations, including complementary and substitute relations, that are important for innovative operation of an actor or a population of actors [2].

community to investigate the impact of blockchain technology on IP and to find appropriate models for the application of blockchain technology in the field of IP [7].

Blockchain technologies impact every industry and have been extensively used in IP; the WIPO Member States have established a blockchain technology task force under the *Committee on WIPO Standards* (CWS). Its purpose is to develop reference models for the use of blockchain technology in the field of IP and to propose a new WIPO standard that would support the potential use of blockchain technology in IP ecosystems. [1]

Even though blockchain technology is recognized as a technology with a relatively low maintenance cost, increased transparency, reduced administrative burden, resilience to fraud, and as versatile technology deployed in many sectors and businesses [8]; there are crucial questions which guide us in this review-oriented paper:

1. How is blockchain technology prepared for IP?
2. How is IP prepared for blockchain technology?
3. How can blockchain technology help protect IP?

Irrespective of the three questions above and crucial for the paper is the status quo, as follows: the number of inventions involving blockchain technology (in the EU) is increasing [9]. At the EU level, those responsible for this field have taken this status quo seriously – even though the growth of blockchain patent applications started in 2016.

The official beginnings of blockchain technology protection in the EU date back to 2018 when the European Patent Office (EPO) organized the first conference on blockchain technology [9]. At the conference, the EPO expressed its desire for organization of blockchain technology to ensure that patent-granting authorities grant blockchain patents that are legally robust in a predictable manner [9]. The EPO has highlighted computer-implemented inventions (CII) as the challenge researchers in this field face today regarding IPR. When we talk about blockchain inventions, we are talking about CII. The EPO has therefore developed stable criteria in this respect based on the case law on CII. "*Blockchain patent applications*" refer to a group of generic patent applications related to blockchain technology [9]. This group can be divided into two sub-groups:

1. patent applications related to core blockchain technologies (e.g., public key decryption, access control and block construction), and
2. patent applications related to application (use) of blockchain technologies (e.g., drug tagging, audit registration and food tagging).

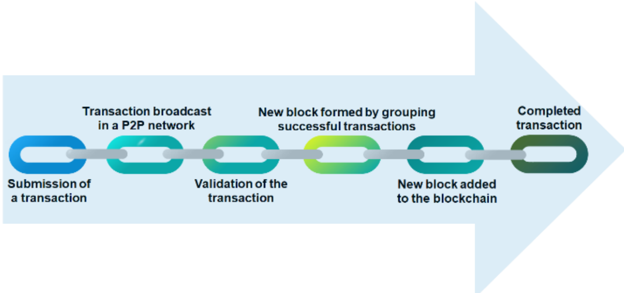
In the following part of paper we, therefore, pay attention to both sub-groups – chapter 2 contains the introduction of blockchain technology from theory to practice.

2 BLOCKCHAIN TECHNOLOGY: FROM THEORY TO PRACTICE

Based on the available peer-review literature, blockchain technology can be defined as [10]: "A distributed database, which is shared among and agreed upon a peer-to-peer network. It consists of a linked sequence of blocks, holding timestamped transactions secured by public-key cryptography and verified by the network community. Once an element is appended to the blockchain technology, it cannot be altered, turning a blockchain technology into an immutable record of past activity". The concept of decentralized blockchain technology has been firstly introduced by Satoshi Nakamoto in 2008 to provide technological support for Bitcoin – a peer-to-peer (P2P) electronic cash system [11].

A schematic illustration of the blockchain technology basics is shown in Figure 1, based on a very general introduction [12]. One can broadly define blockchain technology as a distributed system to record transactions. After a transaction is issued, it is announced inside the P2P network made of nodes that record transactions in blockchain technology. The validator nodes decide if the transaction is valid or not based on the consensus protocol, i.e., a set of defined rules implemented by all nodes that regulate how new transactions are added. If the transaction is deemed valid, it is grouped with other recently approved transactions inside a new block linked to the previously approved block. A completed transaction is made public on blockchain technology.

Figure 1: The flow of the transaction confirmation process in the blockchain [12].



The primary and most known application of blockchain technology is in the field of cryptographic digital currency. There are over 10 thousand cryptocurrencies as of 2022 [13] (Figure 2a) with the total market cap of all currencies reaching more than 1 trillion dollars (as of August 2022 [14]). The two leading cryptocurrencies Bitcoin (BTC) and Etherium (ETH) alone both have market caps above 200 billion dollars and have a market share of 38 % and 19 %, respectively (Figure 2b). These data show a growth of blockchain-based cryptocurrencies.

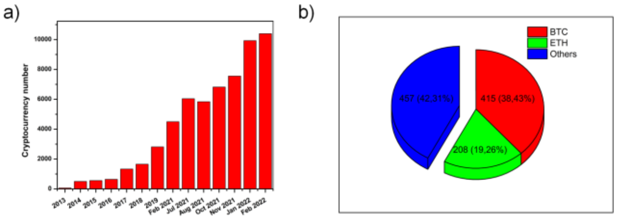


Figure 2: a) Number of cryptocurrencies and b) market cap (in billion dollars) of Bitcoin and Etherium, together with their respective percentages of the total market cap (as of August 2022) [13, 14].

Since the technological benefits of blockchain technology can be implemented into many services, it has stimulated the interest of many industries. Some proposals for applications of blockchain technology also include [15] the Internet of Things (IoT), Healthcare, Supply Chain and even Tourism [16]. However, despite the growing interest, there are few business solutions [17]. Examples of promising live blockchain solutions are presented in Table 1.

Slovenia is, for example, recognized worldwide for its blockchain companies. The Member State promotes its economy as "Green, Creative, Smart" and one that leans towards higher adoption of blockchain technology. Slovenia ranks second in the world for the number of searches for the term Initial Coin Offering (ICO) – surpassed only by Singapore. The country is also home to the second-largest bitcoin scene within Europe based on Google search queries. [4]

Table 1: Examples of successful blockchain technology applications outside cryptocurrencies [17, 20, 21].

Name	Application Field	Reference
TradeLen	Supply Chain	[17]
Solve Care	Healthcare	[20]
Slock.it	IoT	[21]

One of the reasons for this backlog in other areas is that – from a development point of view – blockchain technology is in its early rudimentary stage, still actively seeking new cryptographic algorithms to build reliable, flexible, secure, and stable systems [18]. Another issue is the handling of sensitive data that is highly regulated to ensure the privacy of the customer (for example medical patients). Thus, for blockchain applications to operate within the EU, they are required to be compliant with regulatory frameworks such as General Data Protection Regulation (GDPR) [19].

The status quo in this field is presented in the following chapter no. 3.

3 STATUS QUO OF LEGAL AND REGULATORY FRAMEWORK FOR BLOCKCHAIN TECHNOLOGY IN EU: CHALLENGES

The EU is convinced that blockchain technology can play a crucial role in building Europe's Single Digital Market and drive essential market innovations. If blockchain-enabled markets are to mature, policymakers and businesses must create the rules of engagement together [22]. EC emphasizes that the EU supports an EU-wide rule for blockchain to avoid legal and regulatory fragmentation. The EC, therefore, adopted a comprehensive package of legislative proposals for regulating crypto-assets to increase investments and ensure consumer and investor protection. This package updates specific financial market rules for crypto-assets and creates a legal framework for regulatory sandboxes of financial supervisors in the EU for using blockchains in trading and post-trading securities. [23]

As noted by Timsit and Herian (2019), while the overall goal in the EU is clear, there is the crucial question of how to achieve the goal [22]. These proposals in the context of legal and regulatory relate, as a matter of priority, to the need for legal and regulatory clarity for blockchain technology and less to blockchain protection – a field with recognized challenges. We therefore briefly present some of these challenges which from our perspective are crucial for clarifying legal and regulatory framework in the future [22]:

1. *Challenge no. 1: Legal Value of Blockchain Technology as Registers*
   This challenge assumes the prerequisites for blockchains acquiring legal status would be the legal recognition of blockchain-based signatures, timestamps, validations, and "documents".
2. *Challenge no. 2: Territoriality*
   This challenge assumes that cross-jurisdictional harmonization is crucial. In turn, it requires regulators and legislators to work together across borders to harmonize legal and regulatory regimes and manage potential risks, including monopolies and market manipulation. Addressing them would require significant legal and organizational changes and a cooperation mechanism to ensure harmonization.
3. *Challenge no. 3: Enforceability*
   This challenge assumes the possibility of pseudonymity and, in some cases, complete anonymity in blockchains has given rise to the impression in some quarters that they can be used to create law-free zones for the benefit of criminals.
4. *Challenge no. 4: Liability*
   This challenge assumes core developers make attractive access points for enforcement laws and regulations. Depending on their role in the design, development, and maintenance of the blockchain platform, they are also accessible enforcement targets for accountability issues. Although it is generally – not always – possible to identify the actors in a blockchain network, this takes time and effort and is therefore not always practical. This can consequently be an obstacle to enforcing accountability for actors in blockchain-based networks.
5. *Challenge no. 5: Data Protection*
   Although the GDPR is supposed to consider significant developments in the field of the online world, it was written before blockchain was implemented and was therefore designed with more traditional, centralized data processing paradigms. This has led to, what many believe,

several tensions between blockchains and the GDPR.

6. *Challenge no. 6: Competition*
   Should competition policy be implemented, new norms or tools will depend on the nature and effects of economic activity that will take place in blockchains. No two cases are likely to be the same, so in any case the assessment of competition law will depend entirely on the specific circumstances of each blockchain and the relevant market.

As blockchain technology becomes increasingly widely used to support new types of decentralized applications and platforms, legislators and regulators will increasingly be confronted with the complex issues dictated by the above challenges [22]. The challenges illustrated above undoubtedly result in challenges related to the protection of blockchain technology – especially when it comes to the following cases where we address CII:

1. Patent applications related to core blockchain technologies, and
2. Patent applications related to application (use) of blockchain technologies.

As a reminder, the CII presents any invention that involves the computer, computer network, or other programmable apparatus, the invention having one or more features that are realized wholly or partly using a computer program or computer programs [24]. In the EU there is still no appropriate legal instrument governing such inventions which are highly specific and for which demonstrating technical contribution and industrial applicability may pose different interpretations – for the inventor and the end user. The lack of such a legal and regulatory framework results, among other things, in challenges related to blockchain technology protection.

There is no single legal and regulatory framework for protecting intellectual property rights and this can lead to potential disputes between different countries. Blockchain technology does not necessarily provide a check on the integrity of the information initially entered – it only provides assurances that this information has not been compromised or altered. [25]

At the outset, a certain level of internal trust needs to be established between the parties to ensure that there are no underlying issues with the original information that triggered the blockchain. As industries continue to rely on blockchain technology, IP law will need to address the relevant legal issues arising from this new "language" of authentication and verification. [25]

Although the idea of creating a more efficient blockchain-based system for managing and monetizing IPR is still new, new applications of blockchain-based IPR management continue to emerge with remarkable frequency. However, several issues remain unresolved, such as the necessary processing power of blockchains, the compatibility and interoperability of different blockchain platforms, and legal issues such as data ownership, privacy, liability, and jurisdiction. [8]

4 CONCLUSION

While blockchain technology has already demonstrated its potential to be one of the promising emerging technologies, its legal and regulatory foundation is still in the early phase of development.

From the EU perspective, the crucial challenge is the lack of a single legal and regulatory framework for protecting IP, resulting in disputes between countries.

While it is difficult to predict all potential IP-related applications of blockchain technology (especially if we don't know all the pitfalls of IPR), we found three specific fields of application pertinent to technology transfer and IP professionals and relevant for our further work [8]:

1. Blockchain technology can help with IP rights management and technology transfer and commercialization practices.
2. Blockchain as an IP registry.
3. Establishing authorship, proving ownership and provenance of creative works.

Although the idea of creating a more efficient blockchain-based system for managing and monetizing IPR is still new, new applications of blockchain-based IPR management continue to emerge with remarkable frequency [8].

However, several challenges remain unresolved, especially the necessary processing power of blockchains, the compatibility and interoperability of different blockchain platforms, legal issues such as data ownership, privacy, liability, and one of the crucial challenges – jurisdiction [8].

However, on the one hand, it should also be borne in mind that technology transfer created using blockchain technology positively impacts company performance. In 2021, Ceptureanu and colleagues, in a study entitled '*Influence of Blockchain Adoption on Technology Transfer, Performance and Supply Chain Integration, Flexibility and Responsiveness: A Case Study from IT&C Medium-Sized Enterprises*' showed that entrepreneurs have a perception that the adoption of blockchain technology will help them increase technology transfer, they will have better traceability of research, development and production phases, and reduce the likelihood of technology transfer failures that can lead to better business performance [26].

