



**START
FOR
FUTURE**

Promoting Inclusive and Sustainable Entrepreneurship and Innovation in Deep Tech: A good practice guide

Edited by Colette Henry, Sabrina Tomasi,
Slavica Singer, Alessio Cavicchi, Margot Bucaille,
Erik Mass Lovgren & Simone Stilling

startforfuture.eu

EIT HEI Initiative

Innovation Capacity Building
for Higher Education



European Institute of
Innovation & Technology

Funded by the
European Union



@ Start For Future 2024. All rights reserved.

No part of this publication may be reproduced without
prior permission from Start For Future.

Published by

Start For Future, Munich

Strascheg Center for Entrepreneurship | Entrepreneurship-Center
der Hochschule München

SCE gGmbH | Heßstraße 89 | 80797 München

www.sce.de

ISBN 978-3-00-079553-4

Promoting Inclusive and Sustainable Entrepreneurship and Innovation in Deep Tech: A good practice guide

EDITED BY

**Colette Henry, Sabrina Tomasi,
Slavica Singer, Alessio Cavicchi, Margot Bucaille,
Erik Mass Lovgren & Simone Stilling**

ACKNOWLEDGEMENTS

This Good Practice Guide constitutes an official deliverable (D8.2) of the project SFF.DeepT+ (Deep Tech in Higher Education Institutions and Ecosystems through Entrepreneurial Education+), project number 23611, part of the Start for Future (SFF) initiative.

The project is funded by the European Union through the European Institute of Innovation and Technology (EIT). Views and opinions expressed are ,however, those of the author(s) only and do not necessarily reflect those of the European Union or the European Institute of Innovation and Technology. Neither the European Union nor the granting authority can be held responsible for them.

The editors are grateful to the authors who have kindly shared their various initiatives by contributing chapters to this Good Practice Guide. A special thanks is due to Professor Bárbara Gabriel of the University of Aveiro, and Pavlina Vujović, and Professor Klaus Sailer of the Strasczeg Centre for Entrepreneurship, Munich, for supporting this publication.

TABLE OF CONTENTS

Foreword	06
Introduction by the Editors	07
I – Accredited Education Programmes	
1 – Futureproofing Graduates: The Postgraduate Diploma in Strategic Data Analytics for Business Angela Short, Colette Henry, Brian Boyd & Kehinde Ogunjemilusi	10
2 – Creating Responsible Deep Tech Intra- and Entrepreneurs Dana Schultchen, Audrey Stolze, Sebastian Planck, Herbert Gillig	20
3 – Starting from Scratch: The Entrepreneurship and Innovativeness Doctoral Programme at J.J. Strossmayer University in Osijek, Croatia Slavica Singer & Sunčica Oberman Peterka	30
4 – Redesigning Mechanical Engineering Curricula Towards the Promotion of Entrepreneurial Competencies in Deep Tech Bárbara Coelho Gabriel, Robertt Valente, José Rabelo Neto	42
II – Entrepreneurship Training Programmes	
5 – Bus School Baltica: An “out of the classroom” experience Alessandro Tomasi	52
6 – THRIVE4women: Empowering women to succeed in STEM and deep tech sectors Lavina McGahon & Garrett Duffy	60
7 – From Research to Market: A novel entrepreneurship training programme for researchers Alexander Spriet, Jolien Coenraets & Davy Vercruysse	72
III – Accelerators/Incubators	
8 – Contamination Lab: Entrepreneurship education for innovation, sustainability, and inclusion Sabrina Tomasi, Alessio Cavicchi, Cristiana Barghini, Rachele Di Maio, Loredana Guarino & Paolo Cannata	82

9 — Inclusive and Sustainable Hardware Innovation:	90
The case of Industrio – Marlene Klotz, Gabriele Paglialonga, Xiaofeng Wang, Christoph Stoeckmann & Alessandro Narduzzo	
10 — Comon: Catalysing innovative solutions to complex societal problems through transdisciplinary experimentation	96
Jeroen Bourgonjon, Bastiaan Baccarne, Dorien Goubert, Ben Robaeyst, Nell Van hansewyck & Pauline De Wolf	
11 — Beyond: A sustainable and inclusive pre-accelerator programme in deep tech	106
– Malvina Ilieva & Iglia Milosheva	

IV – Other Innovative Initiatives

12 — Lightbulb Moments: The impact of small ‘Lightbulb Grants’ on entrepreneurial intention	116
Philip Davies, Will Shepherd, Alan Martin & Alan Murray	
13 — Askforce.one: From Research to Real Impact	128
Elke Decrock, Elisa Van Kenhove, Margot Vanden Bossche, Sofie Vanassche, Pedro De Bruyckere & Geert De Meyer	
14 — Na.bi: Driving sustainable entrepreneurship through social media communication	138
– Johanna Anzengruber & Bettina Maisch	
15 — Courage for Digital Enterprise	144
– Maria Høegh Beierholm and Simone Stilling, VIA University College, Denmark	
16 — ONKOMICS: Shaping the future of cancer detection	152
Egoitz Astigarraga & Urko Muzquiz	

FOREWORD



Start for Future is an entrepreneurship and innovation mega-ecosystem that brings universities together on a co-creation basis to deliver entrepreneurship education in SDG related domains.

As an international consortium of entrepreneurial universities and business incubators, SFF partners collaborate to revolutionise university education and empower the next generation of responsible entrepreneurial changemakers.

The SFF network offers a range of programmes for students, graduates, researchers and the wider community across Europe and beyond. These programmes comprise entrepreneurship training, specialist coaching and incubation support across three different stages: Learn (idea development), Match & Start (preparing for incubation) and Develop & Co-create (international incubation and start-up).

SFF programmes are designed to be inclusive, adopting an ‘entrepreneurship for all’ approach. The SFF team has recently adopted an added focus on deep tech. Deep tech cuts across many technological areas, and has considerable potential to catalyse change. In the future, it will be the deep tech domains that will offer the greatest potential for solving some of the world’s biggest challenges.

Accordingly, this Good Practice Guide is a welcome publication. It supports the recently launched ‘Deep Tech Talent Initiative’ – a pioneering programme led by the European Institute of Innovation and Technology (EIT) that aims to skill one million people within deep tech fields. I have no doubt that by sharing good practice examples of inclusive deep tech entrepreneurial initiatives, this Good Practice Guide will prove invaluable for higher education institutions seeking to establish inclusive deep tech focused initiatives across education, incubation and funding domains.



Dr. Martin Vendel

Academy Director at EIT Urban Mobility

SFF Cooperative Supervisory Board Member

INTRODUCTION

Recently, at the European level, increasing attention has been placed on the role higher education institutions (HEIs) can play as “regional innovation engines” (European Commission, 2022a). In particular, HEIs’ capacity to attract, nurture and retain talents has been emphasised, and their capacity to achieve compelling priorities (such as the ‘twin transition’) has been highlighted.

The current wave of deep tech innovation has been acknowledged as pivotal in supporting HEIs’ contribution to regional innovation, and augmenting their capacity to leverage diverse talents, intellectual assets, and industrial capabilities. In this regard, the New European Innovation Agenda (European Commission, 2022b) supports university-industry collaboration, fostering research and technology infrastructures to produce, value and spread new knowledge. Furthermore, cutting-edge technological solutions combining fields of science and engineering in the physical, biological, and digital spheres are indispensable in addressing the most pressing global challenges (EIT, 2022).

HEIs in Europe, through their various entrepreneurship education programmes, provide a vital contribution to the new education, research, and innovation agenda by promoting and supporting increased licensing, patenting, and new venture creation activity. When referring to entrepreneurship and innovation, the New EU Innovation Agenda and the European Strategy for Universities emphasise inclusivity and sustainability by encouraging the participation of under-represented groups and guaranteeing equal access to opportunities in the field. They also promote pathways that support the achievement of the Sustainable Development Goals (SDGs) (UN, 2012).

Against this backdrop, the Start for Future (SFF) project aims to enhance the entrepreneurial mindset of HEIs, their ecosystem stakeholders and core target groups, encouraging them to develop sustainable and scalable business models of collaboration and generate impact across Europe and beyond. In autumn 2023, SFF invited HEIs from the SFF consortium and its wider entrepreneurial ecosystem to share good practice examples of inclusive and sustainable entrepreneurship and innovation in deep tech. Following a thorough review and revision process, sixteen good practice examples were selected for publication in this Good Practice Guide. These examples cover four main themes: accredited education programmes (degrees, postgraduate diplomas, masters, PhDs); entrepreneurship training programmes; accelerators/incubators, and other innovative initiatives relating to financial support, diagnostics, and student engagement to promote deep tech entrepreneurship. The countries covered by these examples include Belgium, Bulgaria, Croatia, Denmark, Estonia, Germany, Ireland, Italy, Latvia, Portugal, Scotland, and Spain. This guidebook should prove a valuable resource for HEIs interested in enhancing their current entrepreneurship and innovation offerings to ensure they are both inclusive and sustainable.

References

- European Commission. (2022a). Communication on a European Strategy for Universities. Retrieved from: <https://education.ec.europa.eu/sites/default/files/2022-01/communication-european-strategy-for-universities-graphic-version.pdf> (last accessed: 14.05.2024)
- European Commission. (2022b). Communication from the Commission to the European Parliament, the Council, the European economic and Social Committee and the Committee of the Regions. A New European Innovation Agenda, Brussels, 5.7.2022 COM (2022) 332 final. Retrieved from: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022DC0332> (last accessed: 14.05.2024)
- EIT – European Institute of Innovation & Technology. (2022). EIT Deep tech talent initiative. Available from: Retrieved from: <https://www.eitdeeptechtalent.eu/the-initiative/> (last accessed: 14.05.2024)
- UN – United Nations. (2012). United Nations Sustainable Development Goals. Available from: <https://sdgs.un.org/goals> (last accessed: 14.05.2024)



I.

Accredited Education Programmes

Angela Short, Colette Henry, Brian Boyd &
Kehinde Ogunjemilusi



FUTUREPROOFING GRADUATES: THE POSTGRADUATE DIPLOMA IN STRATEGIC DATA ANALYTICS FOR BUSINESS

ABSTRACT

This chapter discusses the Postgraduate Diploma in Strategic Data Analytics for Business, an upskilling/reskilling educational programme created by Dundalk Institute of Technology (DkIT) Ireland. Designed, validated, and launched during the 2020 Covid pandemic with funding from the Irish Higher Education Authority (HEA), the programme offers 90%–100% funded scholarships to eligible candidates seeking to pursue a career in Data Analytics from a business perspective. Due to its hybrid delivery, small class sizes and student mentoring, the programme attracts a diverse range of learners from different economic backgrounds and cultures who secure valuable employment opportunities upon graduation. Accordingly, the authors consider this as a good practice example of promoting deep tech skills and creating deep tech employment opportunities.

Key words: Data Analytics, Ecosystem, Inclusivity, Deep tech



INTRODUCTION

There is a growing expectation that graduates can adapt to the volatility, uncertainty, complexity, and ambiguity (VUCA) that typify today's world (Euchner, 2013). Graduates will need to be able to learn 21st century skills and apply sustainability concepts to address global ethical issues. Digital and cognitive competencies will be increasingly important as businesses adopt digital technologies to enhance agility and ensure their survival in a time of exponential change. This chapter describes the origins, rationale and delivery of a postgraduate programme designed specifically to respond to these challenges by enhancing the digital and strategic leadership skills of students.

BACKGROUND

Data is a critical part of so many areas of business. This is because developments in internet technologies have facilitated the digitalisation of business. While this assists business growth it also produces large volumes of data. Referred to now as Big Data, it offers businesses the potential to access valued insights that can enhance decision-making processes. This has led many to refer to it as *digital oil* and the *new raw material for the 21st century* (Sivarajah et al, 2016, emphasis in original). Data like oil requires refinement but time spent analysing data offers insights that can drive new revenue streams and deliver competitive advantage over rivals (ibid). However, for many businesses this big data is often unstructured and incapable of being formatted in traditional database systems, presenting businesses with more of a problem than an opportunity. The challenge then is to understand what skills the business needs to access insights from data.

Based on interviews with data analysts and business intelligence professionals, Browne Anderson (2018) found that the ability to communicate the results of analytics was more important than the ability to use sophisticated deep learning models. Moreover, in their research on the gap between industry needs and business school curricula, Turel and Kapoor (2016) identified the topics that should be included in business analytics courses as big data, business intelligence and data visualisation. These skills, they argue, play a pivotal role in improving business performance and overall business strategy. Mindful of the research literature and informed by feedback from industry, the Postgraduate Diploma in Strategic Data Analytics for Business was developed to meet industry needs and address gaps in higher education curricula.

REGIONAL ECOSYSTEM CONTEXT

The institution

Dundalk Institute of Technology (DkIT) was founded in 1970 as an autonomous Institute, established under the Regional Technical Colleges Act, 1992. It offers bachelor's, master's, and PhD degrees across its four academic schools – Business & Humanities, Health & Science, Engineering, and Informatics & Creative Arts. DkIT is also a major contributor to the educational, economic, social, and cultural development of the region, with circa 5,400 full and part-time students and 500 staff. It has extensive expertise in Entrepreneurship and Innovation developed through its established entrepreneurship courses, academic research staff, funded enterprise projects and its state-of-the-art on-campus incubation centre, the Regional Development Centre (RDC). DkIT staff members have won several awards and commendations for their innovative pedagogical approaches and entrepreneurship

programmes. Research staff in entrepreneurship, ICT and science have won awards for the quality and impact of their work. The RDC has won awards for its entrepreneurship training programmes. The recent establishment of a VP role in equality, diversity, and inclusion, and the Institute's achievement of an Athena Swan Bronze award, has created a hub of expertise and activity in the promotion of equality, diversity, and inclusion (EDI).



