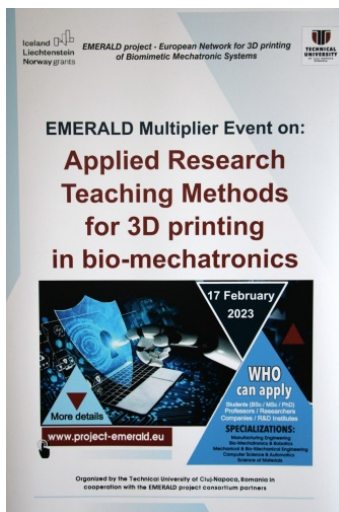


## REPORT – ME 2

# Multiplier Event on Applied Research Methods for 3D Printing in Bio-Mechatronics,

hosted by Technical University of Cluj-Napoca, in Cluj-Napoca, Romania on 17th February 2023

The Multiplier Event that has been organized on 17<sup>th</sup> of February 2023 at the Technical University of Cluj-Napoca in the frame of the “EMERALD - European network for 3D printing of biomimetic mechatronic systems” - 21-COP-0019 - project financed by Norwegian grants, brought together teachers, students, researchers and scientists from higher educational institutions, private companies, research and development institutes, clusters, development agencies, NGOs and other public and private institutions that are interested on the field of advanced technologies manufacturing, with applicability in medicine: 3D printing / bio-printing / robotics / IT / bio-mechatronics domains. More than 150 participants from Romania and from abroad have registered, have participated and have interacted at this event, having one valuable exchange in the field of 3D Printing methods / solutions that can be applied and used in the bio-mechatronics domain.



The Multiplier event agenda was consistent and has been divided in four sessions, one session being especially dedicated to the Higher Education institutions, one session being dedicated especially to the companies that are involved in the 3D printing / 3D bio-printing domain with applicability in the bio-mechatronics field, one session being dedicated to live demonstrations and laboratory visits, the last session being dedicated especially to the clusters, agencies and R & D institutions that have been invited to present their perspectives in exploiting the results reached in the frame of the EMERALD project in future similar institutional and research projects as well.

EMERALD: European network for 3D printing of biomimetic mechatronic systems  
EEA & Norway Grant - Contract No. 21-COP-0019

MULTIPLIER EVENT on Applied Research Teaching Methods for 3D printing in Bio-Mechatronics

(organized by the Technical University of Cluj-Napoca, Romania) -  
b-dul Muncii 103-105, Cluj-Napoca - room: Aula Centenar  
- Event agenda -  
17<sup>th</sup> of February 2023

Session 1 - Higher Education institutions session	
8:30	Registration of participants to the Multiplier Event
9:00	Opening and Welcome ceremony: Rector prof. dr.eng. Vasile Topa (Technical University of Cluj-Napoca, Romania) Vice rector prof. dr.eng. Dan Măndru (Technical University of Cluj-Napoca, Romania) Dean - Faculty of Industrial Engineering, Robotics & Production Engineering - Prof. Corina Birleanu Head of manufacturing Engineering Department, Associate Prof. Adrian Trif City Hall Institution of Cluj-Napoca, Romania - Emilia Botezan, Head of International Relations Office
9:20	25 years of success in the field of Additive Manufacturing for Medical Applications in Romania - prof. dr.eng. Nicolae Bălc and prof. dr.eng. Petru Berce (Technical University of Cluj-Napoca, Romania)
9:30	EMERALD project overall presentation - progress, actions, KPIs, perspectives / details about the event - Associate Prof. Răzvan Păcurar (Technical University of Cluj-Napoca, Romania)
9:40	EMERALD- Applied Research Teaching Methods for 3D printing in Bio-Mechatronics -toolkits for supporting people with amputated arms (Prof. Filippo Sanfilippo - University of Agder (Norway) - recorded presentation
9:45	EMERALD- Applied Research Teaching Methods for 3D printing in Bio-Mechatronics -toolkits for supporting people with amputated arms (Prof. Filip Gorski - Poznan University of Technology (Poland)
10:00	EMERALD- Applied Research Teaching Methods for 3D printing in Bio-Mechatronics - e-toolkits for supporting people with amputated arms (Associate Prof. Diana Băla - Politehnica University of Bucharest (Romania)
10:10	EMERALD- Applied Research Teaching Methods for 3D printing in Bio-Mechatronics - e-toolkits for supporting people with amputated arms (Branislav Rabara - BIZZCOM Slovakia)
10:20	Eu+ and ERASMUS institutional projects - Ludmila Lutencu (International Relations Office - TUCN, Romania)
10:30	Norwegian grants project calls and opportunities - Ramona Demarcsak (coordinator - TUCN, Romania)
10:40	Coffee break
11:00	3D printing of medical products and bioprinting - Polytechnic University of Cartagena - Spain - Roca Joaquin - Academic Coordinator of the Biomedical Engineering Program at ETSII - Ojales Gonzalez Dolores - LIDITEB technical coordinator - Ibarra Berrocal Isidro - Senior Administrative Officer (Head of Administration)

11:20	Artificial intelligence for creative engineering and robotics - Prof. Stelian Brad (TUCN, Romania), president of the Cluj IT cluster and coordinator of the European Digital Innovation Hub DIM4Society
11:38	Additive manufacturing support advances of Biomaterials - prof. Popa Cătălin - Dean of the Faculty of Materials and Environmental Engineering (TUCN, Romania)
11:45	Innovations in Medical Robotics - prof. Doina Pislă - Head of Doctoral School (TUCN, Romania)
12:00	Coffee break
Session 2 - companies session - from evolution to revolution	
12:15	Vice rector Popescu Daniela - TUCN - opening the sessions organized with the companies
12:25	Admaysys - (Markforged, Ultimaker, Formlabs, Minifactory, Evo-Tech, Artec, Shining - representatives in Romania) - company presentation
12:35	Nu Technologies (Stratasys / Materialise / Sisma - representatives in Romania) - company presentation
12:45	CAD Works (3D systems / HP / Markforged - representatives in Romania) - company presentation
12:55	Leykom (DWS Systems / Massivit / 3NTR / BCN3D / Ultimaker) - representatives in Romania - company presentation
13:05	DMG Mori Romania - company presentation
13:15	Pro4D Form (envisionTEC bioplotters / Desktop Metal - representatives in Romania) - company presentation
13:25	Lunch break / press conference
Session 3 - demo room / companies exhibition / TUCN laboratories visit	
14:30	Visiting of TUCN laboratories - Demo room / companies exhibition - main hall, B-dul Muncii - National Centre of Innovative Manufacturing - Robotics and Mechatronics laboratories - CESTER
Session 4 - new project calls /constituting of the EMERALD Network / clusters / R&D agencies	
15:30	Premises of constituting the new EMERALD network for 3D printing in mechatronics Răzvan Păcurar (Technical University of Cluj-Napoca, Romania)
15:35	HORIZON EUROPE - Liliana POP (Knowledge & Technological Transfer Centre - Director-TUCN, Romania)
15:50	North West Regional Development Agency, Romania - Lavinia Chiş, INNO Platform Department & Cristian Oşgon (Intelligent specialization Department)
16:10	Transylvania IT Cluster - Alexandru Roja (expert) - opportunities related to "Health" domain - new project calls
16:30	CREIC + new project calls and perspectives (City Hall Institution of Cluj-Napoca) - Oana Buzatu (cluster of Education) + Ion Petrovai (EIT Health & FreshBlood) + Răzvan Cherecheş (StartupCity Cluj-Napoca)
16:40	Q&A with partners comments and discussions on the possibility of joining different projects / consortium / EU Networks
17:00	Closing words / ending of Multiplier Event