On the other hand, Technology Transfer Offices (TTOs) are closely involved in technology and knowledge transfer activities and, as such, are key link members between research organizations and companies. We believe TTOs based on their experience in helping researchers with inventions, IP protection and capitalization of inventions could also contribute to the development of legal and regulatory frameworks. Initially, could provide practical examples of researchers developing CIIs and thus contribute to a constructive decision-making process on the future of blockchain technology protection in the EU. However, it would be necessary to further explore how they could contribute to the development of legal and regulatory frameworks at the EU level with their knowledge and experience. Undoubtedly, we would like to explore this further in the remainder of this work.

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Technology Transfer: Start and Stop of Deep Well Pumping Through GSM System

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ABSTRACT

The aim of this project was to create a long-distance control through a cell phone in order to turn on a water pump or any kind of machine. The present work documents the low-cost technology transfer (TT) project of a three-phase deep-well pumping system for drinking water supply at the Technological University of Tecamachalco, (TUT) this project was achieved through the collaboration of teachers and students of the Technological University of Tecamachalco of the Mechatronics career, in itself of daily interaction, focused on solving a need for the benefit of the university community, taking advantage of the experience of the teachers and the impetus and attitude of the students who collaborated, It also managed to make learning significant and thereby strengthen professional academic training, successfully achieving and, where appropriate, reproducibility of the project. It is important to mention the use of the Arduino platform and devices for the design and development of the project with which the cost was accessible, since for budget reasons it was necessary to optimize economic resources.

KEYWORDS

GSM Communication, Arduino Platform, Technology Transfer.

1 INTRODUCTION

The development of collaborative projects in the Public Higher Education Institutions (PHEI, where the collaboration of teachers and students, to obtain both an academic impact and also solve a need, is usually not very common, especially because of the economic cost and the lack of resources. However, when the project and the appropriate materials are chosen to cover a need, the project turns out to be viable. The project developed in collaboration between students and teachers, was an automated start-up system via remote using (Global System for Mobile Telecommunications GSM technology, for a three-phase deep well pumping equipment, which is a considerable distance away, and which supplies drinking water to the Technological University of Tecamachalco*. At first place, the importance of the TT, the concept, and the considerations to have according to different authors and perspectives, the communication system via GSM is described. Then, its characteristics as, applications, standards, and their comparison with other communication protocols. Finally, the methodology for the development of the project is described, starting with the identification of the problem, the bibliographical research, the technical proposal of the solution, the operation tests, improvement actions and finally the start-up of the communication and control system for the deep well three-phase pumping equipment. In conclusion, the commissioning of the system was successfully achieved, remaining in operation without any problems except for a failure of the GSM network and a power outage, which makes it necessary for the system to be restarted.

2 TECHNOLOGY TRANSFER

TT is strongly related to knowledge transfer. [1] The country's public PHEI seek, to the extent of the availability of material and human resources, to promote the development of the area of influence, and to achieve this effectively, it is necessary to efficiently carry out technology transfer activities, all PHEI must distinguish the next five items [2]

• The generator of knowledge or technology, being the institution that has generated and seeks its transfer.

• The beneficiary of the knowledge, in this case the beneficiary will be some public institution if the objective of the project is a social benefit

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• The resources used to carry out the transfer, which can be a license, creation of a company, etc.
• The object of transfer, which can be scientific knowledge, equipment, know-how, etc.
• The intermediary agent, which is the body in charge of putting the parties in contact.
• The facilitators of the process, being the institutions that do not intervene directly in the transfer process, but that stimulate or service it. [3]
Technology transfer can take place between universities, companies, government in a formal and informal way with the aim of sharing skills, knowledge, technology, manufacturing processes and more. [4]

2.1 Communication System through GSM System (global system for mobile communication)

They are digital systems capable of supporting voice, short messages (SMS) and data transmission, which allows; large user capacity, wide coverage, efficient use of the spectrum, based on cellular technology, allows the use of a SIM card (Subscriber Identity Mode). At the moment GSM cells are not being deactivated, there are too many security and automation applications based on this technology, [4] in use, in Figure 1 we can see the characteristics of the different technologies.

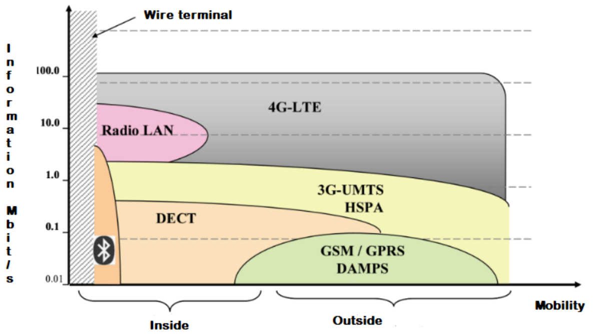

Figure 1: Standards used for Mobile communications (taken from Mobile Communications. GSM, UMTS and LTE Systems, José Manuel Huidobro Moya)

2.2 Arduino Platform

It is a low-cost, free access technology that allows the implementation of electronic projects through the use of predesigned boards, with the advantage of using free access software. It has a graphical development environment that uses a processing/wiring programming language and a bootloader; (IEEE specctrum 2011) regarding the hardware is composed of a microcontroller and input and output ports, through the Arduino IDE (Integrated Development Environment) software. [6] It is possible to develop automation projects, one of the disadvantages that it presents is that when using free access tools, it is not possible to patent a development based on this type of platform, it is recommended for its low cost and a not so complex operation, such as integrating components to be able to make a control card at the same time. Customized and with a unique design, it can be programmed in Windows, macOS and GNU/Linux.
A project that promotes the philosophy 'Learning by doing' (Interactive Design Institute of IVREA) [6]

3 METHODOLOGY

3.1 The Problem

The area where the Technological University is located is part of the Tecamachalco Valley aquifer, according to data from the National Water Commission (CONAGUA), the aquifer has severe problems of contamination, overexploitation. For this reason, it is considered a water risk, so it is important to consider actions for water care, in the case of the University to have a constant supply. Actions have been considered to supply water for the service of the students and collaborators of the University, at some point water pipes were bought, but the cost was high and the supply insufficient, so it was considered to bring the water from a well that is removed from the premises.
This implies that University personnel will have to travel to put into operation and after supplying the vital liquid return to close the well, this gives an opportunity for Mechatronics career collaborators and students to collaborate on a knowledge transfer proposal. that implies the collaboration between teachers, students and the administration to carry out the implementation of a solution that simplifies the task of turning the well on and off.
In figure 2, in the first stage the students supported by a teacher, identify the problem, analyze the solution and make the technical proposal, in the next stage the proposal is compared with the existing technical solutions and a feasibility analysis is carried out. Finally, once the proposal is made, the prototype is made, functionality tests and experimental tests are carried out to detect areas for improvement, once the prototype is tested, it is implemented in the system to be solved.

Figure 2: Development process diagram

3.2 Starting and stopping system of a pumping system via GSM, based on the Arduino Platform

Due to the need to bring the water supply to the University from a considerable distance, a remote start-up system is necessary for the personnel in charge of maintaining the water service to the facilities from their cell phone with wireless technology. [8]

Therefore, the objective of the technology transfer project is to develop a remote control system based on the GSM communication platform capable of turning on the well to pump water to the University, from the cell phone of the technician responsible for the pumping equipment or the staff of the Technological University of Tecamachalco, by means of a text message, from any location within the range that the technology allows, which must be effective, easy to use and low cost.
For this system, the GSM 800l module was used, this allows a global communication network to be connected to the GSM network, the module has a tray where a SIM card is placed, which will allow coverage of a mobile telephone company, this depends on which company telephone is the SIM card.

3.3 Materials

For the development of the project, materials and devices were used for the implementation of the power, control, communication and protection stages of the starting system and for remote means using GSM communication technology, for the communication stage a DC Voltage Converter was used. -DC, GSM 800l Module, Arduino Uno Card, LED display, for the communication and control stages, in the power stage Thermomagnetic Switches, Contactors, Fuses, single-phase and three-phase, were selected, according to the specifications of the pumping equipment that is held for operation

4 RESULTS

Once the materials and equipment to be used were selected, they were all integrated to proceed with operation tests, but not in site due to the problem of not having the availability of the well, once the operation tests were carried out, improvements were made to the system, once these improvements were made, the operation tests were carried out to verify the operation and that it was in accordance with what was required, these tests turned out to be satisfactory since the device did not present any failure with a repeatability of 100%. [7]
After carrying out the operation tests and improvements to the system, the assembly of the system continued in the cabinet that contains the entire system, communication, control and power stage to be protected and functional.
Once the above was done, on-site tests were carried out, because the pumping system was already in operation and the proposal was made subsequently, it was not possible to carry out these tests, so they had to be carried out and verify the proper operation. of the integrated system, which was satisfactory, being able to turn on the pumping equipment remotely using communication via GSM.

5 CONCLUSIONS

Finally, we conclude that the development of the project was hard work since the development of the programming code, was not simple due to the needs that had to be covered. This part of the programming code for the microcontroller was modified several times to fulfill with the functions required for the correct operation of the pumping system.
During the development of the project, involving the students turns out to be a strategy that, through constructivism, achieves significant learning in them and that this low-cost technology transfer project also meets the needs that exist in this institution.
Managing to successfully develop and apply to a need in collaboration between teachers and students to investigate, document and execute a remote start-up system using free platforms and GSM technology that although many of the industrial automation applications are based on this is why there is still time left that, although in the medium term, will give an opportunity to the process of improving and updating the system.
We learned that the technology development with materials available of low cost y human resources in formation, is feasible to applied to cover our need and to low cost.

6 FUTURE WORKS

As a result of this project, the stated objective was achieved, but the use of GSM technology that, although it is still in force due to the enormous number of industrial applications that are developed under this technology, it will be necessary in the short or medium term to update the system. of communication according to the availability and characteristics of the project to be necessarily accessible, viable, economic and functional. change the Arduino devices for Microcontrollers to be able to carry out the patent application, this is because these devices are generic and their programming is done in free access software, as an experience in Mexico, a university generated a project based on Arduino devices and the company when patenting they made the observation of the use of free platforms.

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Advanced 3D sensor system for visual control of geometrically complex products

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ABSTRACT

A prototype of an advanced 3D sensor system for visual bypass quality control of geometrically complex products was developed using an innovative combination of 2D and 3D machine vision methods. We present this optical measuring system named EAGLE and its implementation into a simulated industrial environment. We emphasise the importance of vibration analysis for efficient quality control.

KEYWORDS

visual control, geometry, 3D sensor system, machine vision, vibration

1 INTRODUCTION

The automotive industry took up the smart factory initiative (i) to improve the productivity of old factories through modernizing and digitizing their operations, (ii) to deal with the quality issues that are difficult for people to detect, (iii) to incorporate made-to-order or mass-customization capabilities [1]. Repetitive and exhausting work operations are being replaced by automated and robotized systems. At the same time, customers' habits have changed as customers give more priority to quality and reliability of vehicles. This is the reason why the assurance and automated quality control of components have become of the utmost importance.

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3D scanning technologies are increasingly being used as suitable for quality control in industrial environments [2,3]. Most scanning procedures for 3D geometry control of the products, currently present on the market, work on the principle of 3D image derivation by means of trigonometric processes of triangulation [4], using a large number of cameras, e.g., FARO [5], Smarttech 3D [6]. As a source of lighting, lasers systems, e.g., ZEISS [7] are used in active procedures, while in most cases the projection of structured light patterns on the scene is made with a projector, e.g., Shining 3D [8], GOM [9]. The technology has already been actively integrated in production processes and quality control as part of smart factories [10].

2 PROBLEM STATEMENT

An important part of industrial processes is constant inspection of products to assure required quality. The leading partner of the EAGLE project, TPV Automotive d.o.o., uses geometry and visual surface control of their products on a daily basis. In the production of stamping parts, being geometrically highly complex objects with cavities, embossments and notches, the dimensional control is demanding and time-consuming process. The established procedure for periodic verifications of the product dimensions requires specially-made and maintained mechanical inspection instruments. The weakness of this method is a time-consuming and expensive manufacturing of measuring instruments, periodic wear testing of these tools, and rather long testing time for each inspected product. The stamping parts, made of sheet metal, are sometimes also painted. Despite an accurate examination, controllers are facing big problems due to light reflection, e.g., missing a poor-quality part, which may in turn lead to a quality claim. This is the reason why needs have arisen for new approaches and concepts in terms of visual quality management of products.