Figure 1. Dundalk Institute of Technology (DkIT) Campus View

Location

Dundalk Institute of Technology (DkIT) is strategically located in county Louth in the Republic of Ireland, on the M1 economic corridor close to the border with Northern Ireland (<https://www.m1corridor.ie/why-invest/start-up-ecosystem>). As such, it benefits from a well-established vibrant, and supportive entrepreneurial ecosystem with the necessary components to support and enhance entrepreneurship activity at all stages of the new venture creation process (Mazzarol, 2014). This ecosystem comprises a local enterprise office (LEO), a regional office of the government's national state agency for developing and growing Irish enterprises in world markets (Enterprise Ireland), an advance office business park for multinational companies managed by the national Industrial Development Agency (IDA), a county council (LCC), a network of creative enterprise centres and business parks (e.g., Creative Spark, Blackthorn Business Park, The Mill Enterprise Centre, Oriel Hub), a network of further education institutions and training organisations, a wide variety of SMEs, and a concentration of large multinational businesses with a particular focus on pharmaceuticals and digital technologies, the latter creating positive spill over effects in the region.

Accordingly, education and training, mentoring and advice, human capital, local markets, and a supportive entrepreneurial culture are particularly strong ecosystem components. DkIT contributes to this ecosystem through its education programmes, expertise, start-up and incubation services, graduate output, and industry support. Dundalk is ranked as having the 8th best start-up ecosystem in Ireland (<https://www.startupblink.com/startup-ecosystem/dundalk-ie>), within a country with high graduate employment rates (Kavanagh, 2023), relatively low unemployment rates (4.5% in 2022), and strong growth projections (4.4%



Figure 2. Dundalk Institute of Technology (DkIT)

predicted for 2023) (OECD, 2023; 2023a) making it a prominent choice for both Foreign Direct Investment (FDI) and indigenous businesses.

THE POSTGRADUATE DIPLOMA IN STRATEGIC DATA ANALYTICS FOR BUSINESS

The Postgraduate Diploma in Strategic Data Analytics for Business was developed as part of the Irish government funded Human Capital Initiative (HCI) under its Pillar 1 programme, a scheme managed by the Irish Higher Education Authority (HEA). The main objectives of the initiative were to future proof graduates with industry relevant competencies and increase provision in areas of identified skills needs. Pillar 1 funds full time conversion courses which incentivise graduates to reskill in areas of shortage and emerging technologies, including but not limited to Data Analytics, Artificial Intelligence, Robotics and High-End Manufacturing. Furthermore, the objectives of Pillar 1 align with the European Commission's vision for Europe's digital transformation by 2030 which focuses on digital skills, digital infrastructures, digital businesses, and digital public services.

Design and content

The Postgraduate Diploma in Strategic Data Analytics for Business closely aligns with the objectives of the Pillar 1 initiative. It specifically addresses shortages in digital skills, transversal skills and management and leadership skills, all of which are critical to the workplace of the future. Designed, validated, and launched in 2020, the programme offers 90%–100% funded scholarships to eligible candidates pursuing careers in Data Analytics from a business perspective. Applicants who possess an honours degree in any discipline are invited to participate and candidates with industry experience but no honours degree can also gain access through the Recognition of Prior Learning (RPL) process. The programme aims to provide participants with critical skills in data analytics, strategic management, and leadership. It gives the learners a comprehensive analytical toolkit, enabling them to communicate with data owners, frame data problems, and realise business value.

It comprises five mandatory modules in introductory and advanced Data Analytics, Strategy, Leadership and Research Methods/Ethics. The programme is delivered in blended mode requiring students' attendance on campus during the semester combined with weekly online classes and assessment activities. The programme comprises six 10 credit modules delivered over two semesters, including a 'Adding Value' module where participants choose between a work-placement or a work-based project to help their assigned business boost performance. Each module is worth 10 credits (60 credits in total for the programme) and all modules are assessed on a 100% continuous assessment basis.

Structure and delivery

The programme was launched in 2020 during Covid forcing the redesign of its delivery when the institute moved to remote emergency teaching. The first cohort of 19 students was made up of recent graduates, many of whom had studied previously in DkIT. Delivery of the modules took place over four days – students attended synchronous classes via Zoom two days per week and engaged with a range of learning and assessment tasks asynchronously on the remaining days. It was fortunate that prior to the pandemic, the programme team had already adopted Connect Smartbooks¹ enabling a more personalised learning experience for students. A Smartbook draws on effective learning science principles such as spacing, chunking and interleaving that aid student comprehension and long-term retention (Dunlosky et al, 2013).

Underpinned by machine learning, Smartbooks offer an adaptive learning solution that aims to boost student engagement by creating a baseline of the knowledge while focusing on their knowledge gaps. While considerable emphasis in the curriculum is devoted to the use and analysis of data, equal time is allocated to developing student leadership for digital transformation skills as well as conducting research with a particular emphasis on ethical behaviour. Students also work in groups in a week-long campus-based Business Strategy simulation game as they grapple with the highs and lows of running a multinational manufacturing company. Finally, at the end of the programme students apply these combined skills to complete a work placement or produce a data analytics project for their workplace. However, each year the programme reviews the delivery to ensure maximum flexibility to meet students' needs. This generally comprises a mixture of on-campus short monthly two-day blocks combined with synchronous and asynchronous online delivery. Consequently, timetables for the programme are made available to applicants in advance of their acceptance so they can seek and receive permission to attend during working weeks. This is particularly important for students whose employers are sponsoring their involvement in the programme.

IMPACT

So far, the programme has successfully graduated 25 students, with a further cohort of 12 students due to graduate in Autumn 2024. While the majority of these students held academic qualifications in Business, others held degrees in Fashion Design, Mechanical Engineering and Social Care. 88% of the graduates were born in Ireland, with the remainder coming from the UK, Brazil, Nigeria and Afghanistan.

When applying to the programme 64% of the applicants were in employment, 24% had been unemployed for up to six months and the remainder were unemployed for between six months and two years. Employment backgrounds covered a range of sectors including hospitality, finance, ICT, construction and healthcare.

Almost all of those in employment at the time of their application to the programme (n=23)

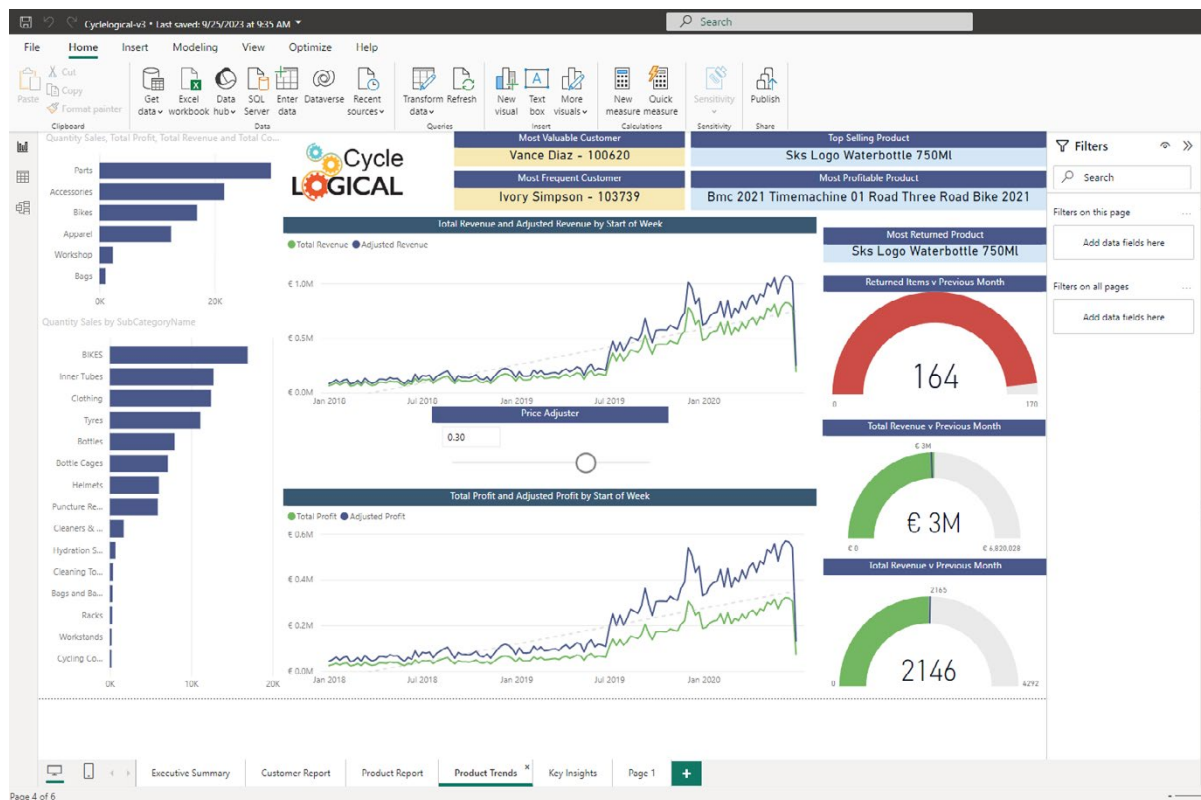


Figure 3. Power BI Dashboard

were employed within 60 miles of DkIT, suggesting that the programme was meeting the demands of local employers. The programme has also benefited from a good gender balance, with graduates being 48% male and 52% female.

Interest in the programme has been sustained since the first intake in 2020. However, the applicant profile has changed considerably with most applications coming from right across the Island of Ireland and in full time employment, a trend in part driven by the flexibility of the blended mode of delivery. This has prompted consideration of how best to redesign delivery to maximise student engagement and collaboration. In the second year of running the programme, students were required to attend one full day on campus each month while also attending weekly online synchronous classes on two evenings per week. This accommodated those students who were working full time. Flexibility in delivery is key to the success of the programme, and each year in response to participants' needs, changes are made in how and when teaching is delivered.

Graduate feedback

Feedback from students who have completed the programme confirms that the qualification has been instrumental in securing or changing their employment. Moreover, they are able to apply the skills acquired on the programme, empowering them to use data analytics to develop and make recommendations across functional management areas in their respective organisations. The qualification and skills acquired appear to have particularly benefitted the more recent graduates, allowing them to make employers' interview lists and subsequently secure a position.

One graduate, Mark who now works as a Data Analyst for a large international pharmaceutical company, explained how he had introduced PowerBi and Tableau into his

organisation allowing him to create dashboards that track the business's key performance indicators (KPIs). His managers seem to love this innovation which allows them to visualise and present data. Speaking enthusiastically about how the programme was benefitting his employers, Mark commented:

MARK — *“I had a meeting with one of the Engineering Associate Directors and the main Engineering Director and they love bringing in Power BI. It’s all quite new in the company but I’ve been able to build on what I learned in the course and get better at it while helping the company a lot.”*

Another graduate Kate, now works as a Data Analyst for a large public sector financial organisation. She also uses PowerBi in her work every day and it was her skills and experience using that software that was instrumental in securing her present position. She analyses huge amounts of data every day drawing on her skills in cleaning and sorting data.

KATE — *“The data analytics modules’ experience using the software was critical to me securing the role, as well as experience with excel and cleaning and sorting large datasets. I really enjoy the work that I do and feel that it’s very rewarding, working for the public interest.”*

It is particularly satisfying for the programme team to see that graduates are using their deeptech skills in private and public businesses.

KEY LEARNINGS



STUDENT ENGAGEMENT AND THE STAFF-STUDENT RELATIONSHIP IS CRITICAL

Maintaining student engagement is critical to ensuring successful completion. A dedicated Programme Director and Programme Administrator who monitor student progress and act as mentors, offering support and guidance, are key success factors. In addition, cognisant that postgraduate students on blended programmes may experience social isolation and a lack of emotional support (Janta, Lugosi and Brown, 2012), phone, email, and Microsoft teams are used to maintain contact with students (Garrison & Vaughan, 2008). The relationships formed between programme staff and students are meaningful and reciprocating in addressing and overcoming obstacles (Karpouza and Emvalotis, 2019). Students continue to contact staff afterwards for advice or references when applying for promotions or new positions.



FLEXIBLE DELIVERY

The onset of the Covid 19 pandemic and the subsequent lock down across Ireland forced the programme team to consider how best to adapt delivery to ensure that students received a comparable and equally engaging experience online rather than face-to-face. The first cohort of students were all recent graduates of DkIT or other Irish universities. While many had part time work, none of the graduates had secured full time positions in roles that would have been commensurate with their honour's degree qualification. In subsequent years, the profile of the applicant changed with most or many potential participants drawn from across Ireland and working full time. This is not surprising particularly as Ireland is experiencing unprecedented levels of employment with the number of people employed estimated to reach 2.64 million, a new record for the country.

However, this also raised concerns about students' capacity to engage in full time study while working full-time. These concerns are addressed specifically in the pre-enrolment questionnaire and interview with all students asked to outline their plans for managing their time while on the programme. This intentional practice of informing and managing student expectations of the time and commitment required is key to retention and success.



ASSESSMENT AND FEEDBACK

Engaging students in their learning is a complex process but as Rust et al. (2005) argue assessment is the single greatest influence on how students approach their studies.

Continuous assessment and feedback that is embedded across the programme duration and linked directly to module and programme outcomes is key to ensuring students engage with and self-regulate their learning throughout. Crucially, this means that everything in the curriculum, learning outcomes, teaching activities and methods of assessment are interrelated and follow seamlessly from one another (Biggs, 1999;2001).

CONCLUSIONS

Strategic analysis of big data offers the potential to drive business process improvements and enable future predictions. Yet despite the volume of data created daily, many businesses struggle to leverage the variety and diversity of their data to inform strategy. The Postgraduate Diploma in Strategic Data Analytics for Business is a government funded conversion programme that incentivises graduates to upskill in this area.

As Ireland experiences strong fiscal growth and near full employment, the programme team's student centred and flexible approach to the design and delivery ensures that demand for the programme remains strong. Furthermore, feedback from graduates confirms that the qualification has been instrumental in securing or changing their employment.