Therefore, in the opening ceremony, Vice rector for International Relations, prof. dr. eng. Dan Măndru (Technical University of Cluj-Napoca, Romania) have addressed one warm welcome to all the participants to the Multiplier Event (on his behalf and on behalf of the Rector of the Technical University of Cluj-Napoca, Romania, prof. dr. eng. Vasile Topa), expressing meanwhile also the support of the Technical University of Cluj-Napoca for the EMERALD project (Technical University of Cluj-Napoca being the coordinating institution of this project) as well as the importance of this project for the Technical University of Cluj-Napoca which is in concordance with the vision and strategy of the Technical University of Cluj-Napoca on long-term basis aiming to increase the internationalization level through the extending of collaborating opportunities with universities from abroad (including the Norwegian universities) in the future.



The message addressed by the Vice Rector with International Relations, prof.dr.eng. Dan Mândru was followed by the message that was addressed by the Vice rector responsible with Management and relationship with the companies at the Technical University of Cluj-Napoca, prof.dr.eng. Daniela Popescu, who addressed one welcome message and expressed her gratitude to the participants, especially to the representatives of the companies that accepted the invitation to attend to the Multiplier event organized within the EMERALD project at the Technical University of Cluj-Napoca on the date of 17<sup>th</sup> of February 2023.



Vice dean Prof.dr.eng. Mihai Dragomir addressed one similar welcome message to all participants in continuing, on behalf of him and Ms. Dean of the Faculty of the Industrial Engineering, Robotics and Production Management, prof.dr.eng. Corina Bîrleanu by expressing meanwhile, besides the Faculty support for this project, the enthusiasm of Hosting in the Faculty of the Industrial Engineering, Robotics and Production Management premises this event.





Former Dean of the Faculty of Industrial Engineering, Robotics and Production Management (former Head of Manufacturing Engineering Department also) - Prof.dr.eng. Nicolae Bâlc - has presented in the opening the main achievements that were reached in the Manufacturing Engineering Department in the field of Additive Manufacturing in the last years. Manufacturing Engineering Department has reached one high experience and expertise in developing Medical Applications in Romania using Additive Manufacturing (3D printing technologies) for more than 25 years, these high top level results being reached within several institutional and research national and international projects that were coordinated by Manufacturing Engineering Department of the Technical University of Cluj-Napoca. EMERALD 21-COP-0019 project that is coordinated by Associate Prof.dr.eng. Răzvan Păcurar (member in the Manufacturing Engineering Department of the Technical University of Cluj-Napoca) has been given also as good example on how such a project can contribute to the extending of the domains where practical applications can be reached in the field of bio-mechatronics by using 3D printing technologies in helping people with special needs (amputated arms) and also one very good example on how such a project can open new opportunities / directions of research and collaboration with other institutions (universities and companies) with wide perspectives and high benefits for the Manufacturing Engineering Department and Faculty of Industrial Engineering, Robotics and Production Management in the near future.



Last, but not least the representative of City Hall institution of Cluj-Napoca, Ms. Emilia Botezan, Head of International Relations Office has expressed her gratitude and Mayor of the City – Emil Boc satisfaction that such wonderful strategic partnerships, actions and events are being developed in the city of Cluj-Napoca. Ms. Emilia Botezan has emphasized also the importance of Cluj-Napoca city in Romania, but also in Europe in terms of wide opening of the city for collaboration in the engineering and medical domain in perspective. City of Cluj-Napoca has more than 120.000 students that are enrolled on different top level universities in Cluj-Napoca, like Technical University of Cluj-Napoca, University of Medicine and Pharmacy Cluj-Napoca, Babes-Bolyai University of Cluj-Napoca, University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca, etc. This represent the frame of a good collaboration in between the universities at the local level in cooperation with other universities of Romania and abroad, with the fully support of the city hall institution of Cluj-Napoca.



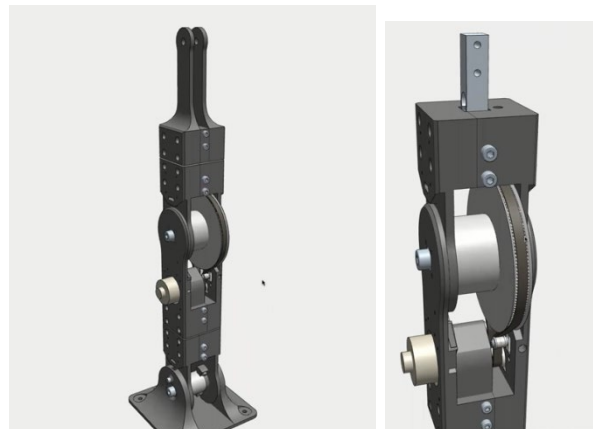
After the opening ceremony speeches, the EMERALD consortium partners have been presented the main results that have been achieved so far in the project, as well as the future activities and results that are expected to be achieved in 2023 at the end of the EMERALD project. Coordinator of the EMERALD project, Associate prof. Răzvan Păcurar (Technical University of Cluj-Napoca) delivered one presentation in which the main aims, the main actions and main activities aimed to be reached within the EMERALD project have been presented, together with the expected KPIs, progress and future perspectives / potential of the results reached so far in the EMERALD project, results that are aimed to be scaled up on the next level to all stakeholders that are interested about the topic of 3D printing in bio-mechatronics in general.