The objective of the EAGLE project was to develop a prototype of an advanced 3D sensor system for automated frequency geometry control of complex products, by using novel machine vision approaches.

3 RESULTS AND DISCUSSION

3.1 Machine vision EAGLE system

Optical measurement methods represent a modern approach in dimensional and geometrical inspection. The project partner Alpineon d.o.o. has got rich experience in developing innovative user interfaces and machine vision systems, being a patent holder of geometry control of tubular objects and innovative 3D sensor [11,12]. In the EAGLE project we explored the usefulness of the combination of 2D and 3D measurement methods. The 2D measurement method is based on a parallel projection of the product image on the camera image plane (see Fig. 1). Such a projection is achieved by using a system of telecentric lenses and transmissive lighting with parallel light beams. The 3D measurement method is based on a binary pattern projection using an industrial HD projector, two high-resolution cameras and blue LED lighting (see Fig. 1). The 2D method allows accurate measurement of cut-outs and comparison with 2D drawing, and the 3D method enable shape and surface measurement and comparison with 3D model.

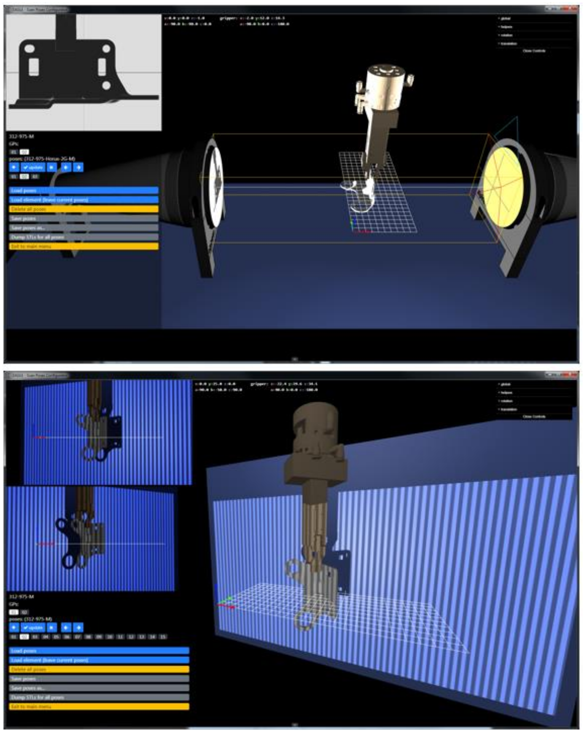

Figure 1: (up) 2D and (down) 3D measuring method

The computer analyses the acquired images, determines the specific areas of interest on the product, measures predetermined tolerance distances, and determines whether the product is within the tolerance range. In order to register the corresponding projections of the measured object, the robotic arm places the object in specific positions according to the optical image acquisition system.

The system allows the accuracy of distance measurement of 20 μm order. The product verification is carried out in 10 sec order time and involves storage of measurements for further statistical analysis and reporting. This procedure does not affect the inspected product and contain wear resistant elements which do not require frequent maintenance or recalibration. The preparation of the procedure for new type of product to be inspected takes less than 1 hour and does not require assigned equipment. Dimensions not visible on the parallel projections of the product shall be checked by additional optical measurement procedures, which are slightly slower and less precise, but they record the entire 3D model of the product.

3.2 Sensor system EAGLE in industrial environment

The prototype of the measuring system EAGLE consists of the following components: 2D and 3D scanning and measuring systems, robotic arm with grips (mechanical and magnetic tongs, quick rotation clutch), measuring system base, carriers for components, dump for inspected parts, and computer with communication, process and measurement software.

In addition to the measuring system, we virtually designed the periphery of the future industrial measuring cell, which intends to be placed into industrial environment, namely: the energetic system (electricity, compressed air), the protection rail and conveyor belt for delivering inspected parts. We also envisaged the possibility of integrating the EAGLE measuring cell with the system for picking inspected parts from the conveyor belt, resulting from joint development between TPV and Alpineon.

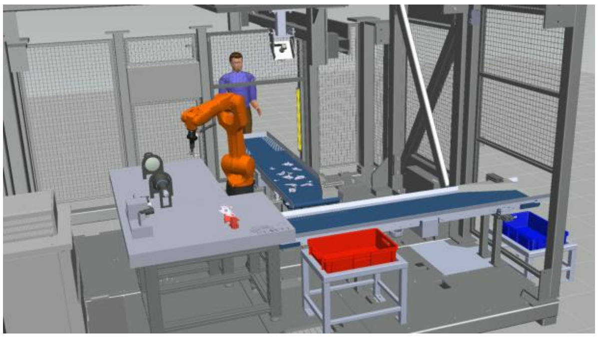

Figure 2: A virtual model of advanced sensor system EAGLE in industrial environment

In Tecnomatix, a tool for modelling and simulation of production processes, a model system according to the following assumptions was designed (Figure 2):

- inspected products are transported by conveyor belt,
- the system for picking scattered inspected parts recognizes and locates products on a conveyor belt,
- a robot with magnetic grip picks a product from a conveyor belt and place it onto a special base,
- a robot with mechanic grip picks a product from the base and transfer it to the sensor system EAGLE to perform geometry and surface measurements,

- a product with desired specifications is placed to the conveyor belt, while the unsuitable product is removed.

3.3 The influence of environment on the measuring method

Before the mechanical integration of the components, we integrated components in a virtual environment. We simulated different environmental influences, such as light and vibration. We also simulated different paths of the robotic arm and accelerations. Optimal movements and turns of the robotic arm depending on the mass of inspected object were determined with the aim of making the measurement as fast as possible and minimizing vibration. The model was prepared using the final element method (FEM) on the basis of the 3D Solid robot model, and simulations were performed using the Abaqus software tool. The results of the simulations were tested using measurements on the prototype measuring system (Figure 3). A single-axle accelerator was installed on the robotic arm in the directions of all three axes, which is connected to the computer with appropriate software for capture and display measurements via a data acquisition and processing device (DAQ).

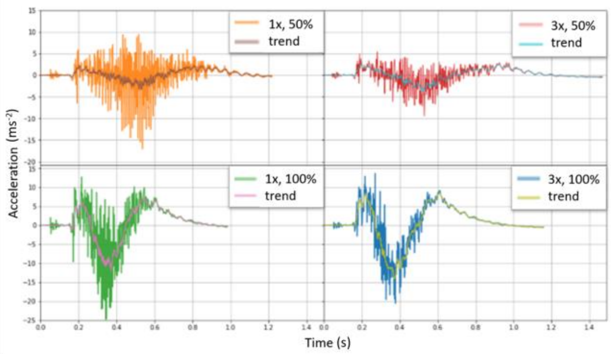

Figure 3: Vibrations during motion of robotic arm for single mass (1x) and triple mass (3x) at half speed (50%) and full speed (100%)

We measured and analyzed the vibrations of the robot's motion, the robot's eigenfrequencies for different masses of inspected object, and the impact of vibrations caused by the robot's servo drives, on the accuracy of measurements. A comparison with the situation when the robot's brakes are turned on for resting was also made. In this way, we were able to compare the results from the simulation model and the prototype.

3.4 Experimental investigation of industrial vibrations with simulator

The vibrations which occur in an industrial environment cannot be completely avoided, therefore it is important to control and manipulate them properly. This requires appropriate vibrations levels determination and further consideration of structural dynamics in the evaluation of quality of products or processes. In the area where some devices cause vibrations, while others require stable surrounding due to precise measurement techniques, it is necessary to understand how these vibrations propagate throughout the room and how they can affect the working process. It is crucial to understand the vibrations propagation process over the whole production area also for proper design and manufacturing of improved industrial building constructions and hardware of industrial processes.

The specific conditions of real industrial environment in which the EAGLE system is supposed to be operating, pose a serious challenge in ensuring the appropriate quality and reliability of optical measurements. This advanced 3D sensor system, designed to carry out quality control of geometrically complex products, shall be subjected, for example, to vibrations caused by heavy devices (e.g., presses) continuously operating in the industrial surrounding in which the sensor system is installed.

A basic starting point for planning and implementation actions in industrial environment is established methodology for determining vibrations which includes the determination of the following characteristics:

- eigen frequencies of the ground,
- the levels of acceleration amplitudes,
- locations in the industrial area, most suitable for the installation of measuring equipment as regards vibrations,
- vibrations at the point of measuring equipment installation.

We established a measurement methodology to analyze the impact of vibrations or disturbances on the quality of product optical control by implementing a system for simulation of disturbances propagation in the industrial environment. A model system, developed at laboratory level, was developed to simulate key elements from the industrial environment that cause vibrations, transmit vibrations and respond to vibrations. It consists of piezoelectric accelerometers, signal analyzer and experimental data evaluation system.

As a basic model, simulating the ground in the industrial area, we used a measuring plate of 150 cm in length and 75 cm in width, with the thickness of 18 mm. The plate consists of a chipboard base to which the plastic plate is glued. The simulator of the press allows falling of the weights from five different positions, which are 10 cm incremental. The lowest position is thus at 10 cm and the highest at 50 cm. The location of the attachment of the impulse exciting simulator to the base plate is shown as a red frame in Figure 4.

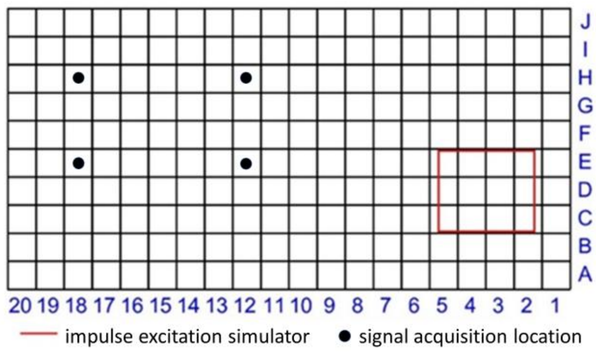

Figure 4: The location of an impulse excitation simulator and signal acquisition on the measuring plate

At impulse excitation of the measuring plate, caused by the weight falling on the plate, the energy that causes wave propagation over the plate surface is released. The measurements of oscillation which occurs after the impulse excitation with two different loading masses, i.e., 632 g and 1085 g, having the same height, were performed at four measuring points in accordance with the mapping shown in Figure 4. The black dots in Figure 4 represent signal acquisition locations with coordinates E12, E18, H12 and H18.

By analyzing the measured signals of response, it was observed that the intensity of the impulse, caused by heavier weight, is higher in comparison to the intensity of the impulse, caused by lighter weight, as expected (see Figure 5). Figure 5 shows the measured average acceleration values which correspond to the maximum impulse amplitudes at each measuring point for lighter and heavier weight. Higher amplitudes of impulse excitation increase the final accelerations which consequently affect the operation of simulated device, representing optical measuring system in real industrial environment.

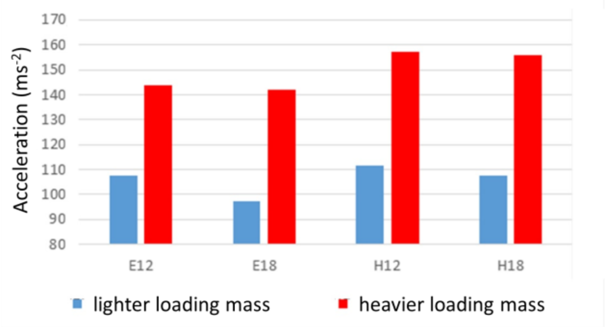

Figure 5: The influence of the location of signal acquisition (E12, E18, H12, H18) and the weight mass on the dynamic response of the measuring plate

The experimental analysis shows that the eigenmodes of measuring plate oscillation affect the experimental results, and therefore the measured values of the oscillation accelerations at the impulse excitation with the same weight differ in measuring points. The eigenmodes of measuring plate oscillation therefore have significant influence on the development of the resonance oscillation response.

4 CONCLUSSIONS

The EAGLE measurement robot cell represents a complete novelty in the global market. It enables visual bypass quality control of the geometry of complex objects using the innovative design of the machine vision system. As a use case we chose metal stamping parts, i.e., geometrically complex products in the automotive industry which are technologically attractive due to their innovative lightweight design. Some breakthrough solutions, contributing to the significant state-of-the-art progress in technology, were developed [13,14].

The advantages of the advanced 3D sensor system EAGLE for geometric inspection of complex products are: (i) successive implementation of several optical measurement methods on the same inspected object without intermediate intervention by the operator, (ii) fully autonomous operation, (iii) accuracy and time stability due to fixed optical measuring components, (iv) a robotic arm movement and measurement system eigenfrequencies do not affect the speed and the accuracy of the measurement method.