AUTHOR BIOS

Dr. Angela Short is Programme Director for the Postgraduate Diploma in Strategic Data Analytics. Passionate about teaching and learning, in 2015, Angela received a National Teaching Expert award for her contribution to Effecting systemic cultural change in teaching and learning as part of the Masters in Learning and Teaching team. Her research interests are in student engagement, assessment, and graduate employability. (Angela.short@dkit.ie)

Professor Colette Henry is Head of Department of Business Studies and Start for Future Project Lead at Dundalk Institute of Technology (DkIT) Ireland, Adjunct Professor of Innovation & Business Strategy at Griffith University Queensland Australia, and Affiliated Researcher at Jönköping University Sweden. Her former roles include Norbrook Professor of Business & Enterprise at the Royal Veterinary College London, President of the Institute of Small Business & Entrepreneurship (ISBE), and Chair of the Global Women's Entrepreneurship Policy Research network (GWEP). (Colette.henry@dkit.ie)

Dr. Brian Boyd is a lecturer in Finance and Research Methods and currently Acting Head of Department of Business Studies in Dundalk Institute of Technology. Brian is also a visiting professor at Heilbronn University Graduate School in Germany. (Brian.boyd@dkit.ie)

Kehinde Ogunjemilusi, MSc, is currently a final year PhD candidate at Dundalk Institute of Technology, Ireland. She holds a master's degree in finance from Technological University, Dublin. Her research interests are in women's entrepreneurship, entrepreneurial ecosystems, and finance. Her PhD dissertation focuses on exploring the intersection of women's entrepreneurship policy and access to finance in Ireland. (kogunje@gmail.com)

References

- Dong, T. & Triche, J. (2020). A Longitudinal Analysis of Job Skills for Entry-Level Data Analysts. *Journal of Information Systems Education*, 31(4), 312–326.
- Biggs, J.B. (1999, 2001). *Teaching for Quality Learning at University*, Buckingham: Open University Press.
- Dunlosky, J., Rawson, K.A., Marsh, E.J., Nathan, M.J. & Willingham, D.T. (2013). Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology. *Psychological Science in the Public Interest*, 14(1), pp.4–58.
- European Commission. (2023). European Commission. Digital Decade 2030. Report on the state of the Digital Decade 2023. Available at https://commission.europa.eu/europes-digital-decade-digital-targets-2030-documents_en

Buchner, J. (2013). Navigating the VUCA world: An interview with Bob Johansen. *Research Technology Management*, 56(1), p.10.

Holmes, N. (2018). Engaging with assessment: Increasing student engagement through continuous assessment. *Active Learning in Higher Education*, 19(1), pp.23–34. <https://doi.org/10.1177/1469787417723230>

Janta, H., Lugosi, P. & Brown, L. (2014). Coping with loneliness: A netnographic study of doctoral students. *Journal of further and Higher Education*, 38(4), pp.553–571. <https://doi.org/10.1080/0309877X.2012.726972>

Kavanagh, R. (2023). Graduate outcomes 2022: Key findings. Gradireland. Available from: <https://gradireland.com/careers-advice/career-ideas/graduate-outcomes-2022-key-findings> [last accessed 02/02/24].

Karpouza, E. & Emvalotis, A. (2019). Exploring the teacher-student relationship in graduate education: a constructivist grounded theory. *Teaching in higher education*, 24(2), pp.121–140. <https://doi.org/10.1080/13562517.2018.1468319>

McLaughlin, C.J. & Sillence, E. (2023). Buffering against academic loneliness: The benefits of social media-based peer support during postgraduate study. *Active Learning in Higher Education*, 24(1), pp.63–76. <https://doi.org/10.1177/1469787418799185>

OECD. (2023). OECD News Release, February 2023. Available from: <https://www.oecd.org/sdd/labour-stats/unemployment-rates-oecd-02-2023.pdf> [last accessed 21/07/23].

OECD. (2023a). A Long Winding Road: OECD economic outlook, June 2023. Available from: <https://www.oecd.org/economic-outlook/june-2023/> [last accessed 21/07/23].

Mazzarol, T. (2014). Growing and Sustaining Entrepreneurial Ecosystems: The Role of Regulation, Infrastructure and Financing. Small Enterprise Association of Australia and New Zealand (Seaanz), P. 17. Available from: https://Smallbusiness.Report/Resources/Whitepapers/28ea2090-9f50-4220-A098-A9435a2dbe20_licie.Pdf [last accessed 02/02/24].

Rust, C., O'Donovan, B. & Price, M. (2005). A social constructivist assessment process model: how the research literature shows us this could be best practice. *Assessment & Evaluation in Higher Education*, 30(3), pp.231–240. <https://doi.org/10.1080/02602930500063819>

Schwab, K. & Zahidi, S. (2020). The future of jobs report 2020. World Economic Forum, October 2020. https://www3.weforum.org/docs/WEF_Future_of_Jobs_2020.pdf. Accessed 14th February 2024.

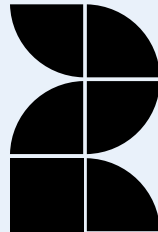
Sivarajah, U., Kamal, M.M., Irani, Z. & Weerakkody, V. (2017). Critical analysis of Big Data challenges and analytical methods. *Journal of business research*, 70, pp.263–286. <https://doi.org/10.1016/j.jbusres.2016.08.001>

Turel, O. & Kapoor, B. (2016). A Business Analytics Maturity Perspective on the Gap between Business Schools and Presumed Industry Needs. *Communications of the Association for Information Systems*, 39, pp–pp. <https://doi.org/10.17705/1CAIS.03906>

¹ <https://www.mheducation.com/highered/connect/smartbook.html>

² According to Kavanagh (2023), drawing on data from Gradireland and the Higher Education Authority (HEA), over 80% of 2019 graduates in Ireland were in “substantial employment” within their first year of graduation.

**Dana Schultchen, Audrey Stolze,
Sebastian Planck, Herbert Gillig**



CREATING RESPONSIBLE DEEP TECH INTRA- AND ENTREPRENEURS

ABSTRACT

The DeepDive Master's Programme represents a good practice example in forming responsible deep tech intrapreneurs and entrepreneurs in a flexible three-semester journey. Since 2019, the programme offers graduates an innovative degree that integrates responsible entrepreneurship, diversity, and technology to tackle real-life challenges. Deeply embedded in the thriving regional innovation ecosystem in Munich, the programme collaborates with industry leaders, fostering practical learning experiences. Through intensive entrepreneurship/intrapreneurship projects, it empowers students to combine tech-driven solution prototyping with responsible entrepreneurship to actively contribute to sustainable development goals. The holistic learning approach presented in this example combines the approaches of project-based learning, research, and theory in entrepreneurship and digitalization.

Key words: Academic Entrepreneurship, Higher Education, Digitalization



INTRODUCTION

Given the challenges and opportunities of the early 21st century, including climate change, digitalization, artificial intelligence, globalization and the intersectionality of these domains, there is a drive for individuals to possess a solution-oriented mindset, proactive abilities, goal-driven focus, self-efficacy, autonomy, optimism, and passion (Porter & Kramer, 2011). In recent decades many countries reformed their higher education systems, which affected the mission and governance of higher education institutions (HEIs). HEIs are now expected to produce entrepreneurial capital and to be catalysts for regional economic and societal development, taking on significant roles in entrepreneurial ecosystems. In these endeavours, internationalization, digital transformation, collaborative networks and co-creation processes are key drivers of the advancement of higher education and help guide HEIs and policymakers to frame decision-making agendas related to possible entrepreneurial pathways (Stolze & Sailer, 2021).

In this context, this chapter presents a good practice example of a project-based master's programme that addresses several dimensions of an innovative and entrepreneurial programme design. Launched in 2019 by Hochschule München University of Applied Sciences (HM) in collaboration with the Strascheg Center for Entrepreneurship (SCE), a non-profit organization responsible for spearheading HM's entrepreneurship initiatives, the DeepDive Master's Programme is an intensive full-time educational offering. It combines professional competencies in digital transformation with the cultivation of an entrepreneurial mindset through the practical exploration of digital and sustainable problems and solutions. This example highlights the programme's distinctive approach – its holistic learning experience that equips students to actively contribute to entrepreneurship, digital transformation and sustainability.

REGIONAL ECOSYSTEM CONTEXT

Munich has evolved as a thriving entrepreneurial ecosystem over recent decades, facilitated by excellent research institutions and technical universities that serve as a magnet for global talents and an incubator for academic entrepreneurship in collaboration with local industries.

As a dynamic hotbed of major corporations such as BMW, Allianz, and Siemens, alongside emerging unicorns like Celonis, Personio and Lilium and several emerging start-ups in diverse tech sectors, Bavaria's capital has been named "Isar Valley" in reference to Silicon Valley and is the 7th best-performing start-up ecosystem in Europe (Startup Genome, 2023).

In this ecosystem, SCE has played a pivotal role in fostering responsible and systemic innovation. Its leadership and openness to collaboration have led to numerous quadruple-helix initiatives, including the impact-oriented projects AI+ Munich (an incubator for AI startups that create a positive societal impact), the Social-Startup-Hub Bayern (an accelerator for social startups), Start for Future (an international alliance to foster responsible and systemic innovation), and the Social Entrepreneurship Akademie (a cross-institutional educational institution for social entrepreneurship). The synergy of entrepreneurship, collaboration and impact at SCE has enabled the development of the DeepDive Master's Programme and positioned HM as the best 'entrepreneurial university' in Germany in 2022.

DEEPDIVE MASTER'S PROGRAMME 'ENTREPRENEURSHIP AND DIGITAL TRANSFORMATION'

The DeepDive Master's Programme was co-created by HM/SCE leaders and different relevant stakeholders (e.g. professors, department deans, and industrial and technology partners). The Co-creation process included individual meetings and a workshop to formulate the requirements and guidelines for future training in the field of Entrepreneurship and Digitalization. The resulting outcome, after several feedback loops, was summarised in a grant proposal that provided funding to develop the programme. Figure 1, provides an overview of the programme.



Overview	
Degree	M.A. Entrepreneurship & Digital Transformation
Course Type	Master
Duration	18 Months (90 ECTS)
Language of Instruction	English

Figure 1. Overview of the DeepDive Master's programme
"Entrepreneurship and Digital Transformation"

This full-time degree programme, delivered in English, was launched in 2019, with a strong interdisciplinary approach, evident in the involvement of seven different departments:

- Department of Mechanical, Automotive and Aeronautical Engineering
- Department of Technical Systems, Processes and Communication
- Department of Computer Science and Mathematics
- Department of Engineering and Management
- Department of Business Administration
- Department of Design
- Department of Tourism

The programme supports learners to develop a holistic set of competencies to drive systemic innovations, based on SCE's approach of 'dynamic innovation'. By combining entrepreneurship competencies with personal and team competencies, learners develop projects that go beyond a mere design thinking process. The competencies developed are based on the European Competencies Frameworks for Entrepreneurship (EntreComp), digitalization (DigiComp) and sustainability (GreenComp). Following a project-based learning

philosophy, the programme blends theoretical knowledge with practical application, preparing students to actively contribute to societal change, address challenges, and thrive in the dynamic landscape of entrepreneurship and digital transformation (Stolze et al., 2018). The programme's primary objectives include cultivating a growth mindset, fostering systemic and innovative thinking, and nurturing the ability to operate effectively in an international and interdisciplinary environment. Commitment to a holistic learning experience adheres to the philosophy of learning about, through, and for entrepreneurship. This entails striking a balance between theoretical knowledge dissemination through lectures (about) and hands-on project work (through) to equip learners with the skills needed to develop both profitable and sustainable digital business models and processes. The approach to learning for entrepreneurship indicates graduation in the master's programme and the opportunity to move forward to SCE's start-up support programmes.

The master's degree requires three semesters and 90 ECTS for completion, including nine courses with a focus on a two-semester project as the centrepiece, as well as courses in entrepreneurship, digital technologies, business models, research, electives, and the master's thesis (Figure 2). The first semester of the project component places emphasises the innovation process, incorporating dynamic innovation, systems thinking, design thinking, lean-start-up methodologies and the integration of SDGs into their projects. In the second semester of the project, lectures focus on business approaches, such as feasibility analyses, testing and iterating of business models, creating sales and marketing strategies, developing a financial plan as well as finding strategic partners. As an additional learning intervention, learners create a reflective journal to present their learning journey during the course. Neck and Green (2011) emphasizes the importance of such reflections for deeper understanding, learning and strengthening the link between theory and praxis. The completion of the lectures on entrepreneurship (Entrepreneurship I and Entrepreneurship II) and digital transformation (Digital Technologies and Digital Business Models) prepares learners to navigate real-world challenges through intensive in-class discussions, case studies and guest speakers from the ecosystem.

1st semester	Project I 15 ECTS	Entrepreneurship I 5 ECTS	Digital Technologies 5 ECTS	Research Methods 5 ECTS
2nd semester	Project II 15 ECTS	Entrepreneurship II 5 ECTS	Digital Business Models 5 ECTS	Elective Course I 5 ECTS
3rd semester	Master Thesis 25 ECTS			Elective Course II 5 ECTS
	Total			90 ECTS

Figure 2. DeepDive Master programme “Entrepreneurship and Digital Transformation” curriculum overview

Startup	XTRPY GmbH Lifesiten	Gutfeel GmbH	Gastimate Technologies GmbH, GasVisor
Founders	Michaela Stauch & Lucas Egglseder	Dominik Grauer, Marius Greubel	David Firmin, Maximilian Betz, David Bassil, Jesus Sandoval, Tobias Braun
Industry/Vertical	MedTech / IoT	ResearchTech, Market Research	IoT, Gastronomy, Hospitality, F&B Industry, Gases, Smart City
Product/Services	Lifesiten is automatic fall-detection smart jewellery that sends real-time alerts to personalized emergency contacts. It is a stand-alone product that utilizes LoRaWAN, an IoT network, to ensure reliable communication independent of location. Our product is indistinguishable from classical and aesthetical jewellery, with the high-tech packaged inside.	gutfeel is a mobile app market research solution that enables B2C companies to quickly, easily and cost-effectively generate market feedback from Generation Z. Companies and brands can independently create digital surveys via the gutfeel platform using modular, innovative survey methods as well as analyse the results in real-time.	GasVisor is an advanced IoT solution that optimizes CO2 gas cylinder management for businesses. Utilising IoT sensors and a React Native platform, it streamlines the monitoring and reordering process, saving time and resources. This user-friendly app minimizes operational disruptions, enhances satisfaction, and reduces costs by providing real-time data on gas cylinder fill levels for predictive planning and efficient replenishment. Additionally, GasVisor contributes to a lower carbon footprint by optimizing gas usage, making it a practical and sustainable solution for businesses.
Impact	In Germany, 17,130 fall-related deaths occurred in 2020. Experiencing a "long lie event" after a fall increases the likelihood of death within six months by 50%. Deaths from falls may be underestimated, affecting statistics. Our team has witnessed such events, highlighting the trauma and avoidable consequences. Falls cost Germany's healthcare system about €3 billion annually, with individual fall costs at €7,500. Lifesiten aims to detect 1.16 million falls in the next five years, reducing both monetary and health impacts for individuals and the healthcare system.	A significant portion of the commissioning companies' funds goes towards community incentivization and is eventually donated to social projects. In collaboration with SOS Kinderdörfer weltweit and Stadtwerke München, the company focuses on SDGs "No poverty", "Zero hunger", "Good health and well-being" and "Climate action", generating social value with every gutfeel survey. Promoting market research in early product stages saves resources, reduces energy costs, and minimizes packaging waste, aligning with SDGs 9 and 12 for sustainable industry innovation.	GasVisor has a multifaceted impact across various domains. Societally, it enhances user experience by simplifying gas cylinder management, boosting workplace satisfaction. Economically, it drives cost savings by optimizing gas usage and eliminating manual processes. Environmentally, it reduces carbon emissions and minimizes resource wastage by efficiently managing cylinder refills. In summary, GasVisor improves convenience, ensures cost-efficiency, lowers carbon emissions, and minimizes resource wastage, addressing societal and environmental concerns.