There were presented, analyzed and discussed the possibilities of improving the teaching methods, based on Applied Research approaches, in which both professors and students can be actively involved in this process, by taking benefit of inter-institutional exchanges, diploma projects that can be run in supervised / co-supervised mode in between Higher Education institutions from Romania and from abroad / with the supporting of companies that are involved in doing research in the 3D printing / 3D bio-printing domain with applicability in bio-mechatronics.

Since the main aim of this Multiplier Event was for the EMERALD partners in the consortium to share the results that were reached in the frame of O2 that is related to an e-toolkit manual that has been produced based on several modules (CAD / CAE / 3D printing / testing / AR / VR / etc.), partners of the EMERALD consortium have revealed in absolute premiere the main concepts that were taken into consideration in the producing of robotic arms / sensorized prostheses for the e-toolkit manual to be realized within the EMERALD project until January 2023.

Prof. Filippo Sanfilippo (University of Agder, Norway) has provided through one recorded presentation the main results that were reached during the summer school that was organized by the EMERALD project consortium at the University of Agder (Norway) in 2022, in which one robotic arm has been conceived, designed, produced by 3D printing, assembled, programmed and tested in 2022 by professors and students that attended the summer school edition in Norway on September 2022.



The robotized arm presented by prof. Filippo Sanfilippo was based on original solutions that were considered for such robotic arms by the EMERALD partners, not just in terms of designing solutions, but also in terms of manufacturing and assembling process solutions. These important achievements that were obtained by the EMERALD consortium partners during the summer school organized in 2022 in Norway has been highly valuable since it has constituted the starting point for the e-toolkit manual that was produced by the EMERALD consortium partners and was finalized in January 2023, right before the Multiplier event that has been organized on 17<sup>th</sup> of February 2023 at the Technical University of Cluj-Napoca.

Next speaker on behalf of the EMERALD consortium partners was Associate prof. Filip Gorski from Poznan University of Technology (Poland). He has presented also very important results that were reached in the frame of O2 (e-toolkit manual) regarding different sensorized prostheses and orthoses that were used actually for producing such parts with low costs to support different patients with special needs (people with amputated arms or people who were born without arm).



All the aspects that have been provided by associate prof. Filip Gorski were impressive since these results were not used just for the e-toolkit manual that has been produced in the frame of O2 in the EMERALD project, but were really used to support patients with special needs (amputated arms), both adults and children's to recover part of their lost capabilities (basic movements necessary for feeding, riding one bicycle or swimming). Many solutions that were provided in the presentation made by associate prof. Filip Gorski (results reached with the contribution and involvement of all EMERALD partners) are subject of patenting already and are considered for publishing (several articles have been prepared, were submitted and were sent to be evaluated and published in ISI journals with Impact factor at the beginning of 2023 year).



POZNAN UNIVERSITY OF TECHNOLOGY

AUTOMATED DESIGN AND 3D PRINTING  
OF PERSONALIZED LIMB PROSTHETICS  
FILIP GORSKI, PH.D, D.Sc, B.ENG, ASSOC. PROF.



WYDZIAŁ  
INŻYNIERII  
MECHANICZNEJ



- biologically disabled people constitute over 1.0% of the population (e.g. in Poland)
- the total number of disabled people is decreasing (2002 vs. 2011) BUT the number of biologically disabled people is increasing!
- causes: aging society, civilization diseases, accidents

Iceland  
Liechtenstein  
Norway grants

During all the activities that have been performed for producing the sensorized robotic arms, sensorized prostheses and orthoses, one important aspect has been identified and several needs for the future perspectives as well in relation to the available to be used materials in 3D printing. In order to increase the flexibility of the motions, in order to highlight the impact of used materials with the skin / human body / mouth of the very little children's that have the tendency of touching parts (e.g. orthoses) with their mouth, one strong need has been identified in extending the range of the materials that are available and can be used in the 3D printing processes / post-processing methods / possibilities to go one step further in the 3D bio-printing process / etc. in the future. Ms. Diana Băilă from University Politehnica Bucharest (Romania) – partner in the EMERALD project – who had the responsibility in producing one module for the e-toolkit manual in the frame of O2 related to smart / intelligent materials has presented and discussed in her presentation the most important aspects related to all these important trends and challenges in the future.



Last but not least, Mr. Branislav Rabara from Bizzcom (Slovakia) – partner in the EMERALD project as well, has delivered one presentation to the participants to the Multiplier Event, in which he has presented the role of the Bizzcom company as partner in this project and the role of the Bizzcom company in the frame of O2 related to the Augmented Reality / Virtual Reality (AR/ VR) applications. This is one important step for digital transformation, but also for the education. Many concepts related to the construction of one sensorized robotic arm or sensorized prostheses can be much easy to be comprised in this mode of visualization. But, as it was mentioned in the presentation, it is not enough just to use such modern methods in training and teaching, but to learn how to do programming of such applications and how to integrate AR/VR methods within the lectures and courses materials prepared for the students.

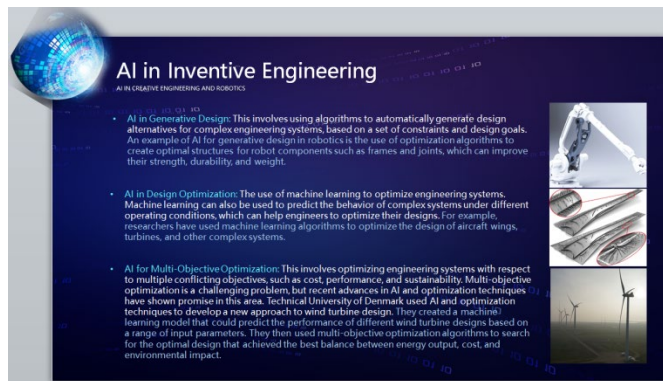


Mr. Branislav Rabara, who is also director of Bizzcom – Slovakia company will be the leader of O3 in the EMERALD project, in which its main role will be related to the producing of one Virtual laboratory platform in which the users will be able to learn in one modern (digitalized) way the main aspects that constitutes the basis in the designing, producing and testing of bio-mechatronics systems using 3D printing methods. Since AR / VR applications are aimed to be integrated in the Virtual platform together with teaching materials on how programming in AR/VR has to be done, at BIZZCOM company in Slovakia, one staff for training event will be organized in May 2023 with the EMERALD consortium partners, so as the participating professors of the EMERALD consortium will learn how programming must be done, so as they will be able to implement further in their work with the students these types of modern methods for teaching. First practical chance to do this will be during the International Summer School 2023 edition that will be organized at the University of Agder (Norway) in the period 15-24 September 2023 when Virtual laboratory created by the EMERALD consortium partners will be ready and participants to this edition of Summer School will have the opportunity to test, to experience and to evaluate its facilities that will be produced in order to boost and improve the digital methods that will be used by the EMERALD partners of the consortium for teaching purposes in the future.