We also established an experimental methodology for multiparametrical analysis of structural dynamics which enables investigation and evaluation of the effect of vibrations on the technological processes in the industrial environment. For that purpose, a model system for simulating disturbance sources and monitoring disturbances, which propagate over the base plate, as appear in different locations in real time, was developed. This model system, developed at the laboratory level, enables simulation of the key elements from the industrial environment that cause vibrations, transmit vibrations and respond to vibrations.

ACKNOWLEDGMENTS

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DODATEK / APPENDIX

ITTC 15

15th International Technology Transfer Conference

LET'S INNOVATE THE FUTURE

INTRODUCTION AND AIM OF THE CONFERENCE

Conference topic:

The role of TTOs in maximizing impact of science, technology and innovation on society.

Objectives of the Conference

The Conference brings the awareness of importance of professional technology transfer activities which must be appropriately placed in a national innovation system. The Conference program includes exchange of knowledge, good practice, and opportunities for collaboration between representatives of academia, industry and government about cooperation and transfer of knowledge and innovations from publicly funded 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.

Since 2008, we hosted more than 2600 participants from Slovenia, Europe and the world, including researchers, students, inventors, technology commercialization and intellectual property experts, investors, start-up funders, industrial development experts etc. Since 2009 we have successfully organized fourteen annual international competitions in which till this year have participated a total of ninety-three (93) teams from PROs throughout Europe with their technology and business proposition with the biggest commercial potential. We are particularly proud some of them made their first steps at the Conference and have later advanced to spin-out companies and licensing agreements. Biannually we organise pre-scheduled Research2Business (R2B) meetings. The meetings are additional matchmaking opportunity for representatives of industry and researchers to meet and identify opportunities for collaboration, cooperation and business synergies.

Additionally, in a special session, the researchers are presenting their work which is being financed by Slovenian Research Agency (ARRS). This is another opportunity for enterprises to get insight to recent discoveries in the PROs and development opportunities.

Conference prize for the best innovations in 2022

The main objective of the special prize for innovation is to encourage commercialization of inventive/innovative technologies developed at PROs and to promote cooperation with industry. One of the main objectives is also promoting the entrepreneurship possibilities and good practices in the PROs. Researchers are presenting their technologies and business models 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 fourteen years led to the establishment of a spin-out company, conclusion of a licensing agreement or further development of a business opportunity in at least one case per competition each year. In many cases, young researchers that participated in the pitch competition in the past years, have been involved for the first time in an organized and structured development of a business model around their technology and preparation and delivery 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.

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

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

Scientific papers on technology transfer (TT) and intellectual property rights (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); The role of TTOs in maximizing impact of science, technology and innovation on society; IP value vs price; Incentives for contract and collaborative research / cooperation with industry; IP negotiation with industry; State Aid in contract and collaborative research; Current status of public investments into research and technology infrastructures; European or national frameworks to transform breakthrough technologies developed for fundamental research purposes into breakthrough innovations with strong industrial applications and societal added value; Examples of IP protection in Artificial Intelligence; Other, chosen by the contributor

Connecting the education system with academia

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. The key stakeholders co-create the conference and share with other co-organisers, partners and audience their knowledge, expertise and thoughts. They also spread the word about the conference among their contacts. Through their activities the awareness about knowledge transfer and IPR is rising in their organisations, in Slovenian and European innovation eco-system.

Target audience and benefits

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

Organization of 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 15th 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 (IS2022), organized by the Jožef Stefan Institute.

The Conference has been organized with the support of partners from the Enterprise Europe Network project (EEN). The project's mission is to help businesses innovate and grow on an international scale. It is the world's largest support network for small and medium-sized enterprises (SMEs) with international ambitions. The Network is active worldwide. It brings together experts from member organisations that are renowned for their excellence in business support. The ITTC is complementary to the mission of the EEN project which is to support SMEs and researchers through a) finding appropriate business partner, b) international technology transfer and c) finding partners/coordinators to apply to EU calls, while providing support on IPR, Access to finances, regulation and legal support.

ACKNOWLEDGEMENTS

The editors and organizing committee of the Conference would like to express cordial thanks to all who helped make the 15th 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**:

- Alexandre Massart, co-founder and director, Blend Ventures,
- Jurij Giacomelli, Investment Manager, META Ingenium,
- Michel Neu, International Technology Transfer Expert, CEA Alternative Energies and Atomic Energy Commission,
- Nina Urbanič, Adviser for equity investment monitoring and reporting, Slovene Enterprise Fund,
- Vladimir Jančič, CEO, Publikum Korpfin,

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 **WIPO EVALUATION COMMISSION**:

- Alojz Barlič, Slovenian Intellectual Property Office (SIPO)
- Nina Urbanič, Slovene Enterprise Fund
- Christoph Kempf, IPEK – Institut für Produktentwicklung, Karlsruher Institut für Technologie (KIT),

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

Special thanks go also to Slovenian intellectual property office for their help with the organisation, communication with WIPO and presence at the Award ceremony. We thank also to ARRS for their presence at the Award ceremony and WIPO for their video for the Award ceremony.

Day 1

OVERVIEW OF THE PROGRAMME

12 October 2022 (hybrid teleconference, virtual and live)

MAIN SESSION

08.30 – 09.00	**Registration**
09.00 – 09.15	**Welcome address** (in Slovene language) Dr. Tomaž Boh, Director-General Science Directorate, Ministry of Education, Science and Sport Prof. Dr. Boštjan Zalar, director, Jožef Stefan Institute Dr. Špela Stres, Jožef Stefan Institute, EIC Board member
09.15 – 10.00	**Keynote speech: CEA's experience in effective collaboration with industry** Michel Neu, International Technology Transfer Expert, CEA Alternative Energies and Atomic Energy Commission
10.00 – 12.00	**Best innovation with commercial potential: pitch competition**
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 – 14.30	**Opportunities arising from publicly funded research projects / presentations of successful scientific projects (partly in Slovene, partly in English)** **Award announcement: WIPO Medal for Inventors**
14:30 – 16:50	**Paper presentations: scientific papers on technology transfer and intellectual property**
16.50-17:00	Closing

PARALLEL SESSION

13:20 – 14:30	**Connecting high-school education system with academia: Presentations of selected research topics from Jožef Stefan Institute and proposals for cooperation**

WELCOME ADDRESSES

From 9:00 to 09:15

Honourable Speakers:

Dr. Tomaž Boh, Director-General Science Directorate,

Ministry of Education, Science and Sport / generalni direktor Direktorata za znanost, Ministrstvo za izobraževanje, znanost in šport

Povzetek uvodnega pozdrava / Abstract of the Welcome address

Hvala lepa za povabilo. Spoštovani direktor, spoštovana kolegica Špela, spoštovani raziskovalci in raziskovalke, spoštovani domači gostje in gostje iz tujine. V veliko veselje in čast mi je, da sem lahko danes tule v imenu Ministrstva za izobraževanje, znanost in šport in vas pozdravim na 15. Mednarodni konferenci o prenosu tehnologij. Pomembno je oboje, petnajst in prenos tehnologij.

Število petnajst pomeni, da je vaša institucija ena tistih, ki na področju prenosa tehnologij, inovacij in znanja že dolga leta orje ledino, postavlja nove standarde in nenazadnje postavlja protokole kako in na kakšen način povezovati raziskave z gospodarstvom. Iz vašega znanja in iz sadov preteklih konferenc se lahko vsi iz širše raziskovalne sfere v Sloveniji marsikaj naučijo. S tega vidika je izjemno pomembno, da sodelujete, da ste ena izmed vodilnih institucij tudi v inštrumentih, ki jih ministrstvo v tem kontekstu financira in ki jih bo podpiralo tudi v prihodnje. V naslednji kohezijski perspektivi si zelo želimo, da povečamo obseg, da damo novo kvaliteto temu, kar je bilo v dosedanjem obdobju že narejeno in naredimo še pomemben korak naprej.

Prenos tehnologij kot drugi del besedne skovanke je ključnega pomena zaradi tega, ker v zadnjem času vedno bolj pridobiva na pomenu, čeprav je moje prepričanje, da za raziskovalce in tiste, ki se s prenosom tehnologij ukvarjate na institucijah, pravzaprav to ni nekaj novega, s čimer bi se začeli ukvarjati in s čemer bi sledili temu kar je politično zaželjen besedni termin na področju raziskav. Ravno zaporedna številka petnajst v imenu konference kaže, da je zavedanje o pomenu prenosa tehnologij bistveno daljše kot pa je to postala moderna politična beseda.

Pa vendar, tudi politični odločevalci se vedno bolj zavedajo, da je potrebno podpirati ne samo bazične raziskave, ki so brez dvoma osnova in temelj vsega, in ne samo gospodarstvo v smislu direktnih spodbud nepovratnih sredstev, ampak da je polje prenosa tehnologij tam nekje v sredini. To mejno področje oz. področje na sredini, ki se ga žal pogosto obravnava kot da ni pristojnost nikogar (a upamo, da se stvari izboljšujejo), je pravzaprav pristojnost obeh, tistih ki podpirajo gospodarstvo in tistih, ki imamo pristojnosti financiranja znanosti.

Ravno tovrstne konference kot je današnja pokažejo, da je svet tam vmes še kako živ, da še kako dobro veste kako in kaj početi v tem kontekstu. Tudi današnji program, ki je sestavljen iz predstavitev dobrih primerov, tekmovanja, ocenjevanja najboljših dosežkov kaže na to kako zelo je to področje živo.

Z vidika Ministrstva za izobraževanje, znanost in šport in predvsem z vidika našega Direktorata za znanost lahko rečem, da bo tudi v prihodnje prenos tehnologij oz. prenos znanja ena izmed pomembnih aktivnosti in sestavni del znanstveno-raziskovalne dejavnosti. V kontekstu stabilnega financiranja raziskovalnih institucij verjamemo, da bomo v letih, ki sledijo, vzpostavili tudi ustrezne načine sodelovanja kako to zapisati v strateške cilje institucij, kaj od tega lahko tudi centralno država, ministrstva v procesu pogajanj oz. bolj v dogovoru naredimo kot pomemben korak k stabilnosti financiranja, k stabilnosti upravljanja tega področja in k stabilnosti podpore, ki jo v tem kontekstu potrebujete.

Želim vam uspešno konferenco in uspešno delo še naprej. Before I finish I would like to welcome all the guests from abroad while it is important to also have a mirror to compare our national system with systems abroad and learn from your experiences. Because of that I would in the name of the Ministry of Education, Science and Sport warmly welcome you in Slovenia and thank you for all the work, for all the cooperation with Slovenian institutions.

Prof. Dr. Boštjan Zalar,

Director, Jožef Stefan Institute

Povzetek uvodnega pozdrava / Abstract of the Welcome address

Dear guests, dear researchers, dear technology transfer experts, we are very glad to have you here again at this annual event. Two years ago, we were fighting with the covid epidemy, last year there's the situation in Europe that has changed a lot the geostrategic points of view of development of our scientists. So, it seems to be that we will be encountering different troubles on and on. Maybe you read a few weeks ago there was a report that NASA was trying to crash a satellite into an asteroid so one would think that probably it's the next crisis that is coming that an asteroid would hit our earth. Anyway, from the technology transfer view crashing a bunch of pounds of high technology into a rock this is what you call technology transfer I would say.

Our institute has been hosting this event for several years and we are really glad to have you here again. I wish you a lot of fruitful discussions and as a part of the technology transfer debates I anticipate and I really hope that there will also be in all these debates suggestions how to improve the transfer of common sense that our humanity really needs in recent years. Thank you very much. I am glad to have you here again and I wish you all the best in your work.

Dr. Špela Stres,

Jožef Stefan Institute, EIC Board member

Povzetek uvodnega pozdrava / Abstract of the Welcome address

I would like to welcome everyone from my heart. Through the years we had a lot of collaboration in particular with many famous institutions from the western part of Europe or from the USA. We had guests from MIT, Leuven RD, Cambridge. I am very pleased to see that in particular our scientific section is expanding a lot towards the widening countries. The internationalization of the efforts in the field of professionalization of knowledge transfer is really an important step for all of us, because knowledge transfer in itself is not just a profession, it's a scientific field in itself. As soon as we are ready to acknowledge that fully also in the widening countries it will be much easier to establish a professional system of knowledge transfer and valorization.

We've had fifteen years of this conference and not all events that happened during that time were totally happy. For example, I remember when we've first asked whether we can organize such an event in the field of technology transfer and whether we can award a prize for best innovation from public research organizations the answer was - a simple no. But here we are fifteen years later and we've organized numerous business to research meetings. We've published many scientific articles in this field. We've had twenty-eight teams awarded. And those teams did not just receive an award here, they went on and received several other awards elsewhere and they attracted venture capital and they took the name of all the major public research organizations that they came from in the first place to the Slovenian economy and also wider, some of them even won very prominent European funding.