Table 1. DeepDive Master programmeme "Entrepreneurship and Digital Transformation" launched Start-up examples

The flexible learning journey can also be individualized through a range of elective courses from all seven departments participating in the programme (see list above). Most learners choose courses focusing on UX/UI Design, strategic business simulation, leadership, product management, technical sales, cloud technology, AI and sustainability. This multidisciplinary approach ensures that learners can tailor their education according to their own unique interests and career aspirations.

The ability to choose a topic for an intrapreneurship or entrepreneurship team project (Project I and Project II, 30 ECTS) enriches the learners' flexible learning journey. Learners are challenged to form international and interdisciplinary start-up teams or collaboratively innovate with corporate partners, mentored by a HM professor and a SCE start-up coach. Since its launch, the programme has had five cohorts with a total of 26 projects, 14 of which have been transformed into start-up projects. Three start-up teams have been incorporated and are active in the market (see Table 1). In recent years, the different project teams have primarily concentrated their efforts on addressing a range of Sustainable Development Goals (SDGs), including SDG #1 (No Poverty), SDG #2 (Zero Hunger), SDG #3 (Good Health and Well-being), SDG #4 (Quality Education), SDG #7 (Affordable and Clean Energy), SDG #8 (Decent Work and Economic Growth), SDG #9 (Industry, Innovation, and Infrastructure), SDG #11 (Sustainable Cities and Communities), SDG #12 (Responsible Consumption and Production), and SDG #13 (Climate Action).

While start-up projects are 'open-topic', from 2022 the programme emphasizes the specific topic of mobility through a partnership with EIT Urban Mobility. Over the past two years, four entrepreneurship projects have addressed mobility challenges such as enhancing public transport for disabled individuals, envisioning the future of mobility, or creating an online platform for EV charging-station searches, focusing on SDG #7 (Affordable and Clean

Energy) and #11 (Sustainable Cities and Communities). These teams receive valuable access to EIT's experts and leveraged their network.

Twelve project teams pursuing intrapreneurship topics collaborated with corporate partners to gain insights on real-world intrapreneurial challenges. Among these, three sustainable intrapreneurship projects are highlighted:

- **KUKA:** Students created a Virtual Innovation Lab (i-Lab), an online platform designed to enhance the accessibility and feasibility of automation for SMEs.
- **Fresenius Medical Care:** Proposed a challenge to tackle chronic kidney disease (CKD), for which students developed a 'KidneyTrack,' a Web Application (WebApp), empowering individuals in the early stages of CKD while streamlining patient monitoring for healthcare professionals.
- **Zeiss:** Striving for a sustainable future, learners are currently developing a business transformation approach from within, in order to motivate employees for active engagement in Biodiversity initiatives.

Through extensive networking opportunities, collaborations, and project-based work with corporate partners, the integration of SDG #9 (Industry, Innovation, and Infrastructure) is addressed.

In summary, the DeepDive Master's Programme "learning by doing" approach facilitates the seamless application of knowledge gained in lectures to real-world projects. By merging theoretical understanding with practical experience, learners are better prepared to thrive in the dynamic landscape of entrepreneurship and digital transformation. Hence, since its launch, the programme has attracted growing interest from German and international students. This upward trend is evident in the application numbers, which surged from 173 in 2019 to 416 in 2023. Moreover, the programme witnessed an increase in enrolled students starting their project-based master's journey, from 25 in 2019 to 38 in 2023 (Figure 1). However, it is important to note that enrolment status is subject to various factors. One

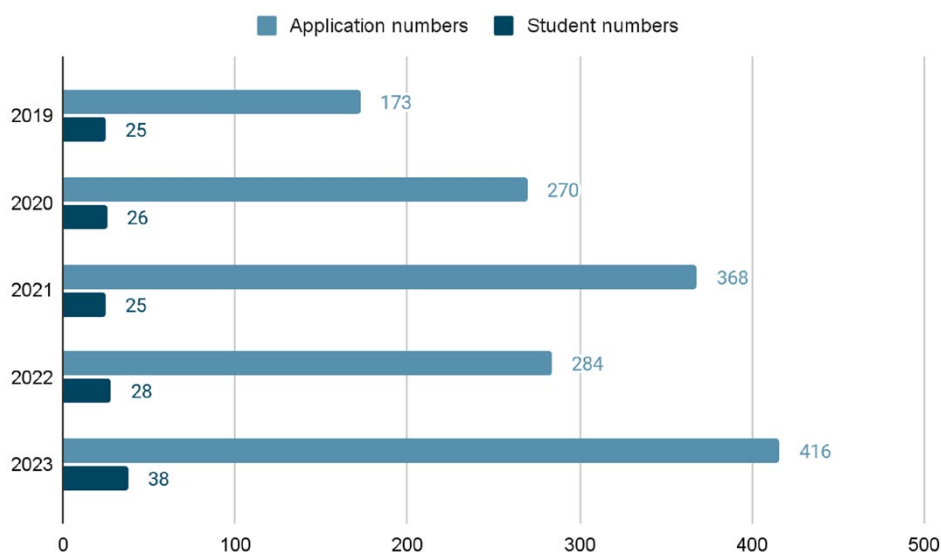


Figure 3. DeepDive Master programme "Entrepreneurship and Digital Transformation" application and student (2019–2023)

such essential factor is the visa process, which may result in delays for some international students, potentially affecting our ability to secure the enrolment process.

Moreover, learner diversity is a key programme characteristic, with participants hailing from various educational backgrounds: Business, engineering, computer science, architecture, design, management, psychology, media, social innovation, law and aerospace engineering. Cultural diversity further enriches the learning experience: In 2023, cohort #4 comprised individuals from 16 different nationalities, and in 2024, cohort #5 maintained a diverse representation with participants from 10 nationalities. Another characteristic of the programme is the balanced gender ratio with 14 men and 14 women in 2023 and 20 men and 18 women in 2024.

Learners' reflections on their experience with the programme prove its innovational feature:



"This programme offers a strong learning enrichment through hands-on experience and coaching by experts in business creation and digital technologies. The growing digital potentials for companies are analysed in this Master's programme to develop appropriate solutions and business models that will enrich society in the future. This Master's programme promotes personality, leadership, creativity and the ability to work in a team and thus perfectly prepares students to enter the professional world as entrepreneurs or intrapreneurs." – Learner from Germany, 2021

"The DeepDive Master's Programme is an innovative master's project for self-starters. Exactly the opposite of the classical and old-fashioned learning methods. This way of education is desperately needed in our society to support the hands-on mentality and start-up enthusiasts. Individuals are formed with a wide range of soft- and hard skills. This is a perfect programme for open-minded personalities who swim against the stream." – Learner from Mexico, 2021

"I stumbled on the master's course Entrepreneurship and Digital Transformation almost by accident and, after gathering more information on the course, I knew it was the right choice for me. I had done my Bachelor's in Business Administration in Italy and I wanted to change from a theoretical approach to a hands-on, practical approach. I wanted a place to train and nurture my entrepreneurial spirit. Looking back, I believe I made the right choice. Besides the content of the lectures, the course helped me establish invaluable connections, both on a personal and a professional level. I am extremely grateful for this course and can recommend it to anyone who wishes to learn more about entrepreneurship, grow their network, have fun with an amazing group of people and start their own business." – Learner from Italy, 2022

"The DeepDive Master's is one of the most memorable programmes that helped me so much with my career. I was able to make valuable connections with people who are part of the SCE and Munich startup

scene and who are all working hard to make their dreams come true. I cannot wait to continue my studies in this programme and meet new people to bootstrap my dream business!” – Learner from South Korea, 2022

“You get the chance to learn something new, develop new skills and immediately apply them to your real-life project. In this programme, you will challenge yourself and you will find something you are truly passionate about.” – Learner from Germany, 2023

“The Master’s Programme enabled me to expand my two passion topics – innovation and sustainability – through the conveyed knowledge about digital technologies and trends, as well as future-oriented business models.” – Learner from USA, 2023

IMPACT

The DeepDive Master programme’s impact, understood as the beneficial outcomes resulting from the prosocial behaviour of participants and the ecosystem (Rawhouser et al., 2019), ranges from forming invaluable connections for aspiring entrepreneurs and intrapreneurs to developing skills and competencies applicable to real-life projects. While the main target group of the programme is international learners seeking to enter the entrepreneurial space, the number of start-ups and intrapreneurial projects launched within and through the programme represent its first indicator of success. Moreover, through its inter- and transdisciplinary approach, enabled by the collaboration of seven academic departments, the programme also has a positive institutional impact at HM, creating a cross-sectoral degree benchmark that transcends traditional disciplinary education silos.

The strong collaboration and co-creation with industry partners and European partners like EIT Urban Mobility also create an impact in the ecosystem, by co-creatively developing relevant solutions to stakeholder challenges. Through intrapreneurship projects with partner companies, learners develop innovative solutions to real-world challenges faced by corporations, fostering a culture of innovation within these organizations that helps them stay competitive in their respective markets. Moreover, the partnership with EIT Urban Mobility lets learners address urban challenges that contribute to creating sustainable solutions for cities and communities, including innovations in mobility, technology, and sustainable business practices.

The DeepDive Master’s Programme’s focus on sustainability principles and responsible entrepreneurship encourages learners to consider the social and environmental impact of their innovations. Graduates may develop solutions to pressing global challenges, such as climate change, healthcare access, and social inequality (see examples presented in Table 1). Regarding the SDGs Framework, the programme mainly addresses SDG #4 Quality Education (Relevant skills for decent work – target 4.4. and Education for sustainable development and global citizenship – target 4.7.) and SDG #8 Decent Work and Economic Growth (especially targets on sustaining per capita economic growth and achieving higher levels of economic productivity through diversification, technological upgrading and innovation – targets 8.1 and 8.2).

By integrating the SDGs framework more prominently throughout the programme, our goal is to enhance the societal impact of our graduates. Through exemplary projects

addressing mobility or food waste challenges combined with sustainability initiatives, the DeepDive Master's Programme contributes directly to the advancement of SDGs.

KEY LEARNINGS



The DeepDive Master's programme offers a great possibility to earn a master's degree, found a start-up or contribute to a business solution for a corporate partner and continue one's career in this company.

—

The challenge of integrating many faculties is worth the effort because it results in a degree programme that integrates diverse disciplines and perspectives.

—

Project sessions benefit from the expertise of the coach, method sessions and lecture input.

—

Students are supported by coaches, but also focus on personal growth and mentoring.

—

A flexible learning journey contributed to an increase in professional expertise and personal interest for learners.

—

We had to include sessions with a focus on intercultural competence to improve international and interdisciplinary teamwork.

—

Focusing on responsible entrepreneurship and deep tech allows learners to experience what it is like to make an impact on society while contributing to the SDGs in their projects.

CONCLUSIONS

In conclusion, the DeepDive Master's programme emerges as an example of innovative pedagogy and practical application in the realm of responsible entrepreneurship and digital transformation. Through its dynamic blend of academic rigour and hands-on learning experience, the programme equips learners with the skills and mindset necessary to thrive in today's complex and rapidly changing landscape. The focus is on interdisciplinary collaboration, internationalization, and sustainability principles that not only prepare learners for success in the entrepreneurial ecosystem but also position them as agents of positive change in society. This programme demonstrates the transformative potential of

education in shaping the future of entrepreneurship and innovation. This is evident through its increasing enrollment and the meaningful ventures launched by its graduates.

AUTHOR BIOS

Dr. Dana Schultchen is the Programme Lead for the DeepDive Master's programme 'Entrepreneurship and Digital Transformation' at the Hochschule München University of Applied Sciences, focusing on the three main areas of education, coaching, and internationalization. (dana.schultchen@sce.de)

Dr. Audrey Stolze is Strasczeg Center for Entrepreneurship Education's Department Head. Her research focuses on academic entrepreneurship, entrepreneurship education and third-mission advancement in higher education. (audrey.stolze@sce.de)

Dr. Sebastian Planck is the Head of Research at Strasczeg Center for Entrepreneurship. He focuses on social and sustainable entrepreneurship and its education, futuring and systems thinking in his research. (sebastian.planck@sce.de)

Professor Dr. Herbert Gillig is Professor of Entrepreneurship and New Venture Creation at the School of Engineering & Management of Hochschule München University of Applied Sciences. He is the academic head of the DeepDive Master's programme. (herbert.gillig@hm.edu)

References

Embry E., Jones J., York J. (2019). Climate change and entrepreneurship. In George G., Baker T., Tracey P., Joshi H. (Eds.), *Handbook of inclusive innovation: The role of organizations, markets, and communities in social innovation* (pp. 377–393). Edward Elgar.

Kirkwood, J., Dwyer, K., & Gray, B. (2014). Students' reflections on the value of an entrepreneurship education. *The International Journal of Management Education*, 12(3), 307–316.

Lundmark, E., Tayar, M., Qin, K., & Bilsland, C. (2019). Does reflection help students to develop entrepreneurial capabilities? *Journal of Small Business Management*, 57(3), 1157–1171.