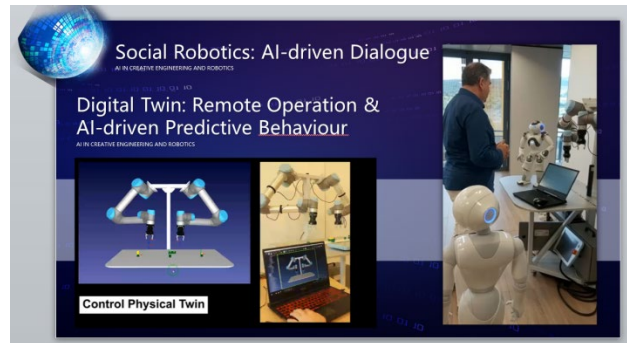


Based on this approach provided by the EMERALD consortium partners and starting from the presented concepts, during the first session of the Multiplier Event (Higher Education institutions session) on behalf of the Technical University of Cluj-Napoca, Romania, there were presented in completion other three presentations that have been in perfect concordance with the main aim of the Multiplier Event organized at the Technical University of Cluj-Napoca on 17<sup>th</sup> of February 2023 and results that were shared by the EMERALD consortium partners related to the applicability of 3D printing methods for bio-mechatronics.

In this sense, one very interesting presentation was brought by Prof.dr.eng. Stelian Brad (president of the Cluj IT cluster and coordinator of the European Digital Innovation Hub DIH4Society) regarding the possibilities of using / integrating artificial intelligence (AI) for creative engineering and robotics.



There are several concepts that were suggested for the future approaches in the bio-mechatronics domain in the EMERALD project, like for instance the inclusion of the artificial intelligence in Generative Design, in Design Optimization and for Multi-Objective Optimization. Such modern approaches in which Artificial Intelligence is used in different applications using Robotics are being already applied within the Department of Design Engineering and Robotics at the Technical University of Cluj-Napoca, under the supervision of Prof. Stelian Brad and his team like for instance in the case of using Autonomous Robotics (selective object recognition / Collision Prevention), Social Robotics, Telepresence Robotics, etc. Such examples can be considered also in the field of Bio-mechatronics aimed to be developed within the EMERALD project in the future.

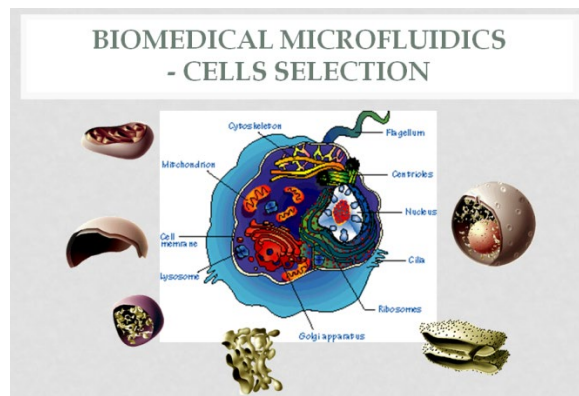


About Innovations in Medical Robotics, one very interesting presentation has been delivered by prof.dr.eng. Doina Pîslă - Head of Doctoral School and Head of Research Center for Industrial Robots Simulation and Testing - CESTER (Technical University of Cluj-Napoca, Romania). CESTER is one of the leading Romanian research center in the robotics field which cooperates closely with the national industrial and medical environments. Since prof.dr.eng. Doina Pîslă and her team was and is currently being involved in several institutional and research projects related to the applicability of Robotics in Medicine at one very high level, like for instance related to how to use innovative safe robotic systems for enhanced patient-centered treatment of liver cancers or how to use innovative modular rehabilitation robots for the efficient therapy of lower limb motor deficit of patients and so on, her presentation was very important and useful for all the participants to the Multiplier Event in identifying how and what kind of innovations would be possible to be brought in the field of bio-mechatronics in the future as one possible continuing of this particular direction at the end of the EMERALD project (EMERALD project will end on September 2023).



Last, but not least on behalf of Technical University of Cluj-Napoca, one important presentation was delivered in the Higher Education institutions session by prof.dr.eng. Popa Cătălin – Dean of the Faculty of Materials and Environmental Engineering, who has approached the topic related to the “Additive manufacturing support advances of Biomaterials”. Prof.dr.eng. Popa Cătălin who is also the Head of Biomaterials Research Group at the Technical University of Cluj-Napoca has emphasized the progress that the Additive Manufacturing technologies have brought in the medical domain in the last decade in close correlation with the possibilities to materialize several parts with lattice structures to enhance the osseointegration process in the case of personalized medical implants to be produced using such modern and advanced manufacturing methods, but also the limitations that are still present in the case when larger parts (hip implants, knee, etc.) are required to be produced using Additive Manufacturing / 3D printing technologies.

Prof.dr.eng. Cătălin Popa presented also few of the most important challenges that are coming with the applications that are being performed in the field of bio-printing in close correlation with the new technological methods that have to be adapted to the use of different types of bio-materials for specific, customized applications like biomedical fluidics, tissues, etc. Even if there are still challenges to be addressed in the future in this field (including the ones that were specified as being necessary to be developed for the EMERALD project bio-mechanics applications), prof.dr.eng. Cătălin Popa has concluded that additive manufacturing (3D printing / 3D bio-printing technologies) provides valuable tools to obtain medical parts, implants and devices that are impossible to be reached by using conventional technologies.