But the story does not end here. As we've heard from the Director General I do also acknowledge the fact that knowledge transfer and valorization is in a transitional period right now. That's also influenced by the fact that we have the new legislation. The new legislation does imbed knowledge transfer a bit more into the system of the public research organizations, but it does not assure that it's going to really be imbedded. So, I think that in this transitional period it's really important that additional funds are available for knowledge transfer that should be used in particular to connect different efforts and to professionalize those efforts. Also, it would make so much easier if the Slovenian system of financing the research would follow the steps that were taken by the European Commission. The European Innovation Council is an example of that how the research throughout the technology readiness levels can be supported in an integrative connected way throughout the TRLs. Improving our own system in such a way would give our researchers much needed security to become more imbedded in the innovation part of their efforts.

And last but not least it's important that the Center for Technology Transfer and Innovation keeps up the good work at the institute in whichever form it will continue because the researchers need the professional assistance in this field. In fact, in Slovenia we don't have the gap between academia and industry, we just somehow need to learn how to shake hands between the two fields and that's also a question of the professionalization that I spoke before about. So welcome everyone here and I hope that after fifteen more years we'll be looking at the totally different situation. Thank you.

KEYNOTE SPEECH: CEA's experience in effective collaboration with industry

From 09:15 to 10:00

Michel Neu, International Technology Transfer Expert, CEA Alternative Energies and Atomic Energy Commission

Abstract of the Keynote speech

The French Alternative Energies and Atomic Energy Commission (CEA) is a key player in research, development and innovation collaborative partnerships in defence and security, low carbon energies (nuclear and renewable energies), technological research for industry and fundamental research in the physical sciences and life sciences.

CEA comprises of 9 research centres with 21.148 employees CEA filed 710 priority patents filed in 2019, created 228 start-ups since 1972 and operates a 5,6-billion-euro budget.

The CEA is one of the leading patent applicants in France and Europe having 6,980 active patent families. CEA is 1st patent-granting research organization in France and 1st French patent applicant in Europe.

As a major player in innovation, the CEA promotes the technologies it develops and transfers them to industry. CEA supports business competitiveness, job creation and national and European technological sovereignty. By encouraging spin-offs, it has supported and promoted creation of start-ups for the past twenty years.

Management of intellectual property is a key element of CEA's strategy, used for the benefit of innovation transfer to companies. CEA has chosen to retain ownership of the results (Foreground) obtained by its sole researchers during collaborative partnerships financed by industry. The Foreground created in a given RDI collaborative partnership with one company is therefore added to CEA's IP portfolio and can be used by CEA as Background for other collaborative partnerships with other companies, for very diverse applications.

The model of Industrial RDI Collaborative Partnerships enables a wide technological dissemination, not only benefiting strategic industrial sectors but also smaller enterprises (SMEs, start-ups) that gain easy access to technological IP Portfolio without having to finance their development.

The company finances only the new RDI collaborative partnerships where new Foreground is created from CEA's Background. This model contributes to CEA's autonomy in its research and valorisation policy, while preserving its industrial partners' competitive advantage through the implementation of adapted and secured exploitation rights.

"Post RD" licence after a collaborative RDI Partnership, covering results of the collaboration carried out with a partner, as well as the pre-existing knowledge required to use these results, is the most frequent mean of transferring CEA's technologies to industry. It represents more than 70% of CEA's commercial licences whilst licences to start-up companies represent 20% and 10% regarding "straight" licences" with existing companies, where no prior RDI collaboration has taken place .

CEA licensing terms (field of use, exclusivity, duration, etc.) are adapted on a case by case basis to meet the needs and exploitation prospects of its partners. CEA grants a licence to the partner on the Foreground and Background needed to exploit the Foreground after a given collaborative Partnership. Licences may also be granted where no prior collaboration has taken place (“straight” licences).

Access to Foreground (or a part of it) can be exclusive in a particular field, with mandatory exploitation thresholds. In the case of insufficient exploitation, the licensee loses exclusivity in its domain. In the event of absence of exploitation, the license is terminated and CEA can then seek a new partner in the Public Interest. In general, access to Background needed to exploit particular Foreground, is non-exclusive.

Commercial and industrial exploitation licences always give rise to payment. The budgets of CEA's collaboration activities only take into account the costs of the R&D work. Licence remuneration must therefore not only cover CEA's IP costs but also contribute to a fair return, for CEA and its inventors, on the value created by the exploitation. This also enables CEA to comply with European legislation on State aid.

CEA royalties’ policy is very compliant to the article 28 d) of the EC Framework:

“The research organisations or research infrastructures receive compensation equivalent to the market price for the IPR which result from their activities and are assigned to the participating undertakings, or to which participating undertakings are allocated access rights. The absolute amount of the value of any contribution, both financial and non-financial, of the participating undertakings to the costs of the research organisations or research infrastructures’ activities that resulted in the IPR concerned, may be deducted from that compensation”.

CEA shares royalties with researchers whilst participating in licensed knowledge.

CEA envisages different payment modalities (lump sum, proportional royalties, minimum, caps, conditional upon an event, etc.) and combine them to meet its partners’ business prospects. Large enterprises with sufficient financial resources prefer lump sum payment term whilst start-ups and SMEs prefer proportional royalties.

CEA undertakes to apply preferential remuneration conditions for post R&D licenses compared to “straight” licenses to ensure a differentiation with a licensee who has not participated in the R&D program.

In order to comply with point 29 (compensation at market price), CEA uses generally point 29 c). In those cases, the arm’s length negotiation is often based either on a method of comparable royalty fees in the field of the license (there are international databases for that) or by carrying out a detailed study of the provisional exploitation of the company: turn over, margin…. Generally, the international good practice is that the amount of the compensation for CEA (owner) is 1/3 of the margin of the licensee when exploiting IP.

The valorisation of CEA’s technologies has also occurred through the creation of new companies, with 228 spin-offs created (89 over the last 10 years) including 2 with more than 1.000 employees (SOITEC and LYNRED) that enabled 5.500 direct jobs created.

CEA start-ups accomplished record fundraising in 2018 accounting to 144 million euros whilst record fundraising of 120 million euros in 2020 was achieved by only one (Aledia).

7 start-ups arising from the CEA are listed on the stock exchange: Soitec, Kalray, Theranexus, Fermentalg, Tronics, Pixiumand Arcure. 70% of the 200 start-ups created over the past 20 years are still active. Since 2000, 50% of CEA start-ups have raised funds, for a total of nearly 1,2 billion euros (excluding SOITEC).

CEA invests significant sums, directly via its internal development/incubation programme (before creation of the start-up) or, at the creation of the start-up by taking equity in the start-up via its CEA Investissement private subsidiary. CEA is therefore a significant stakeholder in the creation and development of these start-ups and shares in the risks.

Success story of CEA start-ups is based on challenging requirements for creating a start-up:

- Innovation must be disruptive and protected by strong exclusive IP (patents, secret know how, copyright for software…);
- Marketing study must have been done showing good market prospects (sometimes start-up creates a new market);
- Research organization must have a sound process to support the creation of the start-up;
- Researchers who participated in the development of the technology transferred to the start-up when it was created and who wish to carry out the start-up project, must have a strong entrepreneurial spirit.

For an R&D partnership with a start-up, CEA applies the same principles of strong IP management and protection as for its other partners with regard to attributing ownership of research results.

CEA keeps the ownership of this IP and grants a license on it to the start-up, generally exclusive in a field (for a part of the technology) since most often start-ups don't have financial resources to pay IP fees for patent costs. On the other hand, start-ups may be developing very fast and be counterfeited by their competitors. In this case, CEA protects (and enforces when needed), its patents effectively. In the event of an infringement lawsuit, the exclusive licensee (the start-up) has the same rights as an owner to assert its rights. The advantage for the exclusively licensed start-up is that in this case, the CEA could also be part of the lawsuit where it intervenes to defend its patents with convergent interests with the start-up. The CEA was thus able to defend several of its start-ups in lawsuits for infringement by big international companies of its patents used exclusively by its start-ups. Of course, a single start-up would have had a much harder time defending itself in these lawsuits in the case where CEA would have waived its ownership to the start up.

CEA has an internal marketing department carrying out a detailed marketing study for each start-up creation. CEA runs regular (4 times per year) internal seminars to increase awareness of researchers in start-up creation and empowering their entrepreneurial spirit. CEA internal PoC fund may be engaged if necessary, depending on the TRL of the technology.

CEA has an 100% owned affiliate CEA Investissement that takes equity in the start-up at creation.

Most of CEA's start-ups have a RDI collaborative partnership with CEA and enjoy RDI support post-creation. Therefore, improvements of the first licensed technologies or additional technologies can be licensed later to the start-up.

Collaborative partnerships may be very different regarding IP background and foreground, having very versatile content or government rules. Thus, CEA does not have developed model contract/ articles for collaborative partnerships or a model process for creating start-ups.

PITCH COMPETITION: BEST INNOVATION WITH COMMERCIAL POTENTIAL

From 10:00 to 12:00

Moderator:

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

Evaluation commission:

Alexandre Massart, co-founder and director, Blend Ventures

Jurij Giacomelli, Investment Manager, META Ingenium

Michel Neu, International Technology Transfer Expert, CEA Alternative Energies and Atomic Energy Commission

Nina Urbanič, Adviser for equity investment monitoring and reporting, Slovene Enterprise Fund

Vladimir Jančič, CEO, Publikum Korpfin

Presentation of six (6) selected business model proposals from public research organizations to the members of the evaluation commission.

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 2022 at public research organizations (PROs) aims at stimulating the researchers from PROs to develop business models for commercialization of their inventions. Each year the competition is initiated with a public call for the teams with inventive technologies. Eligible authors are individuals, employed at PROs, which are developing innovative technologies into a viable business model. The proposed business models are either licensing the technology to industrial partners or commercialization in their spin-out company. The teams have prepared description of their technology and the key discoveries that underpin the commercial activity (licensing or spinning-out). 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 and consultancy, the researchers learned the guidelines to prepare their pitch presentation and improvements of their business model. 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: Alexandre Massart, co-founder and director, Blend Ventures, Jurij Giacomelli, Investment Manager, META Ingenium, Michel Neu, International Technology Transfer Expert, CEA Alternative Energies and Atomic Energy Commission, Nina Urbanič, Adviser for equity investment monitoring and reporting, Slovene Enterprise Fund, and Vladimir Jančič, CEO, Publikum Korpfin.

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 14th 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 Enterprise Europe Network (EEN) project, financed by European Commission. Members of the teams are entirely or partly employed at the following PROs: Fondazione Bruno Kessler, Gdynia Maritime University, National Institute of Chemistry, National Institute of Biology, University of Ljubljana and its Faculty of Chemistry and Chemical Technology and Jožef Stefan Institute.

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? How good will your solution be in solving the problem? How strong is your market differentiator?	1
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

Innovative equipment of intervention/service watercraft: Mobile Electromagnetic Mooring System and Batychron

Authors/inventors: Paweł Kołakowski, Grzegorz Rutkowski

PRO: Gdynia Maritime University

Abstract:

The innovative equipment is designed for use on a floating intervention unit coming to the aid of a vessel in danger (collision, grounding) or a ship requiring a specific service (underwater inspection, cleaning, or cargo and crew transfer). This comprehensive solution includes two inventions: a Mobile Electromagnetic Mooring System and a Batychron. The Mobile Electromagnetic Mooring System is used for mooring the service unit at the side of the serviced ship using a system of electromagnetic grippers with a unique set of mooring lifts ensuring constant rope tension. The invention enables the service unit to move quickly along the side of the serviced vessel, shortening the time needed for mooring and unberthing, limiting the crew's involvement in mooring operations, improving safety, and accelerating intervention to provide proper service. The Batychron is a flexible underwater bell used for underwater transport and diving with high safety standards. Thanks to the lightness and portable structure resulting from the use of new generation materials and integrated systems, it can be used in open and internal waters for underwater transport and various types of diving. These ground-breaking solutions have a global reach and no competition in this field yet. Despite improvements in maritime safety, maritime accidents occur daily around the world. Moreover, both devices can be used in sectors such as marine services, repair interventions, cargo and/or people transfer offshore, diving services - recreational, training, repair or excavation work, and underwater transport. The wide range of use of these devices creates promising opportunities for their manufacturers.