Neck, H. M., & Greene, P. G. (2011). Entrepreneurship education: known worlds and new frontiers. *Journal of small business management*, 49(1), 55–70.

Porter, M. E., & Kramer, M. R. (2011). Creating Shared Value – How to reinvent capitalism – and unleash a wave of innovation and growth. *Harvard Business Review*, January–February 2011, 1e17.

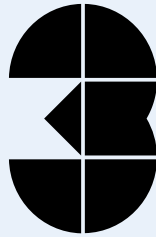
Rawhouser, H., Cummings, M., & Newbert, S. L. (2019). Social impact measurement: Current approaches and future directions for social entrepreneurship research. *Entrepreneurship theory and practice*, 43(1), 82–115.

Startup Genome. *The Global Start Ecosystem Report 2023*. Accessed on 29.02.2024. Retrieved from <https://startupgenome.com/report/gser2023>

Stolze, A., Sailer, K., & Gillig, H. (2018). Entrepreneurial mindset as a driver for digital transformation – A novel educational approach from university-industry interactions. In *Proceedings of the European Conference on Innovation and Entrepreneurship, ECIE* (pp. 806–813). Aveiro, Portugal.

Stolze, A., & Sailer, K. (2021). An international foresight reflection on entrepreneurial pathways for higher education institutions. *Industry and Higher Education*, 35(6), 700–712. <https://doi.org/10.1177/0950422220981814>

¹ Besides conventional metrics such as numbers of start-ups founded, the ranking also includes educational and sustainability metrics into its scoring (Stifterverband, 2022).



STARTING FROM SCRATCH: THE ENTREPRENEURSHIP AND INNOVATIVENESS DOCTORAL PROGRAMME AT J.J. STROSSMAYER UNIVERSITY IN OSIJEK, CROATIA¹

ABSTRACT

The ENTREPRENEURSHIP AND INNOVATIVENESS Doctoral Programme at the J.J. Strossmayer University in Osijek, Croatia, is a good example of how theory and praxis feed each other. In the absence of the necessary resources (e.g., knowledge, money, a supportive university organizational culture), a small group of the university's researchers asked themselves 'what can I/we do?' in an economically impoverished region, one devastated by war and corrupted by the transition from a Yugoslav economic and political system to a full market economy and pluralistic democratic political system. The theoretical concepts of non-linearity, effectuation, and subsidiarity helped shape the establishment of the doctoral programme, ensuring it was strongly embedded in researching the entrepreneurial behaviour of individuals and institutions, and reflective of the nature of entrepreneurship education, and collaboration among Quintuple Helix actors. The findings from this case demonstrate the soundness of these theoretical concepts.

Key words: Entrepreneurship education, Doctoral programme, Innovativeness, Entrepreneurship ecosystem, Quintuple Helix collaboration



INTRODUCTION

At the beginning of 1990s, Croatia faced two major challenges simultaneously: A changing political and economic system, and war. One of these challenges required society's knowledge and commitment, both required a balance between dealing with immediate issues and building a new institutional structure and a societal/political culture. A small team of researchers and educators from the Josip Juraj (J.J.) Strossmayer University in Osijek (University of Osijek) firmly believed that the starting point for any challenge is education; if the context has been changed, then the solution cannot be 'business as usual.' The idea emerged to use education as a tool for building proactiveness, innovativeness and responsibility (entrepreneurial competence) to deal with such mega changes at the individual and institutional level. This resulted in the introduction of educational programmes in entrepreneurship (a master's degree programme, 2000; an undergraduate programme, 2005), to equip learners with entrepreneurial competence. The interdisciplinary, interuniversity Doctoral programme ENTREPRENEURSHIP AND INNOVATIVENESS, the result of a joint project of five universities, was introduced in 2010 and is now internationally recognized.

BACKGROUND

An explanation of the Croatian context is critical to understanding how the ENTREPRENEURSHIP AND INNOVATIVENESS Doctoral programme at the University of Osijek was developed.

Croatia was granted its political statehood in 1991 following the breakup of Yugoslavia. It faced the myriad challenges associated with building the new institutional infrastructure necessary for transitioning from the Yugoslav political and economic system to a pluralistic democratic political system and full market economy. The institutional economic framework of the former Yugoslavia was based on two major concepts: Social² and state ownership over economic resources and workers' self-management (the right of all employed persons to participate in strategic decision-making processes). Despite the mixed economic structure (ownership: state, social, private; size of businesses: big, medium, small) public attention (especially in relation to different government policies on research, education, taxation) was predominantly focused on state/socially owned big businesses. The 1990s were characterized by either war (1991–1995) or a state of neither war nor peace (1996–1998), when the occupied part of eastern Croatia, in which the University of Osijek is located, was under UN administration (see Figure 1). Significant devastation was caused by the war, both in human (killed, wounded and missing people³, mistrust, unemployment, poverty) and material resources terms (infrastructure, business facilities, homes, mined areas).

The university directly experienced the consequences of war. The 1991/1992 academic year was cancelled, 24 students and five lecturers lost their lives, and many university facilities were shelled and devastated. This context broadened the gap between the problems and how to solve them. A group of researchers and teachers at the University of Osijek found themselves grappling with Etzioni's (1968) ethical question about commitment and integrity in individual and collective actions. The decade of surviving (1990s) pushed the team towards the question 'what can I/we do? Their response was to try to change themselves and their surroundings within their own university, and within the region devastated by the war, through social and economic development. Despite many of the university's activities being suspended⁴ or changed, this small group of people was constantly monitoring education outside of Croatia – in countries with successful market economies. They observed a significant growth in entrepreneurship programmes at American universities

and this led them to ask: 'If Americans need to be educated in entrepreneurship, what about us?' Searching for answers to this question helped them design their own approach – one that aimed to bring the devastated region of eastern Croatia, once the richest in former Yugoslavia, back to growth and prosperity. Their approach involved very ambitious mutually intertwined activities to develop the necessary human resources, establishing their own entrepreneurship ecosystem, by introducing the concept of Quintuple Helix collaboration.

REGIONAL ECOSYSTEM CONTEXT

The University of Osijek was founded in 1975⁵ as a public university, and it acts as a regional centre of knowledge through research and education activities. In 2024 it offers 162 study programmes for bachelor's, master's and PhD degrees in economics, law, philosophy, education, medicine, agriculture, food technology, mathematics, civil engineering, electrical engineering, mechanical engineering, chemistry, physics and arts. There are several doctoral studies within interdisciplinary fields, including entrepreneurship and innovativeness. University of Osijek serves around 16,000 students in 18 educational units (2024).

Researchers and educators from the University of Osijek were pioneering research and education in entrepreneurship nationally that was internationally recognized: In 2008, UNESCO awarded the University of Osijek with the UNESCO Chair in Entrepreneurship Education, and in 2015, it was included among twenty European universities as a good example in entrepreneurship education (<http://www.sepHE.eu>). In 2021, the leading researcher from this group received the European Entrepreneurship Education Award from the Sten K. Johnson Centre for Entrepreneurship at Lund University, School of Economics and Management.

Location

The University of Osijek is located in the eastern part of Croatia, which borders with Bosnia and Herzegovina, Hungary and Serbia (around 40 kilometres from each border). From a broader regional perspective, Osijek's location is almost the same distance from Zagreb, capital of Croatia, as it is from Budapest, capital of Hungary; from Sarajevo, capital of Bosnia and Herzegovina and from Belgrade, capital of Serbia (see Figure 2).

Osijek is located in the biggest agricultural region in Croatia, which is enriched with three big rivers (Danube, Sava and Drava). The region is also rich in natural gas. Food, wood, metals and textiles were all traditional industries from the mid 19th century. At the beginning of the 21st century, the economic activities of the region are dominated by food (agriculture, food processing industry), ICT and tourism, and the role of the University of Osijek is crucial. The devastation of Croatia's economic structure as a result of corrupted privatization and the war from 1990s led eastern Croatia to be characterized by low competitiveness, lack of innovation capacity and the absence of an entrepreneurial culture. Eastern Croatia's unemployment rate (12.3%, 2022) is three times higher than Zagreb's (4.1%), and only half of their GDPpc (8,502 EUR vs. 16,070 EUR, in 2020). This situation required the development of an appropriate institutional infrastructure which could form Quintuple Helix collaborations (academia, business, government, civil society and planet). The small team of researchers at the University of Osijek started to work on developing this Quintuple Helix, creating strategic policy papers for the local government, educational programmes in entrepreneurship, training in entrepreneurship competence for small business owners/ unemployed, a business incubator, and an SMEs' think tank (see Table 1 – annex).

The Government of Croatia strategically decided in 1997 to give the former military barracks located in the city of Osijek to the university to build their new campus, which



Figure 1. Areas under UN protection 1992-1995 and the location of J.J. Strossmayer University in Osijek.
 Note: Sector East remained under UN protection from 1996–1998. Source: Croatia.eu Land and People (<https://www.croatia.eu/index.php/en/home-en/history/contemporary-croatia>), developed by the Miroslav Krlježa Institute of Lexicography.



Figure 2. Location of Osijek in Croatia and in the broader region

started in 2002 (see Figure 3). Today, in 2024, the new campus is up and running with several departments, student accommodation, a restaurant, and sports facilities.

The new campus has already contributed significantly to creating a new standard of learning and research. However, the challenge now for the university is to develop a new collaborative culture not only inside the university but also outside – within the Quintuple Helix framework.



Figure 3. J. J. Strossmayer University in Osijek, Campus –
Faculty of Agrobiotechnical Sciences

THE ENTREPRENEURSHIP AND INNOVATIVENESS DOCTORAL PROGRAMME

The University of Osijek was founded in 1975 as a public university, and it acts as a regional centre of knowledge through research and education activities. In 2024 it offers 162 study programmes for bachelor's, master's and PhD degrees in economics, law, philosophy, education, medicine, agriculture, food technology, mathematics, civil engineering, electrical engineering, mechanical engineering, chemistry, physics and arts. There are several doctoral studies within interdisciplinary fields, including entrepreneurship and innovativeness. University of Osijek serves around 16,000 students in 18 educational units (2024).

Origins

The ENTREPRENEURSHIP AND INNOVATIVENESS doctoral programme is a product of the EU-funded TEMPUS project (2007–2009), led by the Turku School of Economics, Finland. Project partners included the University of Osijek, Croatia (a beneficiary institution and programme host); Durham Business School, UK; University of Maribor, Slovenia and University of Klagenfurt, Austria.⁶ However, the doctoral programme was not the University's first attempt to develop entrepreneurship education; rather, the first efforts were in 1989, when an undergraduate specialization in entrepreneurship, parallel to management and marketing, was introduced at the Faculty of Economics. The changed economic and political system following the break-up of Yugoslavia led to educational curricula changes, mostly the elimination and renaming of courses that were based on the principles of workers' self-management, the role of state and the social ownership of businesses. Surprisingly, entrepreneurship programmes were abandoned.

Ten years later, in 2000, the master's degree programme in entrepreneurship was introduced (following a two-year approval process by the Ministry of Science and Education).⁷ Behind this project, supported by Professor Allan Gibb from Durham Business School, was a small team of researchers/educators who had some experience in researching entrepreneurship as well as training small business owners and the unemployed in self-employment.

Given that the university had no entrepreneurship education programme, no serious research base, and no educators, the decision to start with a master's degree programme was not taken lightly. There was no existing capability to deliver entrepreneurship courses at undergraduate level, and no research base for a doctoral programme. The master's programme seemed the quickest way for the university to develop its capacity for researching and teaching entrepreneurship. It was expected that some of the programme's graduates would be interested in research, and that these could constitute potential candidates for a doctoral programme. Accordingly, this was how the team created candidates for a doctoral programme that it introduced ten years later in 2010.

The university's organisational structure and culture were designed around developing local capacity through an international network of researchers and educators. Different approaches were employed, like shadowing international experts who were participating in the master's degree programme, working on their own doctoral thesis with external mentors, and participating in training events around the world, mostly in Europe (e.g. Durham Business School; a train-the-trainer programme organized by the European Foundation for Entrepreneurship Research and funded by Bert Twaalfhoven; programmes for doctoral students – Gate2Growth Academic Network Doctoral Track, 2004–2006) and in the United States (Harvard Business School, Syracuse University, St Louis University, Babson College, University of Wisconsin). At the same time, the programme hosted experts in learning methods (e.g., case method, team teaching, project-based learning, drama)⁸. These activities were financially supported by the Open Society Institute.

The ten years between the start of the master's programme in 2000 and the introduction of the doctoral programme in 2010 were also characterized with intensive annual research in the field of entrepreneurship (Global Entrepreneurship Monitor (GEM), from 2002), significant regional development and changes in the role of universities. GEM data enabled further comparative research into the various trends and patterns emerging in entrepreneurship. This research was offered to doctoral students as a valuable scholarly resource.

Based on research into the entrepreneurship phenomenon, working closely with Allan Gibb and consulting with global experts⁹, the doctoral programme was designed around the broad definitions of entrepreneurship as a lifelong competence. This competence provided people with the ability to be proactive, innovative in defining and solving problems, and responsible for their own choices, always in interaction with their context (Stevenson & Jarillo, 1991; Stevenson, 2004; Gibb, 2002, 2007; Sarasvathy & Venkataraman, 2011). This concurs with the accepted EU definition that "Entrepreneurship is when you act upon opportunities and ideas and transform them into value for others. The value that is created can be financial, cultural, or social" (Bacigalupo et al., 2016).

Programme structure

The ENTREPRENEURSHIP AND INNOVATIVENESS doctoral programme is designed to fulfil expectations of crossing the boundaries of disciplines by challenging assumptions and connecting unconnected pieces of knowledge.

In achieving this goal, all participants should be able to co-create an entrepreneurial learning experience with a focus upon: Futures (the doctoral concept deconstructed in the context of university/society change); Relevance (to society and stakeholder problems and opportunities); Multi-disciplinarity (working across the established bodies of knowledge); Experiential Learning (valuing tacit knowledge and heuristic models); Cultures and Meanings (global challenges and meanings in different cultures); Philosophy of Practice and Entrepreneurial Personal Development. Trying to teach entrepreneurship using

traditional methods was like learning to drive using the rear mirror (<https://www.ices.hr/en/doctoral-program/website>, Brochure, Allan Gibb, 2018). This was the reason why these new perspectives were needed.