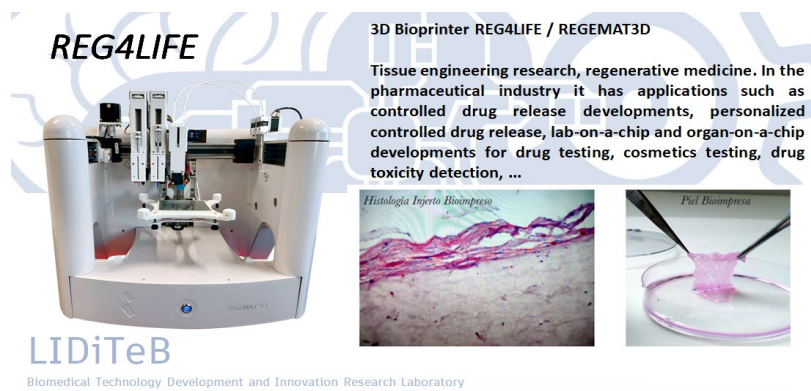


In continuing and in perfect correlation with the conclusions drawn by Prof.dr.eng. Cătălin Popa, one group of invited professors coming from Polytechnic University of Cartagena (Spain) – prof. Roca Joaquin – Academic Coordinator of the Biomedical Engineering Program at Polytechnic University of Cartagena, prof. Ojados González Dolores – LIDITEB technical coordinator and prof. Ibarra Berrocal Isidro - Senior Administrative Officer (Head of Administration at Polytechnic University of Cartagena (Spain) ) – members of EuT+ project consortium have delivered one presentation in which they have emphasized their vision about “Trends and opportunities of 3D printing / bioprinting methods” with applicability in the medical domain (including bio-mechanics).





In October 2022, at the Polytechnic University of Cartagena in Spain it has been inaugurated the Biomedical Technology Development and Innovation Research Laboratory (LIDITEB). LIDITEB laboratory that belongs to the Polytechnic University of Cartagena has been inaugurated and placed inside the Santa Lucia Hospital in Cartagena (Spain). This is one very good example on how engineers and medical doctors can work together on specific topics inside the hospital to quickly support different patients facing all kind of issues where they need quick help and support. One 3D bio-printer has been bought and installed in the LIDITEB laboratory in hospital that is coordinated by prof. Ojados González Dolores (professor at the Polytechnic University of Cartagena), this bio-printer being already used in producing of different types of applications that were developed in cooperation with Santa Lucia Hospital in Cartagena (for producing of medical swabs, skin samples, etc).



In the future one of the main aim of Polytechnic University of Cartagena (Spain) will be to receive students and professors coming from Technical University of Cluj-Napoca, Romania who are interested to work on the bio-printing domain, as well as to send students from Polytechnic University of Cartagena, Spain to Technical University of Cluj-Napoca, Romania to realize interdisciplinary research / complementary research in developing new materials for bio-printing and developing of post-processing procedures, tests and analyses for specific bio-medical applications / bio-medical parts printed in Cartagena. This is in perfect correlation with the objectives aimed to be reached in the EMERALD project since students that are going to Polytechnic University of Cartagena, Spain for mobility training on behalf of the Technical University of Cluj-Napoca will be the ones that are going to be involved in the EMERALD summer school edition in September 2023 at the University of Agder (Norway). Exchanging of students in different mobility will be done in the frame of EuT+ or strategic partnerships that are going to be realized in collaboration between Technical University of Cluj-Napoca, Romania and Polytechnic University of Cartagena, Spain in 2023.

About this important aspect (strategic partnerships) and EuT+ opportunities for students and for professors, Ms. Ludmila Lutencu from the International Relations Office of Technical University of Cluj-Napoca, Romania has delivered one short presentation. The European University of Technology EUt+ is the result of the alliance of eight European partners (Technical University of Cluj-Napoca, Romania and Polytechnic University of Cartagena, Spain are part of it) who share in common a human-centred approach to technology from which both students and professors can take benefit.



There are also other strategic partnerships (Erasmus projects) or Erasmus agreements through which there are possible both for the students and professors to use the opportunity to perform different mobility for training or for studying abroad. Such exchanges bring lot of benefits both, for sending and for receiving institutions and provides the frame for the strengthening the existing cooperation in between all involved Higher Education institutions in this program.

This is actually also one of the main aims of the Norwegian grants also. Ms. Ramona Demarcsek (coordinator of projects with Norwegian grants on behalf of Technical University of Cluj-Napoca, Romania) has presented in this sense the opportunities that the students and professors have also in the frame of different Norwegian grants, like the one of the EMERALD 21-COP-0019 project, that is coordinated by the Technical University of Cluj-Napoca, Romania.



Ms. Ramona Demarcsek has recently won one new project that is financed by the Norwegian grants (one project for mobility - project entitled "Mobility for sustainability" - ID code: 22-MOB-0032, with duration of 15 months (period of implementation: 1.02.2023 - 30.04.2024). Both, students and professors were very enthusiast to find out about the opportunities that they have for exchanging

experience in Norway. University of Agder (Norway) is part of the 22-MOB-0032 project coordinated by Ms. Ramona Demarcsek and will be considered as one good opportunity for professors and students that will be interested to be part of the summer school 2023 that will be organized at the University of Agder (Norway) in September 2023 if there will be a higher number of students and professors that will be interested to apply and attend the summer school (above the planned number / budget allocated in the frame of EMERALD 21-COP-0019 for this type of activity), but also for other types of mobility in 2024, since the 22-MOB-0032 project is ending in April 2024.

In the second session that has been addressed to the companies, the point of view expressed by the 3D printing companies who did presentations as replying to the needs, challenges, trends and issues addressed in the first session by the Higher Education institutions and especially by the EMERALD consortium partners regarding the needs that they have identified during the preparing of the e-toolkit manual in the frame of O2 where super professional and very convincing. The session addressed to the companies was coordinated by Ms. Vice-Rector Prof. Dr. Eng. Daniela Popescu, responsible for the management and relationship with the companies from the Technical University of Cluj-Napoca, Romania. Ms. Vice-Rector Prof. Dr. Eng. Daniela Popescu has presented in the opening of this session, the vision and perspective of the Technical University of Cluj-Napoca, Romania in relation with the companies, as well as the strategic collaboration opportunities that the Technical University from Cluj-Napoca, Romania intends to develop and continue in close collaboration with the companies at the regional, national and international level, on very long term basis.



In continuing the 3D printing companies that are representatives in Romania of very important companies in Europe in the field of 3D printing were invited to do their presentations very specific and in concordance to the type of technologies that they were presenting, correlated with the type of materials (plastic, metallic, etc.) these technologies are using and correlated also with the type of the applications in the medical field that the technologies are being addressing to (e.g. for bio-mechatronics applications that were developed within the EMERALD project in the frame of O2 and are aimed to be developed in continuing in this project).



The Admasys company which is located in Odorheiu-Secuiesc, Romania (Admasys company is representative of Markforged, Ultimaker, Formlabs, Minifactory, Evo-Tech, Artec and Shining companies in Romania) have performed within their presentation one live demonstration related to the 3D scanning methods that they are using particularized for medical products along with the applications they are developing for parts made of composite, plastic, resins and metallic materials to be realized by 3D printing using specific 3D printing technologies in concordance with the type of the application that is required to be produced.