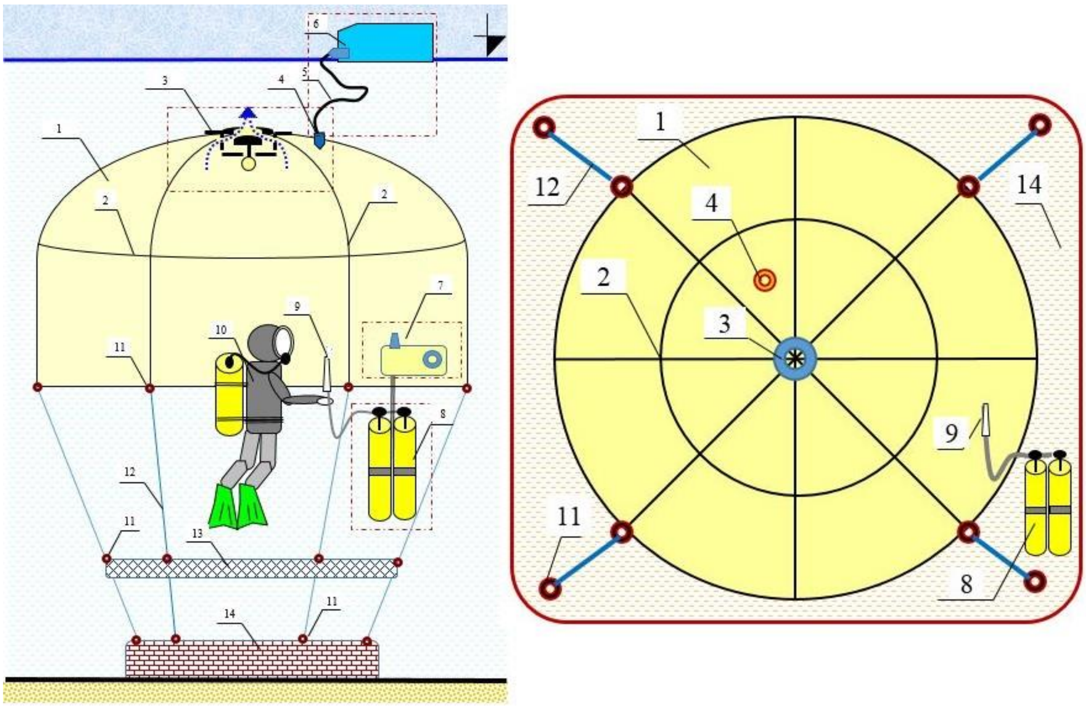

Figure 1: The Batychron. G.Rutkowski. 2022.

Figure 2: Batychron main components A) transparent dome, B) openwork mesh, and C) flexible diving bell – the Batychron. P.Kolakowski. 2022.

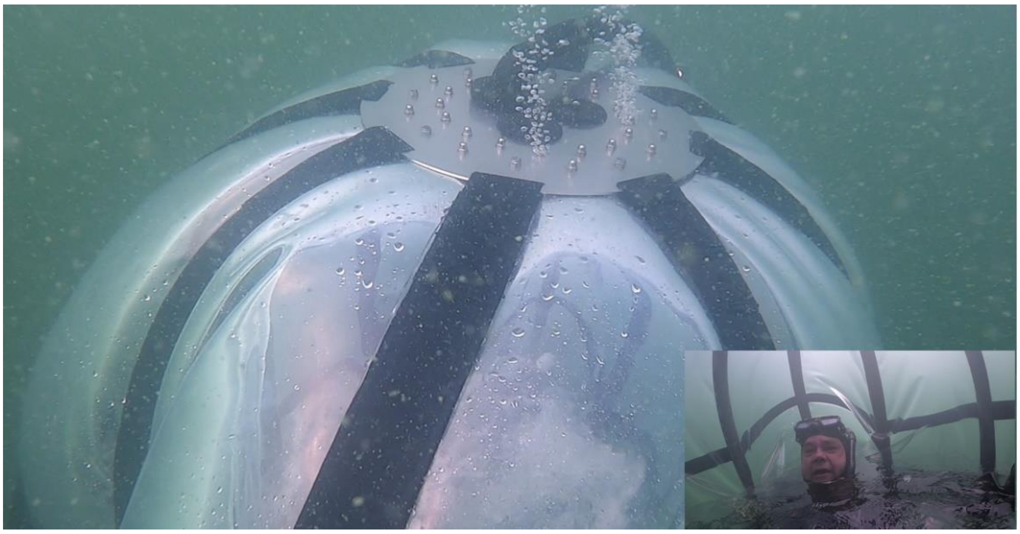

Figure 3: Research conducted in a real environment on the invention of Batychron. G. Rutkowski. 2022.

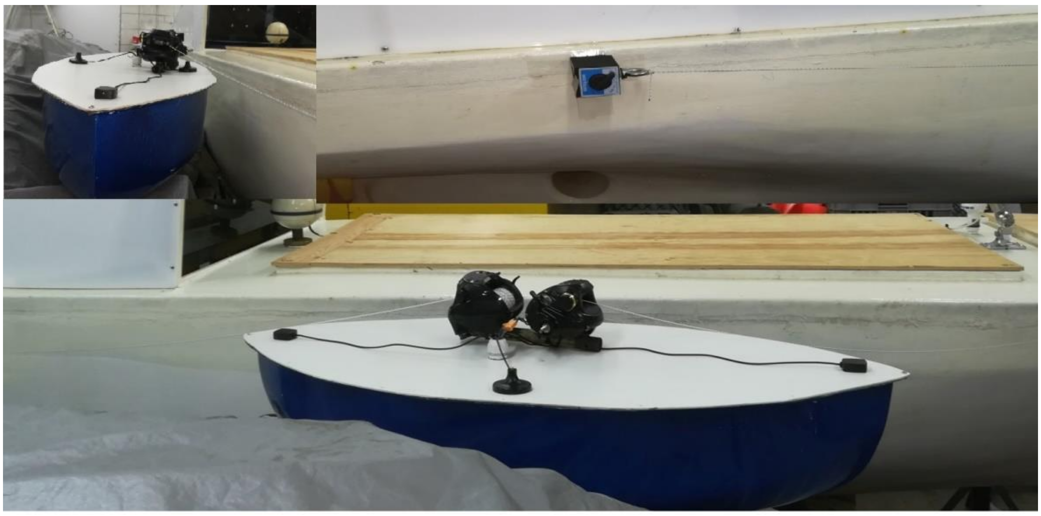

Figure 4: Mobile Elecromagnetic Mooring System (MEMS) – laboratory model in scale 1;30. P.Kolakowski. 2022.

Antiviral surgical masks, gowns and drapes

Authors/inventors: Mark Zver, Rok Zaplotnik, Miran Mozetič, Alenka Vesel, David Dobnik, Arijana Filipić, Polona Kogovšek, Maja Ravnikar and Gregor Primc.

PROs: Jožef Stefan Institute, National Institute of Biology

Abstract:

The COVID-19 pandemic showed we lack methods to prevent the spreading of airborne pathogens. Face masks and covers are currently employed to protect the wearer from pathogenic organisms. The issue lies in the survivability of pathogens, which remain viable on medical textiles for several hours or even days, serving as a potential source of infections.

Our team has developed a technique to prepare functional textiles which successfully inactivate viruses upon contact. These are standard materials (non-woven textiles) for production of disposable medical masks, which are treated according to our method of invention. The treatment does not disrupt the filtering efficiency. We performed biological tests, demonstrating that the final product is safe.

The innovative method is safe, low-cost, and scalable, addressing the single-use medical face mask market with a total size of over 5 billion EUR (Y2029, futurebusinessinsights.com). We believe that our innovative technology will be instrumental in combating current and future airborne infectious diseases, resulting in over 1 million mortalities yearly (World Health Organization, 2022). As experts in plasma technologies, developing custom plasma systems, and virology, we are an excellent partner for co-developing a commercial-scale production system and see that it fulfils the necessary regulatory requirements of the medical sector. At present, the technology is at TRL 4. The current team consists of academic staff at the Jozef Stefan Institute (JSI) and the National Institute of Biology (NIB). We seek for a partner to possibly establish a joint venture or to license the technology to producers of respiratory masks and medical textiles. Alternatively, we consider establishing a company for producing medical textiles according to our method – the patent application was filed recently.

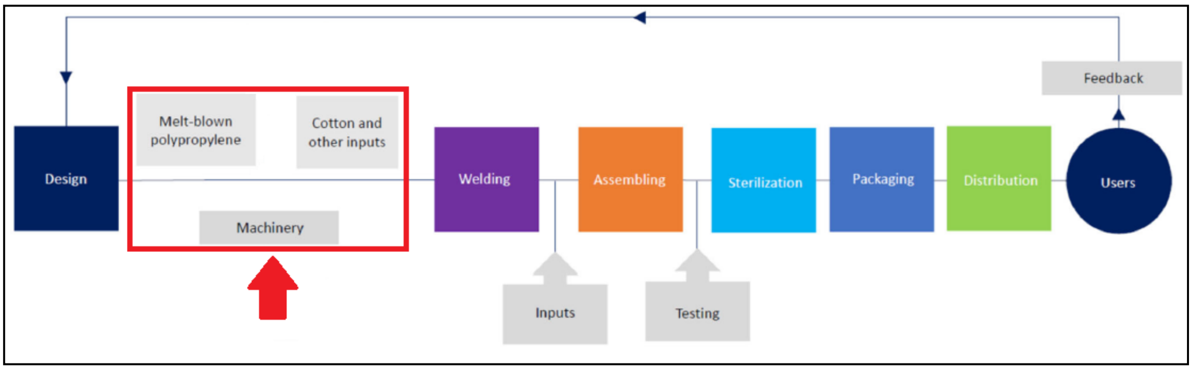

Figure 1: Facial masks value chain. Our solution is implemented in the space marked in red (Adapted from Findlay et al. 2021).

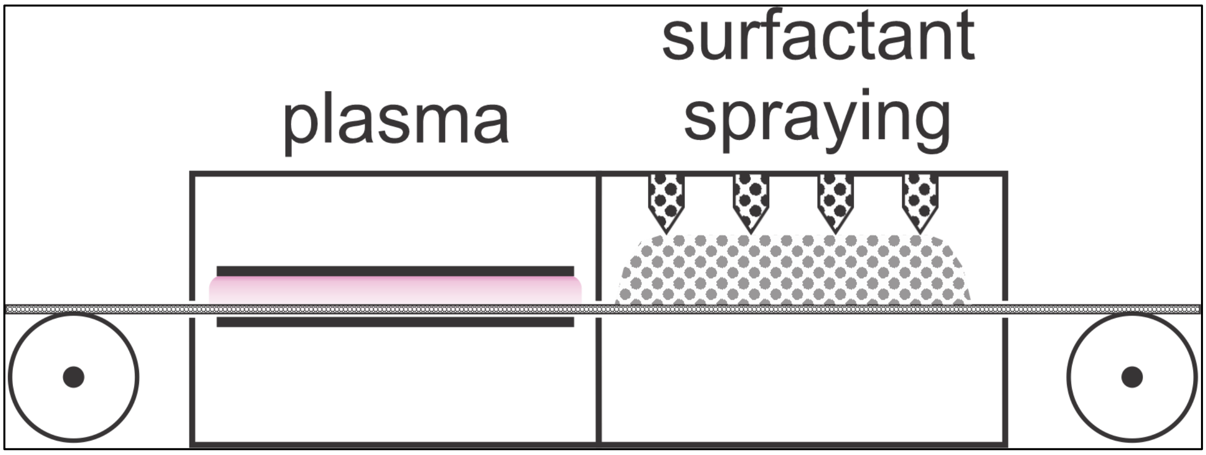

Figure 2:Proposed treatment process for producing antiviral textiles. Gregor Primc. 2022.

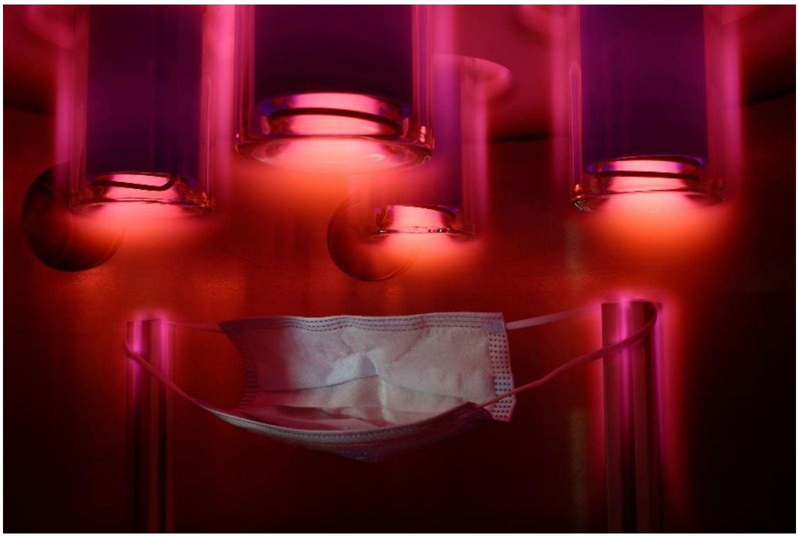

Figure 3: Our department at JSI is a great partner for designing robust and precise plasma treatment systems. Showcase: quadruple inductively coupled plasma system. Dane Lojen. 2022.