The three year programme is divided into class activities, research activities and teaching/publishing activities, structured around:

- Theoretical foundations of entrepreneurship and innovativeness
- Methodology of entrepreneurship research
- Three research focuses: Technopreneurship; effectuation, learning organization and human resources; entrepreneurial finances.

Examples of defended doctoral thesis show the diversity of research interests covering different aspects of societal issues:

- Effectuation and development of entrepreneurial intentions, Marina Jeger, 2013
- Establishment of an effective model of distinct heating in the Republic of Croatia and energy poverty, Dalibor Pudić, 2015
- Entrepreneurial Competencies in Creative and Cultural Industries, Sonja Bračun, 2020
- Energy efficiency as support for managing buildings in the public sector, Adela Has, 2022
- Modelling innovativeness of an enterprise using intelligent data analytics, Marko Martinović, 2022
- A stakeholder perspective on entrepreneurial performance and success, Charles Richard Plant, 2022

Due to the increased number of international students and the impact of COVID-19, in 2020 the doctoral programme switched to online communication between lecturers, mentors and students. The programme has been delivered in the English language from the outset.

From an organizational perspective, the programme is positioned within the International Centre for Entrepreneurial Studies under the leadership of the UNESCO Chair in Entrepreneurship Education. This ensures interdisciplinarity. The signed agreement between universities which participated in developing the programme allows the mobility of doctoral students across the doctoral programmes of those universities, without them having to pay additional fees. The programme is governed by its Council, which oversees all strategic and organizational processes related to enrolments, lecturing, mentoring and research activities. For more detailed insights into the programme structure, see: <https://www.ices.hr/en/doctoral-program/>

Interdisciplinarity and internationalisation

The ENTREPRENEURSHIP AND INNOVATIVENESS doctoral programme was structured around interdisciplinarity, connecting knowledge from psychology, sociology, economics, and engineering to contribute to the personal development of doctoral students. Such an approach requires an understanding of the different perspectives of different sets of knowledge (disciplines), transdisciplinarity, and the ability to identify linkages – a departure from fragmented knowledge toward integrated, relevant knowledge. The programme has also been internationally focused in terms of both students (Austria, Bosnia and Herzegovina, Canada, China, Germany, Ghana, Greece, Kosovo, Nigeria, Oman, Pakistan, Spain, Switzerland, U.S.A.) and researchers (Finland, the Netherlands, Slovenia, U.S.A.). It is fee-based and includes part-time students from academia, business, and the public sector. From its inception, it has been highly inclusive, targeting individuals with different educational

backgrounds, including social sciences, humanistic sciences, engineering, biosciences, arts.

Testimonials

The following testimonials are from researchers who participated in the design of the programme or joined the programme at a later stage. These testimonials describe the approach used in building the ENTREPRENEURSHIP AND INNOVATIVENESS doctoral programme, including its conceptual framework, research methods, expected outcomes and impact):

 **ANTTI** – *“Entrepreneurship is the key driver for job creation, innovation and economic growth. This programme challenges the students to become top level international academic experts in a challenging entrepreneurial learning environment” – Antti Paasio, University of Turku, Finland*

 **JEROME** – *“With over 180 English-language refereed journals in Entrepreneurship and related fields (<https://bit.ly/eweb-journals>) the opportunities and responsibilities for entrepreneurship research have never been greater. PhDs in Entrepreneurship are the key drivers of this effort to develop policies and theories that will shape Entrepreneurship’s contribution to the world. Program’s like J.J. Strossmayer’s lead this effort, concentrating top-level worldwide experts and resources in a programme that is accessible to all” – Jerome Katz, Robert H. Brockhaus Endowed Chair in Entrepreneurship, Department of Management, Chaifetz School of Business, Saint Louis University, USA*

 **SARAS** – *“Entrepreneurship is the engine of growth in all economies. Furthermore, it is increasingly a method to tackle big problems such as climate change, migration and poverty. Good entrepreneurship can and should tackle all kinds of problems in ways that are both financially and socially sustaining. Therefore, we need to not only teach entrepreneurship to everyone in the same we teach science, but we need to invest in training educators. Research, especially cross-disciplinary and cross-border research, is key to developing deeper understanding as well as creating relevant and engaging educational experiences in entrepreneurship. A doctoral programme such as ENTREPRENEURSHIP AND INNOVATIVENESS is crucial to this endeavor. Incorporating DREAM (Designing Research in Entrepreneurship As Method) is an important and inspiring part of this programme” – Saras Sarasvathy, Paul M. Hamaker Professor of Business Administration, University of Virginia, The Darden School of Business, U.S.A.*

And, some doctoral students’ comments:

 **MIA** – *“This interdisciplinary doctoral study was my preference because staying in merely one lane in the 21st century results in missing out on the abundance of accessible yet unexplored information. The study provides multidisciplinary approaches to contemporary issues combining*

entrepreneurship with innovation, and a chance to soak the knowledge and learn from many renowned experienced international educators.”
Mia Hocenski, Croatia

 **MARTA PATRICIA** — *“The programme provides tools not only for research, but also for my life. I am now immersed in a professional transformation towards excellence, rigour, and relevance. I am proud to experience how this study is opening my mind towards new perspectives and a variety of cognitive tools.”*– Marta Patricia Aparicio, Spain

 **VLAD** — *“My motive to enrol at my age (just celebrated my 71st birthday) in the doctoral study ENTREPRENEURSHIP AND INNOVATIVENESS is my wish to write the doctoral thesis with the topic “Economic Beneficence of the Third Age Generation” and send a written message to anyone who wants to know more about significance of the well-being and contribution of the third age generation to economic development through working with younger generations.”* – Vlad Veckie, Canada

IMPACT

The ENTREPRENEURSHIP AND INNOVATIVENESS doctoral programme was not designed to be isolated in an academic bubble; rather, it was intended to be inclusive and develop its own entrepreneurial ecosystem. Therefore, impact cannot be measured merely by the number of enrolled students, nor by the number of people who defended their thesis.

The most important impact measures of the programme include the following:

- The programme’s sustainability (it has been operating since 2010)
- Increased number of international students (from zero in 2010 to 60 percent of the enrolled annual quota of 10 students in 2024)
- A stable cohort of international staff (lecturers, mentors)
- Several students who have successfully defended their PhD thesis are employed in other HEIs, strengthening their entrepreneurial learning capacity across Croatia and internationally

A Quintuple Helix collaborative ecosystem emerged, with some involving activities/actors that developed out of an immediate necessity:

- Academia: The University of Osijek is now recognized as a leading institution not only in Croatia but internationally for entrepreneurship education; inclusion in the Global Entrepreneurship Monitor (GEM) (2002); establishment of the UNESCO Chair in Entrepreneurship Education (2008); establishment of the International Centre for Entrepreneurial Studies (2010)
- Government: Collaboration with government in providing research reports on entrepreneurship for designing research-based policies (since 2002);
- Business: Establishment of the microfinance institution NOA (1996); collaboration with innovative businesses
- Civil society: Establishment of the Centre for Entrepreneurship (1997); establishment of the SMEs and Entrepreneurship Policy Centre (2000)
- Planet: The programme explicitly emphasizes the need to localize the UN SDGs through both teaching and research (since 2022)

KEY LEARNINGS



Several key learnings have emerged from our experience of the ENTREPRENEURSHIP AND INNOVATIVENESS doctoral programme. Collectively, these learnings provide evidence of specific programme components that are still valid today, ones that should be abandoned, others that require redesigning and those that necessitate an entirely new approach.

What is still valid – The doctoral programme’s conceptual framework was based originally on interdisciplinarity and a positioning within the Quintuple Helix collaborative model. Both these components are still valid. These components will be further informed by the global debate on the recalibration of the PhD generally and the new role of universities as change makers (e.g. Tönismann & Lafon, 2024).

What should be abandoned – The fragmentation of knowledge caused by the curricular approach should be abandoned because it limits the implementation of interdisciplinarity as a key feature of the programme.

What should be re-designed – Abandoning the curricular approach could open the door for customized, research/project-based work by involving all doctoral students in contributing to the efficient collaboration of actors in the Quintuple Helix and in line with the challenges of the 2050 UN Sustainable Development Goals.

What necessitates a new approach – The traditional indicators for measuring the success of universities and determining rankings are limited mainly to academic publications and the number of graduated students. These indicators are not conducive to the new role of universities as change makers and their contribution to the well-being of both people and planet. The university’s researchers are now planning to focus on exploring new metrics relevant to gaining insights into the success of universities in this new role.

CONCLUSIONS

The ENTREPRENEURSHIP AND INNOVATIVENESS doctoral programme at the J.J. Strossmayer University in Osijek demonstrates that non-linearity and subsidiarity are two important and effective features of social systems. The context in which the programme was established was far from being supportive (limited knowledge on entrepreneurship, lack of money, a university organizational culture dominated by autonomy rather than accountability, post-war devastation). The team managed to escape linearity by opting for a non-linearity approach and it worked. Using the principle of subsidiarity, the team implemented a range of different trajectories (e.g., research, entrepreneurship as a learning method, developing their own entrepreneurship ecosystem, networking, etc) to overcome initial resource limitations. The holistic approach implemented in developing the ENTREPRENEURSHIP

AND INNOVATIVENESS doctoral programme provided a critical thinking framework based on Quintuple Helix collaboration in which doctoral students/early-stage researchers look for innovative approaches to define and solve problems related to achieving the 2050 UN Sustainable Development Goals.

AUTHOR BIOS

Professor Slavica Singer is Professor Emerita of Entrepreneurship at the J.J. Strossmayer University in Osijek, Croatia. From 2010 she has been leading the interdisciplinary interuniversity doctoral programme – ENTREPRENEURSHIP AND INNOVATIVENESS. With her team she contributed to building the institutional infrastructure (ecosystem) needed to support entrepreneurship activities in Croatia (micro credit institution NOA in Osijek, 1996; Centre for Entrepreneurship in Osijek, 1997; CEPOR Policy Centre for development of SMEs and entrepreneurship in Zagreb, 2001). Professor Singer has been leading the Global Entrepreneurship Monitor (GEM) research team in Croatia since 2002. Slavica is often engaged by the OECD as a consultant/expert in the field of reviewing national policies on entrepreneurship, inclusivity and entrepreneurship education. For her contributions to the development of research/university-based entrepreneurship education, in 2008 she was awarded with the UNESCO Chair in Entrepreneurship Education. (singer@efos.hr)

Professor Sunčica Oberman Peterka is a full professor at the J.J. Strossmayer University in Osijek, Faculty of Economics and Business in Osijek, Croatia, where she teaches entrepreneurial and strategic courses. She has been a member of the GEM research team for Croatia since 2002, and is also a member of the research team of CEPOR – a policy centre for small and medium enterprises and entrepreneurship. Her research interests include entrepreneurship education, entrepreneurial university, authentic leadership and small business strategic management. (suncica.oberman.peterka@efos.hr)

References

- Bacigalupo M., Kampylis P., Punie Y. & Van Den Brande, L. (2016). EntreComp: The Entrepreneurship Competence Framework. EUR 27939 EN. Luxembourg (Luxembourg): Publications Office of the European Union. JRC101581.
- Etzioni, A. (1968). The Active Society: A Theory of Societal and Political Processes. Collier-Macmillan.
- Gibb A.A. (2002). In pursuit of a new 'enterprise' and 'entrepreneurship' paradigm for learning: Creative destruction, new values, new ways of doing things and new combinations. *International Journal of Management Reviews*, 4(3): 232–269
- Gibb, A. A. (2007). Enterprise in education: Educating tomorrow's entrepreneurs. Pentti Mankinen, 2007, 1–19.
- Harmeling, S. S. (2001). An introduction to Researching, Writing and Teaching Case Studies, J.J. Strossmayer University in Osijek.
- Sarasvathy, S. D. & Venkataraman, S. (2011). Entrepreneurship as method: Open questions for an entrepreneurial future. *Entrepreneurship Theory and Practice*, 35(1): 113–135.
- Stevenson, H.H. & J. Jarillo (1991). A New Entrepreneurial Paradigm, in Etzioni, A. & Lawrence P. (eds.), *Socioeconomics: Toward a New Synthesis*. New York: M.E. Sharpe.
- Stevenson, H.H. (2004). Intellectual Foundations of Entrepreneurship, in Welsch, H. (ed.). *Entrepreneurship: The Way Ahead*, New York and London: Routledge.
- Tönismann, T. & Lafon, M. (2024). Recalibrating the PhD: How global bodies can shape academia. *University World News*, 27 April 2024.
- www.ices.hr/en/doctoral-program/website

Footnotes

- ¹ This case was written in honour of the late Professor Allan Gibb. Professor Gibb was the main thinker, activist,

mentor, and friend in the development of the doctoral programme. He worked with the J.J. Strossmayer University in Osijek team from 1995 until his death in 2019. His leadership was characterized by co-creation and learning about critical thinking, creative deconstruction, new perspectives of looking at problems, and the entrepreneurial university.

² Social ownership meant that workers/employed persons were actually shareholders of a firm and had the right to participate in strategic decision-making processes and in the profits. But they could not sell their 'shares' or if they left a firm, they would cease to be 'shareholders' in that firm, but if they were employed in another firm, they again got the 'shareholder' status there. This type of ownership disappeared in the transition process from the Yugoslav economic system and corrupted privatization causing a lot of bitterness among workers because they felt cheated.

³ Croatia is still trying to identify 1,797 people who are missing, killed during the war (Government of Croatia, February, 2024).

⁴ Ironically, the EU-funded project on regional development and entrepreneurship (1991–1992), led by one of the researchers from this group, was cancelled at the end of 1991 due to the war.

⁵ Later named after Josip Juraj Strossmayer, born in Osijek in the 19th century. Strossmayer played an important role in developing the scientific and cultural infrastructure in Croatia, being a bishop and theologian, politician and statesman, art collector and donor. His personality, ideas, open-mindedness, global reasoning and his overall legacy have been recognized and are still reflected in the mission of the University of Osijek.