NU Technologies company located in Timisoara, Romania (NU Technologies company is the representative of Stratasys, Materialise and Sisma companies in Romania) has delivered one presentation about their perspective in using several 3D printing technologies (like FDM, Polyjet, SLM) etc. for specific applications to be made of plastic, resin and metallic materials. NU Technologies have provided also information about the possibilities of going from Dicom images to printed models, but also about new developed materials that are customized to be used for specific medical applications (rigid / transparent / colored) including bio-medical applications.



Soft, rigid, colored, transparent and biocompatible

Basic	Rigid
<ul style="list-style-type: none"> <li>• DraftGrey™</li> </ul>	<ul style="list-style-type: none"> <li>• VeroultraClear™</li> <li>• VeropureWhite™</li> <li>• Verovivid Colors Cyan/Yellow/Magenta</li> </ul>
Low cost material for fast iterations	Rigid transparent and colored materials for improved contrast

Nutechnologies

### A wide portfolio of materials

Soft	Biocompatible
<ul style="list-style-type: none"> <li>• Agilus30™ Clear</li> <li>• Agilus30™ Black/White</li> <li>• Agilus30™ Colors Cyan/Yellow/Magenta</li> </ul>	<ul style="list-style-type: none"> <li>• MED610™</li> <li>• MED615RGD™</li> <li>• MED Digital ABS™</li> </ul>
Soft transparent and colored materials for improved realism	Up-to 24hours biocompatible material Skin/Mucosal Membrane/Tissue

CAD Works company which is located in Craiova, Romania (CAD Works is representative of 3D systems, HP and Markforged companies in Romania) have presented also their portfolio that they have both in 3D scanning domain, but also in 3D printing, in which they are developing different types of applications using materials in powder state forms or resins. CAD Works (who is also representative of Dassault systemes – SolidWorks – in Romania) has emphasized also the importance of designing principles that have to be taken into consideration when structures are being required to be materialized using different types of 3D printing technologies in close correlation to the limitations of the methods to be used for different types of medical applications, such as the ones related to bio-mechatronics.



Leykom company, which is located in Bucharest, Romania (Leykom company is representative of DWS Systems, Massivit, 3NTR, BCN3D and Ultimaker companies in Romania) has done one presentation related to their portfolio of 3D scanning devices and 3D printers also, by being focused on several case studies that they have been developing for and in cooperation with the medical / health sector. Several examples similar to the ones developed in the EMERALD project, like prosthesis limbs, prosthesis cover, life-saving models used in different types of surgeries, rehabilitation devices, etc. were provided within the made presentation, along with the benefits of using the Additive Manufacturing (3D printing technologies) for such applications in customized / very personalized manner in concordance to the specific of the patients' needs.



### #1. Case study

PROSTHESIS COVER



### #2. Case study

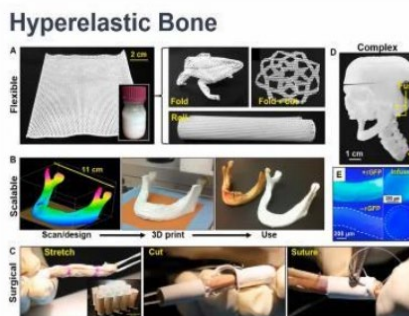
prosthetic limbs  
with Ultimaker S5 3D printer



DMG Mori Romania company which is located in Pitesti (Romania), which is the subsidiary company of DMG Mori from Germany has realized one presentation related to the solutions that they are providing in the field of the Selective Laser Melting (SLM) technology and Direct Energy Deposition (DED) method in the producing of parts made of metallic materials for medical and industrial applications. Benefits of using the Hybrid Technologies (method that is combining SLM or DED method with subtracting technologies (like milling or turning) have also been explained in the presentation, along with the main benefits in reaching lightweight designs of produced parts, aspect that is important in several cases of medical components to be realized by using such advanced manufacturing methods to be made of metallic materials.

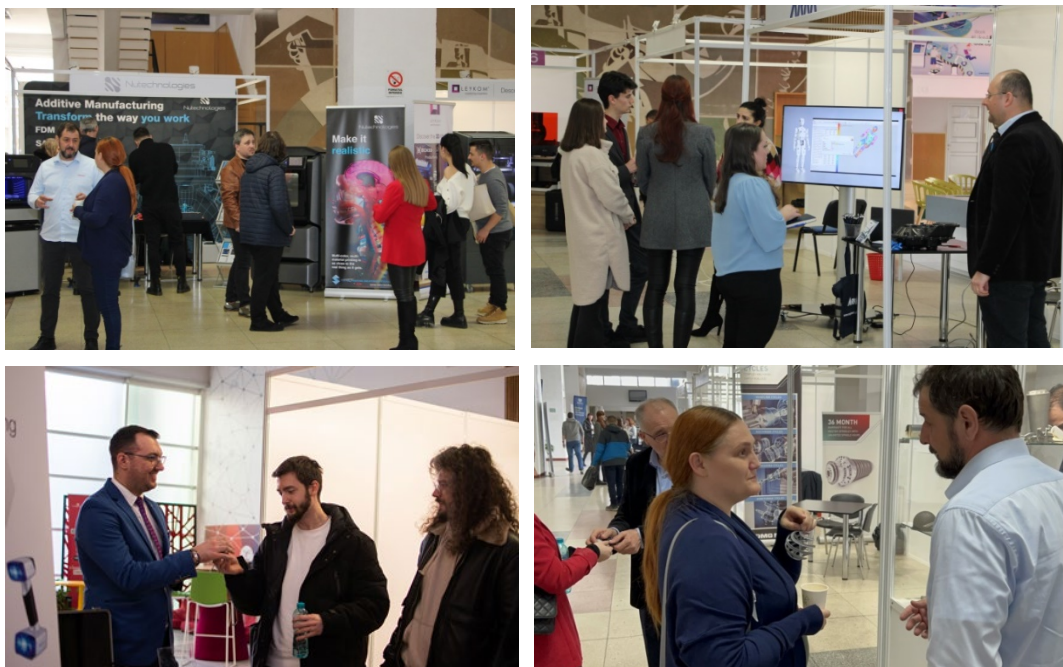


Last, but not least, Pro4D Form company, which is located in Bucharest, Romania (Pro4D Form company is representative of envisionTEC and Desktop Metal companies in Romania) has realized one presentation about the 3D bio-printing method that is available on the market in this domain. Main differences in terms of working principle of this new type of technology as compared to the other existing 3D printing methods, as well as the trends, limitations, challenges and opportunities of this process were explained in detail, along with the field of applications where this new technology can be used for and research trends that this new technology is bringing on to the market (scientific articles that were published in the field of bio-printing in the last years proving the interest that exists among the researchers in the engineering, bio-engineering and medical domain in this sense nowadays).