MEEVA - Measurable Enhanced Virtual Reality platform for teens with Autism and Neurodevelopment Disorders

Author/inventor: Elio Salvadori

PRO: Fondazione Bruno Kessler

Abstract:

The rate of kids diagnosed with Autism and Neurodevelopment Disorders (NDD) is increasing worldwide together with the demand for psycho-behavioral therapies provided by Specialised Centers (SC). However, the current operation of SC suffers from lack of scalability both in term of therapists involved and space occupied. Moreover, the recent pandemic has accelerated the adoption of digital technologies in all sectors; in healthcare, novel solutions for telemedicine are emerging where Virtual & eXtended Reality (VR/XR) is expected to play a major role, e.g. to perform mental health therapies from remote. VR-based mental health therapy (VRT) for people with NDD is a well-studied subject in research which has proved to be effective in improving their life quality.

MEEVA is building a teletherapy platform exposing children and teens with NDD to role-play XR games aimed at improving their social skills. The solution increases the geographical reach of SC and optimizes their operations, while families of NDD individuals can save travel time and costs. The unmet need addressed by MEEVA is twofold: (i) excess demand of psycho-behavioral therapies to people with NDD (ASD, ADHD,...), not matched by capacity for therapeutic services by the Specialised Centers; (ii) current teleconference systems are highly ineffective with these individuals, as demonstrated in the experiences during the pandemic.

The developed platform is composed by: (i) an app running on top of a VR headset exposing NDD teens to role-play games aimed at improving their social & emotional skills in a playful environment; (ii) a data-analytics software analysing biometrics data collected via wearables and correlating the emotional status of an NDD teen with the experience s/he is having during the session. The aim is facilitating ex-post session assessment by the therapist while enabling predictive therapy methodologies based on quantified data.

Compared to existing VR-Therapy tools (like C2Care, Amelia Virtualcare, Floreo) dealing with general mental health issues in settings where the patient is alone, we focus on NDD-specific treatments by engaging small groups of patients in VR based multi-player games performed under the supervision of a therapist properly tuning the scenarios.

MEEVA business model is based on subscription agreements with SC (such as private clinics, Foundations and social cooperatives) which provide tele-therapy service to families of NDD teens. For each teen receiving the remote therapy, MEEVA will charge a monthly fee (pay-per-use) to the SC plus a flat yearly fee to cover maintenance and updates of the service. The economic benefits obtained by both SC (in terms of additional earnings enabled by the extended reach, without increasing their headcount) and the families (in terms of time & transportation costs savings) can compensate the costs incurred by adopting our solution.

The team behind MEEVA is currently involved in a project supported by EIT Digital (XR4A, www.xr4a.eu) coordinated by FBK with the involvement of Xenia Reply (Italy) and iED (Greece). An MVP has been released at the end of June 2022 (TRL4-5) and a preliminary validation pilot has been organised already which involved 30+ kids and teens with the support

of a rehabilitation center. The MVP is currently being enriched with new functionalities and we plan to organise further pilots in Italy and in Greece within the end of 2022.

Figure 1. An excerpt of VR scenes from MEEVA platform: (left) Coin hunt (right) Space station. E. Salvadori, M. Dianti. 2022.

From polyurethane waste to high value added raw materials

Authors/inventors: Maja Grdadolnik, Blaž Zdovc, David Pahovnik, Ema Žagar

PRO: National Institute of Chemistry, Department of Polymer Chemistry and Technology

Abstract:

Extensive use of inherently non-biodegradable plastic leads to an excessive accumulation of plastic waste in the environment, which is associated with related climate change. In Europe, the production of about 1.1 million tonnes of polyurethane foams (PUFs) results in more than 600,000 tonnes of PUF waste per year. PUFs are used in a variety of durable applications such as upholstered furniture and insulation. The most common way of PUF waste disposal is landfilling, which is, along with incineration, unacceptable from environmental pollution point of view. An alternative is chemical recycling, which converts PUF waste into high value-added raw materials.

Our solution for PUF waste management is an energy- and cost-efficient microwave-assisted chemical recycling process using a small amount of specialty reagents. Our innovative process enables highly efficient PUF degradation in a short time, which results in about 80% lower energy costs compared to recycling processes based on conventional heating of reaction mixtures. State-of-the-art chemical recycling technologies for PUF waste produce low-quality recycled polyols, while our technology is distinguished by high-quality polyols with properties comparable to the corresponding commercially available polyols. This enables production of high-quality flexible PUFs exclusively from recycled polyols, which has not been possible up to now.

Behind the innovation is a team of experts in polymer synthesis, degradation and characterization, with extensive experience in working with industrial and research partners. Our plan is to transfer IPR to companies dealing with PUF recycling and/or manufacturers of polyols or PUFs.

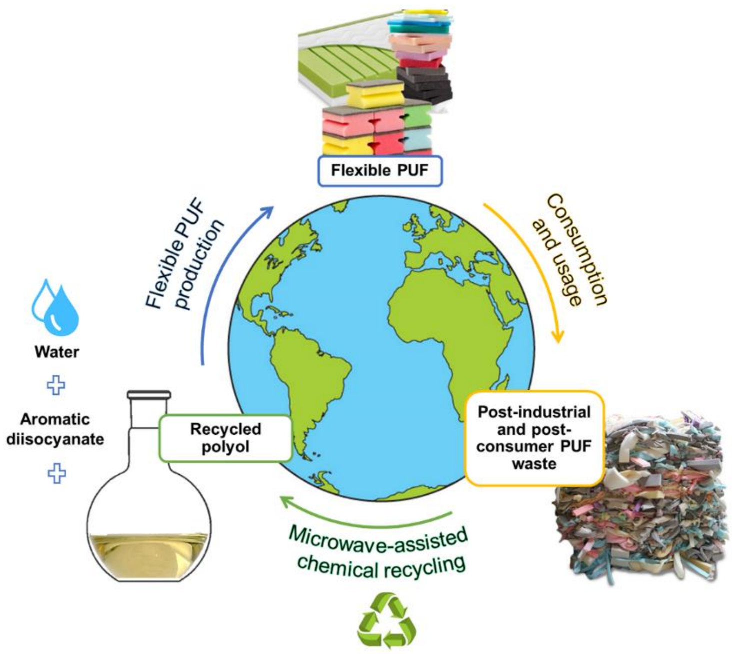

Figure 1: Recycling of polyurethane foams as proposed in our innovation. Maja Grdadolnik. 2022.

Figure 2: The high quality of recycled polyols produced by our method was confirmed by Repsol in Spain, a multinational company that produces commercial polyols for the synthesis of polyurethanes. Repsol synthesized flexible PUFs that were tested for their mechanical properties. The mechanical properties of PUFs made from our recycled polyols are comparable to PUFs made from virgin polyols. Company Repsol. 2021.

Water soluble cannabinoids with increased stability

Authors/inventors: Mitja Križman, Jure Zekič, Primož Šket, Alojz Anžlovar, Barbara Zupančič, Jože Grdadolnik

PRO: National Institute of Chemistry

Abstract:

Our technology relates to the field of water-soluble cannabinoids. Cannabinoids have become an important global commodity, and found their place in the food & beverage, food supplement and cosmetics industry, but also elsewhere (e.g. pharmaceutical industry). The major inherent problem related to cannabinoids is their very low water solubility. Our invention provides cannabinoid and hemp resin water solutions, with increased stability and bioavailability. We seek to commercialize the technology through spin-out company on EU market (waterborne cannabinoids and hemp resin with increased stability), taking our share of the 2 billon USD worth EU market (2021) with expected annual growth of 30 % (CAGR), and through licensing with technical assistance for US, Canadian, Australian and Asian markets (selling knowledge and IPR so companies in these geographic areas can utilize local hemp production and develop their own products). The global market is estimated at 13 billion USD (2021) with CAGR at 20 %. Since the market for cannabinoids is well established and growing we will be able to take the advantage of existing marketing and distribution routes to reach our customers and business partners. The team of highly qualified scientists that has developed present patent pending technology is supported by NIC's Knowledge Transfer Office, by Ljubljana University Incubator and by a local CBD utilizing company. The technology is currently at TRL 5. We also have the capability and facility for production quantities of the final product(s) in multi-kilogram quantities.

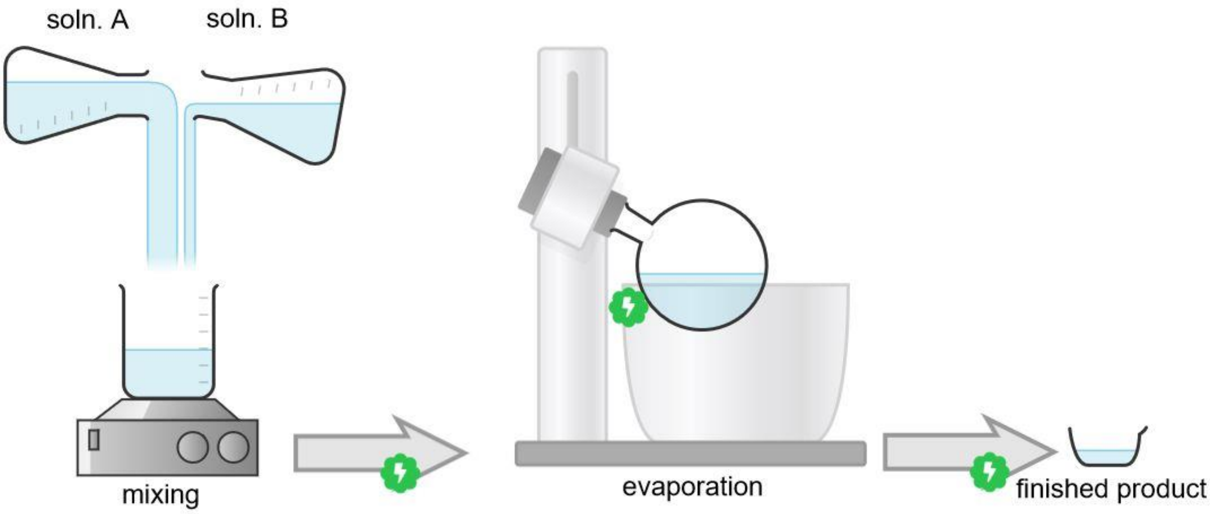

Figure 1: Schematics of our process. Mitja Križman. 2022.

Figure 2: Comparison in water solubility between unmodified (left) and modified (right) hemp resin. Mitja Križman and Jure Zekič. 2022.

Rationally designed lutein esters: “The onset of improved and sustainable eye health remedy”

Authors/inventors: Alen Albreht, Valentina Metličar, Krištof Kranjc

PROs: National Institute of Chemistry; University of Ljubljana, Faculty of Chemistry and Chemical Technology

Abstract:

Lutein and other carotenoids are natural antioxidants with many beneficial effects on human health. Lutein is especially efficient in the prevention of age-related macular degeneration, which currently affects 15% of the EU population alone (67 million). The global lutein market was valued at $354 million in 2022 and is predicted to double by 2032.[1] The existing lutein-containing products are sold mainly as food supplements, but owing to lutein’s intrinsic physicochemical properties, these products have limited shelf-life and bioavailability. Additionally, the main ingredient is obtained through processes that are harmful to humans and to the environment. The overarching motivation behind our innovation is the production of an improved line of lutein supplements that overcome the above hurdles by chemically tweaking lutein’s structure in a sustainable manner through esterification. The main targeted partners (customers) are large food supplement producers that aim to introduce improved products into their portfolio and/or integrate a green, inexpensive, and sustainable technology into their manufacturing process, reducing carbon footprint. The partners’ financial and market gain stems also from the revenues of unique, efficient, and trustworthy lutein-based ingredients, backed by scientific research. The founding team, consisting of three scientific researchers from two PRO’s backed by their TTOs, established a means to various lutein ester compounds with improved chemical stability (over 20-times). Future efforts will be focused on the determination of activity and bioavailability of lutein esters which will drive further technology development and demonstration at a higher TRL level, promoting technology transfer and product commercialization, predicted for 2026.