⁶ This is a good example of how networking works: The idea of the doctoral programme was part of the 'what can I/we do?' thinking of a small group of local researchers/educators. However, they could not apply for funding from the EU TEMPUS programme because, at that time (2007), Croatia was not an EU member. Because his university did not have the administrative capacity to collaborate on such a project at the time, Professor Allan Gibb introduced the team to Professor Antti Paasio from Turku School of Economics, Finland. Professor Antti Paasio and his team took over the submission of the proposal and the leadership of the project.

⁷ In its first decision to reject the proposed programme, the Ministry stated that entrepreneurship is not a topic that should be taught at HEIs, implicitly accepting the long-abandoned concept of entrepreneurs being 'born' and not 'made.'

⁸ E.g., Susan Harmeling (2001), professional case writer for Harvard Business School, visited the programme in Osijek in 2001 and 2002, and trained local educators on how to write and teach using case-method. Or, Professor Allan Gibb, Durham Business School and Joan Gibb, Drama teacher at the English Department at Durham Johnston School, who trained local educators on how to use team teaching and drama in entrepreneurship education.

⁹ With the help of Allan Gibb, the international advisory board was established and consulted in 2005–2006 to brainstorm and evaluate the doctoral programme and its related conceptual framework: Howard Stevenson, Harvard University; Allan Gibb, Durham University; Antti Paasio, University of Turku; Jerome Katz, St. Louis University; Robert Brockhaus, St. Louis University; Sankarann Venkataraman, University of Virginia; Harold Welsch, De Paul University; Raphael Cohen, University of Geneva; Adolph Hanich, Swinburne University; Deirdre Hunt, University College Cork; Joan Gillman, University of Wisconsin-Madison; Piotr Korynski, Open Society Institute, New York.

Annex

Table 1: Timeline of developing the sustainable entrepreneurship ecosystem related to entrepreneurship education at the J.J. Strossmayer University in Osijek, Croatia

1996 NOA, Osijek – microfinance institution, established with initial financial support from U.S. International Aid (USAID) ('for the revitalization of multi-ethnic economic life in eastern Croatia')

1997 Centre for Entrepreneurship, Osijek – training and counselling services to start-up owners and those interested in self-employment, using the model of U.S Small Business Development Centres. Financial support from the Open Society Institute, New York, U.S.A.

2000 Experts' support in re-designing the Business Incubator's strategy and business model

2000 – 2010 Educational programmes in Entrepreneurship at the University of Osijek:

(i) At the University of Osijek, Faculty of Economics: 2000 MSci programme, 2005 undergraduate programme (revised programme according to Bologna declaration)

(ii) At the University of Osijek:

UNESCO Chair in Entrepreneurship Education, 2008

Doctoral programme Entrepreneurship and Innovativeness, 2010

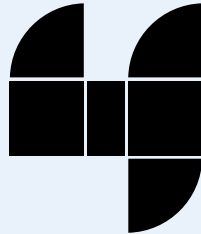
International Centre for Entrepreneurial Studies, 2010

2001 CEPOR – SMEs and Entrepreneurship Policy Centre (think tank), Zagreb. Financial support from the Open Society Institute, New York, U.S.A.

1990–2009 Development strategies:

- EU funded survey, 1990–1992 (regional development and entrepreneurship) – cancelled in 1991 due to the war
- University of Osijek – The University's vision in post-war years, 1993 (in the middle of the war years 1991–1995)
- City of Osijek – Towards the intelligent city, 2005
- Osijek-Baranya County – Where young people want to stay and others want to come, 2009.

**Bárbara Coelho Gabriel,
Robertt Valente & José Rabelo Neto**



REDESIGNING MECHANICAL ENGINEERING CURRICULA TO PROMOTE ENTREPRENEURIAL COMPETENCIES IN DEEP TECH

ABSTRACT

This chapter provides an overview of the bachelor's and master's Mechanical Engineering programmes at the University of Aveiro, Portugal. The curricular structure of these programmes was recently revised to create flexible and agile programmes that can provide opportunities for students to act as potential entrepreneurs. The revised programmes align with the UN Sustainable Development Goals (SDGs) and are inclusivity focused. They incorporate elective modules, project-based learning, and extracurricular activities to prompt students to consider the use of deep tech to address societal challenges. The success of these programmes is demonstrated by their diverse student participation, positive feedback, and spin-offs. These revised programmes are good examples of how engineering education can foster innovation, knowledge transfer, and societal impact through a holistic and industry-integrated curriculum.

Key words: Engineering Education, Curricular Transformation, Entrepreneurial Mindset, Mechanical Engineering



INTRODUCTION

Various studies have considered how Mechanical Engineering curricula can encourage entrepreneurial and innovative behaviours. Huang et al. (2018) and Sang & Hao (2011) both emphasize the need for reform and exploration, with a focus on practical application and the development of an entrepreneurial mindset. Davis & DiGiuseppe (2017) and Li & Chen (2012) provide specific examples of how this can be achieved, with Davis infusing entrepreneurial ideas into existing courses and Li implementing teaching reformation to improve innovation capability. These studies collectively highlight the importance of integrating entrepreneurial and innovative elements into Mechanical Engineering curricula to better prepare students for the challenges of the modern engineering landscape. Adopting this approach, researchers from the University of Aveiro (UA) used a stakeholder lens to analyse the challenges facing contemporary Engineering curricula (Ferreira et al., 2024). Based on this work, the researchers redesigned the university's Engineering curricula to incorporate entrepreneurship skills, specifically emphasizing deep tech applications and inclusivity to align with the Sustainable Development Goals (SDGs).

In the revised programmes, inclusivity is promoted through a diverse range of elective modules and extracurricular activities that accommodate students from various backgrounds and cater for their different needs. The new more flexible curriculum structure supports students of different age groups, including adult returners seeking to reskill and upskill. This aligns with SDG 4 (quality education) and SDG 10 (reduced inequality). Additionally, the emphasis on addressing societal challenges, such as urban mobility and energy, directly contributes to SDG 9 (industry, innovation, and infrastructure) and SDG 11 (sustainable cities and communities).

REGIONAL ECOSYSTEM CONTEXT

UA is one of the most dynamic and innovative universities in Portugal, recognized for the quality of its infrastructure, the strength of its research, and the excellence of its staff. Established in 1973, UA is one of the country's youngest universities, and its mission is to provide undergraduate and postgraduate education to generate research and promote cooperation with society. By applying the entrepreneurial university model (Rabelo Neto et al., 2024), UA has become synonymous with producing human capital and knowledge transfer that generates societal transformation and addresses the needs of its entrepreneurship ecosystem.

UA has more than 16,000 students. It is a research-led education institution comprising various university departments (16), research units, polytechnic schools (4), interface units, and a vocational education network. Its integrated structure enables the construction of individual educational pathways, from post-secondary technological specialization programmes to doctoral degrees. Throughout the academic year, the university organises dozens of national and international conferences, generating a dynamic and multicultural atmosphere for students and staff.

The uaCoopera sector, an interface unit responsible for linking UA researchers to society – plays an important role at UA. uaCoopera helps research staff exploit their applied knowledge through, for example, patents, utility models, and software creation. It also acts as a broker between external stakeholders (industry sectors, companies, government representatives) and academic staff, offering innovative solutions to external organisational problems. Finally, uaCoopera also acts as a “talent hunter”, identifying potential opportunities for the creation of spin-offs and start-ups within the university community (academic and

non-academic staff, including students). Once relevant talents are identified, and their ideas are developed, ualncubator – an in-house organisational, physical and HR support structure in UA – provides mentoring to incubate and accelerate the business ideas.

UA has been a part of the European Consortium of Innovative Universities (ECIU) since 1998. ECIU is an international cluster of higher education institutions (HEIs) with a collective emphasis on innovation, creativity, and societal impact as drivers of knowledge-based economies. These HEIs share distinctive characteristics – each is committed to innovation and applied research and has close links with industry and other stakeholders within their innovation and entrepreneurship ecosystem. ECIU reinforces UA's commitment to collaborate with other institutions nationally and internationally.

UA's revised bachelor's and master's programmes integrate specific entrepreneurship and deep tech elements through several key initiatives. For example, introductory courses cover core engineering topics including nanoengineering and robotics, which are essential components of deep technology. These courses lay the foundation for students to understand and engage in advanced technological innovation. Extracurricular initiatives, developed through relationship-focused European-funded projects, encourage students to participate in international programmes to develop their entrepreneurial competencies.

In the bachelor's programme, elective modules are included in the third and fourth semesters; these focus on both soft competencies (e.g., leadership, communication) and advanced hard skills (e.g., artificial intelligence, IoT), which are directly linked to deep tech developments. These modules provide students with the technical and entrepreneurial skills required to innovate. In the final semester of the Mechanical Engineering bachelor's programme, students work on projects that address real-world challenges posed by local companies, thus fostering practical problem-solving and entrepreneurial attitudes using deep technology solutions. During the master's programme on Mechanical Engineering, students take a small number of mandatory courses (all based on societal projects), and can choose from more than 40 elective curricular units during the first three semesters of the two-year programme. Hence, each student is responsible for creating his/her personalized curricular pathway, depending on their backgrounds, expectations, aptitudes, and life goals. This is a unique pedagogical strategy at national level that helps increase the programme's inclusivity and accounts for the individuality of each student.



Figure 1. Department of Mechanical Engineering, University of Aveiro

MECHANICAL ENGINEERING CURRICULA AT THE UNIVERSITY OF AVEIRO

The Department of Mechanical Engineering is recognized as a driver for transforming UA into an entrepreneurial university. The university's revised bachelor's and master's degree programmes were implemented in the academic year 2021/2022. Following lengthy discussions, the original five-year (bachelor's degree programme) + two-year (master's degree programme) study format was replaced with a three-year (bachelor's) + two-year (master's) format. During this process, teachers, researchers, staff, and students came together to create a new learning environment – one more conducive to equipping learners with innovative and entrepreneurship competencies (Ferreira et al., 2024; Liang et al., 2022; Rabelo Neto et al., 2024; Wu, 2024).

In the academic year 2023/24, the Department of Mechanical Engineering has enrolled 1,100 students: 52% in bachelor's Courses; 39% in master's Courses, and 9% as PhD students. Of these 1,100 students, 20% were female and 8% international students. The transition process to a new design for UA's bachelor's and master's degree programmes was used as an opportunity for self-reflection and to prepare teachers and support staff to equip the next generation of engineers with the necessary entrepreneurial skills to address the big societal challenges of the future. The following sections describe the most innovative aspects of these revised Bachelor's and master's courses.

At the bachelor's level

In Portugal, bachelor's courses in Engineering tend to be highly regulated with a set number of credits (i.e., ECTS¹) assigned to core areas such as mathematics, physics, and chemistry. Although this rationale can be justified by the need to ensure that students acquire a solid foundation in these subjects, it does not leave much room for innovation in the curriculum, nor does it allow much scope to collaborate with industry or address societal needs. Despite this, four innovative aspects can be highlighted in UA's revised bachelor's programme in Mechanical Engineering, two at the institutional level, and two at the departmental level.

Institutional level:

1 – Following the transition to the new, post-Bologna² model, each bachelor's course in Engineering at UA now begins with an introductory curricular unit (6 ECTS) that provides an overview of core engineering topics. "Introduction to Mechanical Engineering" introduces students to ten core engineering topics over a period of 15 weeks: Applied and structural mechanics; materials; fluid mechanics; thermal machines; automation; robotics; transportation systems; biomechanics; nanoengineering; and mechanical design. These areas include a wide range of concepts related to the Deep Tech initiative of the European Commission.

2 – During the 3rd and 4th semesters of the bachelor's Programme in Engineering, students choose a total of six elective modules (two ECTS each) dedicated to the development of soft competencies (3rd semester), and hard, advanced, skills (4th semester), the latter linked directly to UA's research and development activities.

Departmental level:

1 – During the 5th and 6th semesters, students choose elective curricular units which, during the final semester of the course, will converge to a seminal curricular unit – the Mechanical Engineering Project. This final curricular unit is grounded in societal challenges as well as challenges emanating from local companies associated with the Department.



Figure 2. Detail of the Rectory building façade, University of Aveiro

2 – Through several of the university’s entrepreneurship-focused European-funded projects, students are given the opportunity to participate in an international, large-scale extracurricular programme to develop their entrepreneurial competencies. Students are incentivised to form teams and choose societal challenges that relate to one (or more) of the following areas: Manufacturing; urban mobility; energy; circular economy; health, and food. During these extracurricular programmes, the teams use their engineering skills to develop and co-create engineering solutions to pressing challenges in these sectors. These activities take place over the course of three months in each semester and, although initially initiated by the Department of Mechanical Engineering, they now involve students from different engineering and non-STEM pathways. To date, more than 400 students at the University of Aveiro have taken part in these activities, gaining skills in entrepreneurship, innovation, and teamworking.

At the master’s level

UA’s newly revised master’s in Mechanical Engineering has a unique curricular structure. During the first three semesters of this four-semester programme, each student takes just two mandatory curricular units. These major units are entirely dedicated to different (yet complementary) areas of Mechanical Engineering design: (i) product development; (ii) thermal engineering systems; (iii) automation systems; and (iv) machines and structures.

Around these mandatory core curricular units, revolve a total of 46 elective curricular units that focus on different areas of knowledge associated with the future of the Mechanical Engineering profession. This structure allows each student to create their own academic pathway, according to their particular needs, expectations, and affinities. Over the past three years, this flexibility has proven extremely effective in accommodating master’s students from different backgrounds and age groups. This structure also suits both the “classical” age group of young adults studying for a master’s degree (20~25), and older adults, including adult returners seeking to reskill and upskill. (The full curriculum and structure of the master’s in Mechanical Engineering can be found here: <https://www.ua.pt/en/c/488/p>).

This revised structure supports Saxe et al. (2022) who emphasize the need for a “birds’ eye view” on lifelong learning in undergraduate engineering programmes. This includes aligning course design with lifelong learning outcomes and providing experimental initiatives. Additionally, Morozova et al. (2016) further underscore the importance of collaboration between education, industry, and business structures in creating a system of lifelong engineering education that supports youth employment.

KEY LEARNINGS



Flexible curricula lead to tailored pathways better suited to students' preferences and competencies, enhancing their engagement, and ensuring their education aligns with their career goals and interests.