In the end of this session, many responses have been provided to the all the participants to the Multiplier event, including to the EMERALD consortium partners regarding the addressed concerns in the field of 3D printing for bio-mechatronics. 3D printing is one very dynamic domain and lot of new technological methods / new types of materials occur very fast on the market each year. It is one big plus that the 3D printing companies are one step beyond the universities and have access to the latest technological solutions, materials that are being developed in accordance with the market needs in terms of medical products. One of the main important questions that have been addressed was related to how companies and universities could be in contact and collaborate so as also the universities will have the possibility to remain anchored in reality and provide specialists (students) well prepared for the market needs in the future. Companies expressed widely their opening in finding ways to sustain the teaching process and access of professors and students to the latest solutions in terms of technologies and materials, through several visits that will be performed by the companies in the universities (similar to the one organized on the Multiplier Event on the EMERALD project) or by facilitating students and professors visits in their premises or by providing access to students (under supervision of professors) to the equipment items / new materials that can be used for realizing different BSc / MSc / PhD thesis with their support based on different projects or other cooperation agreements. More than 15 companies' representatives that have attended the presentations made within this section by 3D printing companies representatives have agreed with this conclusion. At the end of this session, all participants were invited to visit the stands that were especially prepared by the 3D printing companies' exhibition, through which many of the solutions presented in the amphitheater were emphasized by live demonstrations and one to one interactions in between the presenters and the participants to the Multiplier Event. ARRK and EMERSON companies that are using 3D printing technologies, including for the bio-mecatronic domain were present during the exhibition and have offered information about internships to the students that have been present at the Multiplier Event.



This was truly one very constructive moment since lot of 3D scanners, 3D printers and parts that were produced from different types of materials using different 3D printing equipment items were seen by the participants to this event and lot of questions and answers were provided to all participants that were curious and interested to find more information about the use of 3D printing methods in different types of applications, including the ones related to bio-mechatronics in particular. In the same time, during the company exhibition session, visits within three representative laboratories / centres of the Technical University of Cluj-Napoca, Romania, namely National Centre of Innovative Manufacturing, Design Engineering and Robotics laboratories and Research Center for Industrial Robots Simulation and Testing – CESTER laboratory – have been organized with the participants that were interested to visit these laboratories in order to see the applications of bio-mechatronics and robotics that can be materialized in the medical field with the support of 3D printing technologies.



After the visit, the last session of Multiplier Event, session that has been addressed to the clusters, R & D agencies / NGOs / City Hall institution has been realized together with the participating of the representatives of the Higher Education institutions and companies that were present all day long at the Multiplier Event organized by the Technical University of Cluj-Napoca on 17<sup>th</sup> of February 2023, with the main aim to discuss, in the light of the aspects that were heard and seen during this event, about the possibilities to be involved in different types of strategic projects in the near future in 2023 as potential partners in different consortiums.

In the beginning of this session, Associate Prof. Răzvan Păcurar (coordinator of the EMERALD project) has presented the premises of constituting the new EMERALD network for 3D printing in bio-mechatronics based on one Cooperation agreement that has been prepared both, in English and Romanian language, being expected to be signed by the companies' representatives in March 2023. Constituting of the EMERALD network for 3D printing in bio-mechatronics – is also one very important objective that it is aimed to be reached in the EMERALD project in 2023. Companies' representatives agreed with the variant of the agreement that has been presented by Associate Prof. Răzvan Păcurar (coordinator of the EMERALD project) and expressed verbally their willing to be part in the EMERALD network, in order to be kept up-dated related to the results reached within the EMERALD project and to be informed about future actions and activities that will be organized in the frame of the EMERALD project in 2023.



COOPERATION AGREEMENT

ACORD DE COLABORARE

Universitatea Tehnică din Cluj-Napoca (UTCN) și ..... (instituție / firmă colaboratoare), recunoscând importanța cooperării educaționale, culturale și științifice între universități/companii naționale și internaționale și împărțind același interes în promovarea legăturilor care pot duce la relații de cooperare între instituțiile mai sus menționate stabilesc următorul Acord.

UTCN este beneficiarul unui proiect finanțat din fonduri norvegiene prin Mecanismul Financiar SEE 2014-2021, intitulat: „Rețea Europeană de printare 3D a sistemelor mecatronice biomimetice” - EMERALD, contract nr. 21-COP-0019. Unul dintre obiectivele principale ale proiectului EMERALD constă în constituirea „Rețelei Europene de printare 3D a sistemelor mecatronice biomimetice” coordonată de UTCN. Prin semnarea acestui acord de colaborare, instituția / firma colaboratoare sus-menționată își exprimă interesul de a face parte din Rețeaua EMERALD, în baza căreia principalele rezultate, activitățile viitoare și potențiale direcții de colaborare legate de tehnologiile de printare 3D care vor fi obținute în cadrul proiectului EMERALD vor fi distribuite și comunicate de UTCN tuturor colaboratorilor din rețea.

The Technical University of Cluj-Napoca (TUCN), Romania and ..... (cooperating partner), recognizing the importance of educational, cultural and scientific cooperation between international universities / companies and sharing the same interest in promoting links that may lead to strong and fruitful relationships between the above mentioned institutions establish the following Agreement.

TUCN is the beneficiary of a project financed from Norwegian funds through the EEA Financial Mechanism 2014-2021, entitled: "European Network for 3D Printing of Biomimetic Mechatronic Systems" – EMERALD, contract no. 21-COP-0019. One of the main objectives of the EMERALD project is to establish the "European Network for 3D Printing of Biomimetic Mechatronic Systems" coordinated by TUCN. By signing this collaboration agreement, the cooperating partner expresses its interest in being part of the EMERALD Network, based on which the main results, future activities and potential collaboration related to the 3D printing technologies to be developed within the EMERALD project will be shared and communicated by TUCN to all cooperating partners that are included in the network.

After the introductory message addressed in the opening of this session, there were the main representatives of the City Hall Institution of Cluj-Napoca Oana Buzatu (cluster of Education) + Ion Petrovai (EIT Health & FreshBlood) + Răzvan Cherecheș (StartupCity Cluj-Napoca) who presented their perspectives regarding the startup of new businesses in the field of the Medical sector. In terms of new project calls and perspectives, there is not one limit in terms of age when someone can perform, start to innovate and have smart ideas (this message has been addressed especially to the students who were present in the amphitheater at this event as encouragement).