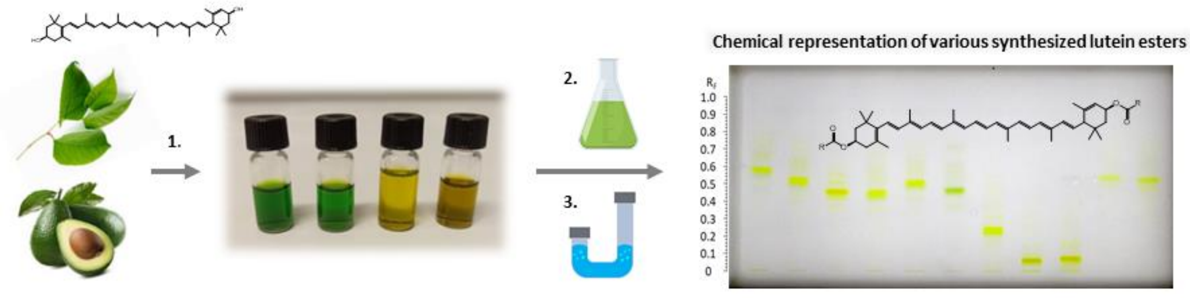

Figure 1: Sustainable platform for the production of lutein esters; Step 1: Extraction, Step 2: Synthesis, Step 3: Purification. Authors: Alen Albreht, Valentina Metličar, Mirica Karlovits. 2022.

[1] https://www.futuremarketinsights.com/reports/lutein-market

Award announcement Best innovation with commercial potential

13:00 to 13:10

Moderator:

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

Evaluation commission members:

Alexandre Massart, co-founder and director, Blend Ventures,

Jurij Giacomelli, Investment Manager, META Ingenium,

Michel Neu, International Technology Transfer Expert, CEA Alternative Energies and Atomic Energy Commission,

Nina Urbanič, Adviser for equity investment monitoring and reporting, Slovene Enterprise Fund,

Vladimir Jančič, CEO, Publikum Korpfin.

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 2000 Euro goes to the team members:

Maja Grdadolnik, Blaž Zdovc, David Pahovnik and Ema Žagar, **National Institute of Chemistry** for **from polyurethane waste to high value added raw materials.**

The award of 500 Euro goes to the team members:

Paweł Kołakowski and Grzegorz Rutkowski, **Gdynia Maritime University** for **Innovative equipment of intervention/service watercraft: Mobile Electromagnetic Mooring System and Batychron.**

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)

ANNOUNCEMENT OF THE WINNER WIPO IP ENTERPRISE TROPHY

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.

Two years ago, at the 13th International Technology Transfer Conference the WIPO awards were given in Slovenia for the first time.

The members of the selection committee were Mrs. Nina Urbanič, Slovene Enterprise Fund, Mr. Alojz Barlič from the Slovenian Intellectual Property Office and Christoph Kempf, Karlsruher Institut für Technologie (KIT).

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 for the last 10 years:

- 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.

Among the applications, the jury has decided to give the IP Enterprise Trophy to company **Elan, d. o. o.**.

Short justification: Elan is actively cooperating with several public-research organisations. Their products have a suitable IP protection and are promoted at different fairs and events. Through the social responsibility programs, they cooperate with schools and youth clubs and are having a Reducing carbon footprints program. And finally, they constantly and methodologically encourage the creativity and innovativeness among their staff.

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

From 13:20 to 14:20

Moderators:

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

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

Katja Cergol, University of Ljubljana, Knowledge Transfer Office

Successful Slovenian scientific projects were presented in short popular lectures. The goal of the presentations is to further promote the science to economy and general public. The future steps towards higher TRLs were also discussed in order to stimulate researchers to bring their technologies closer to the market with different steps that can take place like networking with other PROs to create interdisciplinary teams, by applying for additional EU or national funds.

Title	**Presenter(s)**	**Organization**
Karstology in the Classical karst	Assoc. Prof. Nataša Ravbar, PhD	Karst Research Institute, ZRC SAZU
Antecedents of environmentally and socially responsible sustainable consumer behaviour	Prof. Žabkar Vesna, PhD	Faculty Of economics, University of Ljubljana
Why the World Needs Anthropologists	Prof. Dan Podjed, PhD	Institute of Slovenian Ethnology, ZRC SAZU
New halogen bonds in biological systems	Assoc. Prof. Martina Hrast	Faculty of pharmacy, University of Ljubljana & National institute of Chemistry
Ionically charged topological defects in nematic liquids	Prof. Miha Ravnik, PhD	Faculty of Mathematics and Physics, University of Ljubljana, Jožef Stefan Institute

Table 1: List of presentations of successful scientific projects

Award announcement: WIPO Medal for Inventors

From 14:20 to 14:30

Moderator:

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

ANNOUNCEMENT OF THE WINNER WIPO IP MEDAL FOR INVENTORS

The WIPO Medal for Inventors is awarding a Slovenian public researcher for his contribution to the national wealth and development.
The selection committee members were Mrs. Nina Urbanič, Slovene Enterprise Fund, Mr. Alojz Barlič from the Slovenian Intellectual Property Office and Christoph Kempf, Karlsruher Institut für Technologie (KIT).

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.

The committee ranked all applications and decided that the "WIPO Medal for Inventors" goes to **Prof. Dr. Miran Mozetič**.

Short justification:
Prof. Mozetič has over 10 granted patents with examination in the last 10 years and additional 5 without the examination. He is a co-founder of a company Plasmadis. His inventions had impact also on 4 new jobs created in different companies.

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

Parallel session from 13:20 - 15:00

Moderator:

Urška Mrgole,

Center for Technology Transfer and Innovation, Jožef Stefan Institute

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 15th International Technology Transfer Conference a parallel section "Connecting education system with academia: Presentations of selected research topics from Jozef 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.

For the introduction the development of breakthrough technologies at the Jožef Stefan Institute video was presented. After the video, 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 cooperation 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. Participation in various European projects and initiatives such as "Science with and for Society": the Center for Technology Transfer 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. Within the STEM4Youth project nine chemistry modules were prepared and implemented in 19 Slovenian primary and secondary schools, with 20 mentors and over 500 elementary and high school students participating. The modules are now available online for all schools to implement them.

In the second part researchers from various research departments presented their work.

Rok Novak, mag. inž. teh. var. okolja, 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 presented ongoing research projects was related to the investigation of the presence of mercury in the environment. As part of the presentation, various possibilities for cooperation with schools were presented, such as: mentoring, technical day and similar.

Žiga Ponikvar, mag. kem, Materials Synthesis Department, 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.

dr. Janez Kokalj, The Reactor Engineering Division, R4: The Division, who plays a leading role on the nuclear energy stage in Slovenia, is focused mainly on fundamental and applied nuclear engineering and safety research, with special emphasis on the safe operation of the Krško nuclear power plant. At the conference various interdisciplinary researches were presented, that integrate thermal-hydrodynamical, structural and probabilistic safety analyses.

Mark Zver, MSc, Department of Surface Engineering, 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.

Junoš Lukan, MSc, Department of Intelligent Systems, E9: The principal goals of the Department are to contribute to the computational theory of intelligence and to develop high-impact practical applications in various areas such as intelligent information systems, data analysis, intelligent web retrieval, intelligent agents, language technologies, etc. Main focus of the presentation was about the Artificial intelligence and its use in the education.

Center for Technology Transfer and Innovation at the Jožef Stefan Institute and similar organisations in Europe represent a bridge in connecting researchers on the one hand and education system on the other. One of our goals is 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.

Paper presentations: research papers on technology transfer and intellectual property

From 14:30 to 16:50

Moderator:

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

Technology transfer officers presented the research papers on technology transfer and intellectual property. The research papers comprised the following topics:

- Key factors for successful technology transfer from different points of view (researchers, knowledge transfer experts, enterprises)
- The role of TTOs in maximizing impact of science, technology and innovation on society
- IP value vs price
- Incentives for contract and collaborative research / cooperation with industry
- IP negotiation with industry
- State Aid in contract and collaborative research
- Current status of public investments into research and technology infrastructures
- European or national frameworks to transform breakthrough technologies developed for fundamental research purposes into breakthrough innovations with strong industrial applications and societal added value
- Examples of IP protection in Artificial Intelligence
- Other, chosen by the contributor

The papers as presented in the Table 1 are published in the main part of the 15.ITTC proceedings.

Title	**Authors**
Technology transfer offices as a facilitator of knowledge triangle integration in the knowledge valorisation era: focus group discourse analysis	Ivana Vuka, Nikola Balić, Andras Havasi, Marie Mifsud, Leandra Vranješ Markić
Proof of Concept typology: a method for classification of PoC activities according to a technology cycle timeframe	Linas Eriksonas
The “Incubator of Innovativeness” program driving technical readiness levels of the Cracow University of technology innovations	Jacek Kasz

Science meeting the needs of entrepreneurs	Magdalena Kukowska-Kaszuba, Agnieszka Piotrowska-Kirschling, Paweł Kołakowski, Grzegorz Rutkowski
Commercialization of R&D results created with public funds in the National Academy of Sciences of Belarus	Alexander Uspenskiy, Aliaksei Uspenski, Maxim Prybylski
Selection and evaluation of technologies for the transfer to the industry	Vadim Iatchevici
Subsidizing Knowledge Transfer with Public Funds	Michal Belusky
Effective collaboration and IP management	Levin Pal, Robert Blatnik, Špela Stres
Project support services of a technology transfer office	Tomaž Lutman, Špela Stres
Challenges of Legal and Regulatory Framework for Blockchain Technology in the EU	Urška Fric, Jurij Urbančič
Technology Transfer: Start and Stop of Deep Well Pumping Through GSM System	Pedro Maldonado, Silvestre Sarabia, Emmanuel Costilla, Roberto Avelino
Advanced 3D sensor system for visual control of geometrically complex products	Urška Florjančič, Mario Žganec, Vili Malnarič, Hidajet Kurbegović, Anatolij Nikonov, Jerneja Žganec Gros, Tomaž Savšek

Table 1: List of research papers on technology transfer and intellectual property

Scientific Review Programme Committee representative has selected and ranked the best three papers of the Conference:

1st place: **Advanced 3D sensor system for visual control of geometrically complex products** for a great example of knowledge transfer.

2nd place: **Subsidizing Knowledge Transfer with Public Funds** for deep and wide knowledge and understanding of technology transfer processes

3rd place: **Challenges of Legal and Regulatory Framework for Blockchain Technology in the EU** for competent insight into the perspective area of blockchain technology.

The Conference closing

From 16:50 to 17:00

Moderator:

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

Overview of the conference: In 2022 the conference took place at the Jožef Stefan Institute and via Zoom and attracted 100 participants. Among them 30 attended the section Connecting education system with academia. The key note speaker, Mr. Michel Neu from CEA French Alternative Energies and Atomic Energy Commission presented their experiences in collaboration with companies and spin-out creation. Two awards for the best innovation with the business potential from PROs were given to the two winning teams (out of six competing). The six competing teams consisted of 25 team members all together. Two teams came from the PROs abroad. This year, for the first time, the team from abroad was awarded. WIPO IP Enterprise Trophy and WIPO Medal for Inventors were given. 12 research papers on TT and IPR from several countries and 5 successful scientific projects of Slovenian researchers were presented.

Day 2

CONFERENCE CEREMONY

Overview of the Conference Ceremony

14 October 2022

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 / Slavnostni govor** dr. Igor Papič Minister za digitalno preobrazbo Republike Slovenije Minister for Education, Science and Sport
11:20 – 12:25	**Greetings / Pozdravni govor** prof. dr. Mojca Ciglarič Chair of the Programme Committee of IS2022 / Predsednica PO IS 2022 Dean of Faculty of Computer and Information Science / Dekanica FRI Ljubljana
12:25 – 12:55	**Awards of IS2022 / Nagrade IS2022** 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 Awards "Hall of fame of Slovenian Computer Science and Informatics" prof. dr. Borut Žalik, president of "Hall of Fame" **15. ITTC: Awards ceremony – competition for the best innovation with commercial potential in the year 2022, WIPO Medal for Inventors and WIPO IP Enterprise Trophy**

	15. ITTC Organising Committee World Intellectual Property Organisation representative / Slovenian Intellectual Property Office representative
12:55 – 13:00	Musical Performance / Glasbena točka

Indeks avtorjev / Author index

15. mednarodna konferenca o prenosu tehnologij

15th International Technology Transfer Conference

Urednika • Editors:
Špela Stres, Robert Blatnik