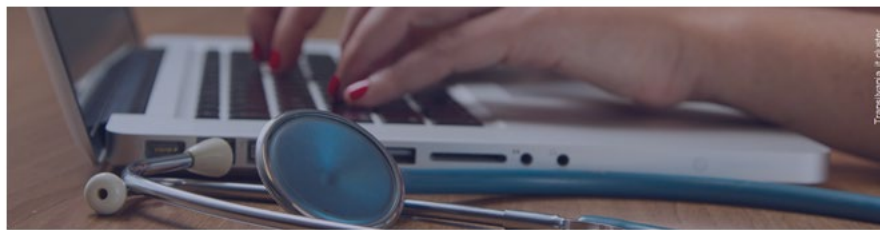
There is a strong support that City hall institution of Cluj-Napoca that is being brought especially to the startup companies through CREIC – Cluj Innovation Park centre, through which there are proposed several dynamic spaces, some even atypical, for communities of creatives, freelancers, for start-ups, but also for corporations, that have the aim of starting one activity in the cultural and creative industries with applicability in the medical domain also. Within CREIC centre there are three labs which are opened for the local community in Cluj-Napoca, namely CGI & VFX (for cinema, entertainment and gaming), Design and Development (for prototyping) and Machine Learning and Automation (which is directly linked to the Artificial Intelligence and Smart Robotics laboratories also).



In continuing it was Mr. Alexandru Roja (expert) – within Transylvania IT Cluster that has realized one presentation about the opportunities that exists and are addressed for SMEs especially, with the involvement, cooperation and support of the universities as well. During his presentation, Mr. Alexandru Roja has explained the concept of Transylvania IT cluster and Transylvania Digital Innovation Hub (DIH), along with the strategic directions and focus of Transylvania IT cluster.



One of the most important directions of the Transylvania IT cluster is oriented to the field of Digital Health. One working group is aimed to be constituted in this direction within Transylvania IT cluster, with the purpose to identify the current needs of the digital health community and to find the proper tools and resources to implement relevant projects that are replicable in several regions/sectors where Transylvania IT has access to. A series of funding opportunities are aimed to be discussed and identified within the group with the aim of creating collaborative teams that could further on apply for funding in order to implement their eHealth solutions. Digital Transformation is one of the key terms to bear in mind for the future since there are going to be several DIH project calls launched and addressed to the SMEs (companies) that could take benefit of it and could get involved in, with the direct support of Transylvania IT cluster.



### DIGITAL HEALTH WORKING GROUP

Meets regularly, every 2 months. The purpose of the working group is to identify the current needs of the digital health community and to find the proper tools and resources to implement relevant projects that are replicable in other regions/sectors. A series of funding opportunities are discussed within the group with the aim of creating collaborative teams that apply for funding in order to implement their eHealth solution.

Next speaker was Mr. Laviniu Chiş – who is representative of the INNO Platform Department within the Northwest Regional Development Agency in Romania. After presenting the main vision of the Northwest Regional Development Agency in Romania to become the most innovative, entrepreneurial and attractive region in Eastern Europe, along with the mission of the Agency to support the continuous economic and social development of the Northwest region through business support services, tools and financial instruments, one of the key focus of the presentation was oriented on the Regional Life Sciences Accelerator that we will be launched by the Northwest Regional Development Agency in Romania in March 2023.



#### Vision

For the Romanian Northwest Region to become the most innovative, entrepreneurial and attractive region in Eastern Europe



#### Mission

Support the continuous economical and social development of our region through business support services, tools and financial instruments



#### Objectives

- Reducing disparities between localities and micro-regions
- Sustain social and economic development
- Support regional and international cooperation
- Attract foreign investments in the region
- Increasing the number of innovative start-ups
- Accelerating the exploitation of intellectual property



Invitation to join the Accelerator was addressed to the ones that have one startup or know one startup in the life sciences fields, as well as to the ones that have practical expertise and knowledge in the life sciences and want to get involved as an expert or mentor within the Regional Life Sciences Accelerator starting from March 2023 in cooperation with the Northwest Regional Development Agency in Romania for maximizing the economic and development opportunities of the startup companies in this field.

Last, but not least, one important presentation has been delivered by Ms. Liliana POP (Knowledge & Technological Transfer Centre – Director – Technical University of Cluj-Napoca, Romania), who was presenting the opportunities that exist in the Horizon Europe program (open calls). There have been presented details about the Program and Budget of the Horizon Europe in general for the period 2021-2027, together with the clusters of the Pillar II, in which cluster 1 – Health is representing one of the key domain of interest in this program. Deadlines to apply for the Horizon Europe 2023 – cluster 1 – Health is quite close (April 2023), so this is the reason why presentations and discussions were oriented more in perspective, by taking into consideration the Strategic plan and Work Program of the Horizon Europe program for the period 2023-2024.



**Horizon Europe – Cluster 1 'Health'**

**Strategic Plan 2021-24** → 6 Expected Impacts  
= 6 "Destinations" of :

**Work Programme 2023-24** → **Topics (Calls)**

1. Staying healthy in a rapidly changing society
2. Living and working in a health-promoting environment
3. Tackling diseases & reducing disease burden
4. Ensuring access to innovative, sustainable & high-quality healthcare
5. Unlocking the full potential of new tools, technologies and digital solutions for a healthy society
6. Maintaining an innovative, sustainable & globally competitive health industry

Focus on outcomes contributing to the impacts specified per Destination

Project proposals should

- make a **clear case** (value proposition)
- supported by a **convincing trajectory** (pathway to impact) for the project proposal to deliver the **output**, promote the **outcome** described in the topic, and contribute to the **impact** expected under that destination.

Strategic Plan: 2021-2024 – [link](#)  
Work Programme 2023 – 2024 - [link](#)

In the end of the Multiplier event, which was very intense, there have been drawn the main conclusions by Associate Prof. Răzvan Păcurar (coordinator of the EMERALD project) and Vice rector for International Relations, prof. dr.eng. Dan Mândru (Technical University of Cluj-Napoca, Romania), who have addressed their closing words, their appreciations and have expressed their special thanks and considerations to all the participants that have attended to the Multiplier Event organized on 17<sup>th</sup> of February 2023 at the Technical University of Cluj-Napoca, Romania.

Associate prof.dr.eng. Răzvan Păcurar

[razvan.pacurar@tcm.utcluj.ro](mailto:razvan.pacurar@tcm.utcluj.ro)

Coordinator of the EMERALD project - 21-COP-0019