By involving industry stakeholders in curriculum (re-)design and project-based learning, students gain practical experience and insights into how to apply their skills in the real world.

The focus on the entrepreneurial mindset is introduced through curricular and extracurricular activities that equip students with the skills necessary to become innovators and leaders in their fields.

Promoting entrepreneurial mindsets with extra-curricular activities requires the effort of the whole community, not just teachers who often work in silos.

Elective modules to develop soft competencies allow students to complement and improve the skills, knowledge, attitudes, and values recognised as important by the labour market.

Stimulating methods to strengthen engineering students' advanced technological skills in areas such as artificial intelligence, automation, IoT, and emerging technologies, is important.

Future trends to be considered in subsequent curricula re-design include exploring the use of artificial intelligence in personalizing teaching and developing critical skills for innovation; developing psycho-pedagogical strategies to promote the development of socio-emotional skills such as resilience, creativity, and collaboration, and designing innovative and entrepreneurial engineering curricula that incorporate practical learning, multidisciplinary projects, and collaboration with industry.

The following provides evidence of the programmes' re-design success:

- to date, over 400 students have participated in relationship-focused extracurricular activities within these programmes
- participants have reported significant gains in entrepreneurial skills such as innovation, business development and teamwork.
- the programmes have successfully attracted a diverse range of students, with 20% female and 8% international students, indicating their broad appeal and inclusivity.
- the Ualncubator has supported the creation of several spin-offs and start-ups, demonstrating the practical impact of entrepreneurial training, human capital valorisation, and knowledge transfer.

CONCLUSIONS

UA's experience demonstrates how a university's institutional mission goes beyond technological innovation and academic spin-off creation, and contributes to the expansion of entrepreneurial competencies, human capital valorisation, and knowledge transfer (Neto & Neto, 2018; Rabelo Neto et al., 2024). In this regard, UA is committed to becoming a “transformative university,” which seeks not only to transmit knowledge but also to catalyse positive change in society.

Fostering entrepreneurial mindsets and behaviours through engineering curricula has the potential to drive positive innovation and address societal challenges. However, a tailored strategy must be based on a comprehensive understanding of the long-term impact; this requires a holistic approach involving several university stakeholders.

Concerted efforts from various stakeholders within university partnerships are required. Embracing a holistic perspective and fostering collaboration among diverse ecosystem actors can help students develop the necessary skills, knowledge, and mindsets to actively contribute to solving the complex challenges of contemporary engineering landscapes. Through continued innovation in curriculum design, developing strategic partnerships with industry, and adopting a commitment to nurturing entrepreneurial talent, universities can play a pivotal role in shaping a future in which engineering education drives positive change and societal progress.

AUTHOR BIOS

Bárbara Coelho Gabriel is an Assistant Professor at the Department of Mechanical Engineering (DME), University of Aveiro, and conducts research on engineering education, entrepreneurial education, innovation, and nanoengineering. She is Vice-Dean for Internationalization at DME, a board member of the university's Doctoral School, and a member of the Rectoral team for pedagogical and curricula innovation. (barbara.gabriel@ua.pt)

Robertt Valente is an Associate Professor and Dean at the Department of Mechanical Engineering (DME), University of Aveiro. He led the transition process discussed in this chapter during the Bologna Process (2005), as well as the accreditation processes that followed, including the latest curricular revision (2018) that led to the current format of the programmes described. (robertt@ua.pt)

José Rabelo Neto is currently a doctoral researcher at the Department of Mechanical Engineering (DEM), University of Aveiro, focusing on innovation ecosystems, academia-enterprise co-creation models, and knowledge transfer. He holds two master's degrees and a Ph.D. in Materials Engineering. He is currently studying for a second doctorate in Public Policy. He also has an MBA in Innovation, specialising in Project Management, and Intellectual Property Management. (joserabelo@ua.pt)

References

- Davis, G. W. & DiGiuseppe, G. (2017). Infusing an entrepreneurial mindset into mechanical engineering courses: Two case studies. 2017 IEEE Global Engineering Education Conference (EDUCON), 1354–1358. <https://doi.org/10.1109/EDUCON.2017.7943023>
- Ferreira, C., Gabriel, B., Valente, R., Andrade-Campos, A., Dias-de-Oliveira, J., Neto, V., Soares, S., Carvalho, T. & Figueiredo, C. (2024). In Search of a More Balanced Engineering Curriculum: The Perspective of Students, Teachers, Alumni and Employers. *Trends in Higher Education*, 3(1), 142–154. <https://doi.org/10.3390/higheredu3010008>

- Huang, C. D., Guo, J.W., Xie, L. & Cao, X. C. (2018). The design of innovative and entrepreneurial courses of mechanical majors against the background of new engineering. *Proceedings of the 2017 International Seminar on Artificial Intelligence, Networking and Information Technology (ANIT 2017)*. <https://doi.org/10.2991/anit-17.2018.49>
- Li, Z. & Chen, H. (2012). The curriculum reform and practice of mechanical innovation design with CDIO in higher vocational education. *2012 7th International Conference on Computer Science & Education (ICCSE)*, 1430–1432. <https://doi.org/10.1109/ICCSE.2012.6295332>
- Liang, K., Shang, J. & Luo, Z. (2022). The Course Reform of Mechanical Design Fundamentals to Cultivate Engineering Literacy and Innovation Ability. *Journal of Contemporary Educational Research*, 6(7), 6–11. <https://doi.org/10.26689/jcer.v6i7.4176>
- Morozova, M. V., Kust, T. S., Sokolova, E. Y., Osipova, S. I., Gafurova, N. V., Vaganova, V. I., Ovchinnikov, V. A. & Agaveyan, R. O. (2016). The Management of Youth Employment in a Lifelong Engineering Education System. *International Review of Management and Marketing*, 6(2S), 247–252.
- Neto, J. da S. R. & Neto, A. R. (2018). Talent Management for Innovation. In *Handbook of Research on Strategic Innovation Management for Improved Competitive Advantage* (1st ed., Vol. 1, pp. 602–620). <https://doi.org/10.4018/978-1-5225-3012-1.ch031>
- Rabelo Neto, J., Figueiredo, C., Gabriel, B. C. & Valente, R. (2024). Factors for innovation ecosystem frameworks: Comprehensive organizational aspects for evolution. *Technological Forecasting and Social Change*, 203, 123383. <https://doi.org/10.1016/j.techfore.2024.123383>
- Sang, J. & Hao, C. (2011). Reform and Exploration of Innovative and Entrepreneurial Talents Fostering Mode on Mechanical Engineering under the New State (pp. 392–395). https://doi.org/10.1007/978-3-642-23357-9_69
- Saxe, A., Mahmoud, R. & Razavinia, N. (2022). Systems Theory Framework for Embedding Lifelong Learning Holistically in Undergraduate Engineering Education. *Proceedings of the Canadian Engineering Education Association (CEEAA)*. <https://doi.org/10.24908/pceea.vi.15885>
- Wu, Y. (2024). Exploring the Methods and Paths of Integrating Entrepreneurship and Innovation Education into Applied Undergraduate Education. *Applied Mathematics and Nonlinear Sciences*, 9(1). <https://doi.org/10.2478/amns-2024-0778>

¹ European Credit Transfer and Accumulation System

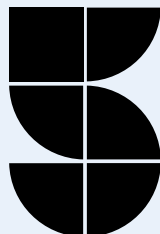
² The Bologna Process started in 1999 and was the basis for establishing the European Higher Education Area.



II.

Entrepreneurship Training Programmes

Alessandro Tomasi



BUS SCHOOL BALTICA: AN “OUT OF THE CLASSROOM” EXPERIENCE

ABSTRACT

Thanks to the ubiquitous availability of information and various learning modalities, education can now expand beyond traditional learning environments and move out of the classroom. Entrepreneurial behaviour and entrepreneurial learning are prime examples that benefit from Challenge Based Learning projects in the real world. This chapter explores an innovative learning format that will be launched in late 2024 – the Bus School Baltica – a week-long learning programme run by Kimitisik B.V. The programme will comprise workshops delivered on buses in the morning and field-based idea validation sessions in the afternoon. The project will be delivered in the region of the planned Rail Baltica high speed train line which will impact local mobility as well as local economies within the Baltic region. Given the level of innovation involved in this project, it has the potential to act as a good practice example.

Key-words: Out-of-the-classroom education, Entrepreneurial education, Entrepreneurship



INTRODUCTION

"Learning at Not-School" by Julian Sefton-Green (2013) is a comprehensive examination of non-formal educational settings, emphasizing their significance in contemporary learning landscapes. The book delves into the varied dimensions of non-formal learning, exploring the roles of context, the learner, and knowledge. It addresses the methodological challenges involved in studying these environments and critically evaluates how these settings differ from formal schooling, underscoring their unique contributions to learners' development.

Similarly, in "Experiential Education in the College Context" (2016), Roberts emphasizes the transformative potential of experiential learning in higher education. He explores the shift from traditional instructional methods to more dynamic, experience-based approaches. His philosophy argues for the integration of experiential learning into the curriculum, highlighting its relevance in today's digital and globalized world. It challenges the conventional structures of university education, advocating for a more student-centered approach that values learning through real-world experiences, beyond the confines of traditional classroom settings. This approach aligns with current educational trends that prioritize practical, hands-on learning experiences.

In a similar vein, "Get out of the building" is a key concept promoted by Eric Ries in his influential text "The Lean Startup." This concept encapsulates the idea of validating business hypotheses by engaging directly with potential customers, rather than relying solely on theoretical assumptions or secondary market research. In traditional business models, a lot of time and resources are often spent on product development and perfecting an idea before it ever reaches the customer. However, Ries argues that this approach is flawed, especially in the context of start-ups where levels of uncertainty are high and resources are limited. He suggests that instead of building a product in isolation and



Figure 1. Out-of-the-classroom educational experiences are a key step outside the doors of traditional learning environments. Photo of the Roman Port in Florence, courtesy of the Author.



Figure 2. Conference centres, parks, shopping malls, public sites, museums and sport events are great opportunities to take learning out of the classroom and meet stakeholders. Photo taken at SOLUTRANS 2023 in Lyon, courtesy of the Author.

hoping it meets market needs, entrepreneurs should first “get out of the building” and into the real world to test their hypotheses about their customers and their needs. This involves talking to real people, gathering feedback, observing behaviours, and understanding the problems customers face. The aim is to learn quickly what work and what does not in a practical context. This approach is part of the larger Lean Start-up methodology, which emphasizes rapid iteration, agile development, and validated learning.

Constantly testing and adapting, start-ups can avoid building products that nobody wants, saving time and money. „Get out of the building“ is about embracing a hands-on, experimental approach to entrepreneurship. It is a call to action for start-ups to be more dynamic and customer-focused, to test their assumptions in the real world, and to pivot or persevere based on what they learn. This philosophy is a cornerstone of the Lean Start-up approach, aimed to make start-up processes more efficient and increasing their chances of success in a competitive and uncertain market.

Additionally, research by Caplin et al. (2021), highlights the mental health benefits of vigorous exercise in physical education programmes and proposes a more comprehensive approach to student well-being, one that advocates for a holistic education system where physical health is seen as a key component of overall academic performance and stress management.

REGIONAL ECOSYSTEM CONTEXT: EIT, RIS REGION AND THE UPCOMING RAIL BALTICA TRAIN LINE

The relevance of out-of-the-classroom education, particularly in the context of the European Institute of Innovation and Technology’s (EIT) Regional Innovation Scheme (RIS), is highlighted by the challenges and characteristics of the EIT ecosystem, especially within RIS regions. The EIT RIS was launched in 2014 to enhance the innovation capabilities of countries based on their European Innovation Scoreboard rankings (Es-Sadki et al., 2024), with a focus on areas scoring in the “Moderate” or “Emerging” categories. These countries are encouraged

to team up with Innovation Leaders, like The Netherlands, to establish a know-how transfer between project participants. The RIS scheme is vital at EU level as it provides tailor-made support to meet the diverse innovation needs of eligible countries and regions.

One of the key characteristics of the EIT RIS is the establishment of on-the-ground Hubs in eligible countries and regions. These Hubs foster closer interactions between local innovation actors and link local innovation ecosystems to the broader EIT pan-European innovation ecosystem. They play a crucial role in integrating potential new partners and participants from local innovation ecosystems into EIT Community activities.

The challenges faced in RIS regions include overcoming the slower pace of innovation and minimizing disparities in innovation capabilities among EU regions. The EIT RIS addresses these challenges by supporting a wide range of initiatives, including start-ups, scale-ups, and spin-offs, transforming innovative ideas into marketable products, and creating positive socioeconomic change. The scheme has made significant contributions to sectors such as healthcare, nurturing entrepreneurial talents, and supporting new and early-stage ideas. It has been instrumental in expanding innovation-fostering activities across Europe, transforming innovation ecosystems in countries and regions where support is most needed.

The lack of homogeneity across the RIS region, the increased EU interest in active learning and the upcoming Rail Baltica high-speed train railway line, are the main drivers of the Bus School Baltica project. Participants will embark on a bus journey that weaves through the vibrant cities of Tallinn, Riga, and Vilnius, the future itinerary of Rail Baltica – a trailblazing project set to revolutionize travel and economic dynamics in North-East Europe. This is a gateway to a connected future, a ribbon of steel and dreams that links the beating hearts of the Baltic States to the broader European network. The project exposes participants to the Baltic region, thus empowering them to ideate and co-create new products and services related to sustainable transportation in the soon to be transformed region. Rail Baltica is a visionary corridor breathing new life into the region. Picture sleek, modern trains gliding through the historic streets of Tallinn, the bustling markets of Riga, and the charming baroque architecture of Vilnius. Each city, a unique jewel in the Rail Baltica crown, promises a tapestry of culture, history, and innovation to travelers.

This project is about moving learners and economies. Rail Baltica is set to be a catalyst for job creation, fostering knowledge transfer and technology advancements. It is a story of integration, bringing the Baltic States into the European fold, smoothing out the wrinkles of past infrastructural challenges. This railway promises a future where borders blur in the face of seamless connectivity, where distances shrink and opportunities grow. Rail Baltica represents a beacon of cooperation, transparency, and commitment, showcasing the best of European collaboration. Led by visionaries, this project is a dance of commercial savvy and long-term sustainability, ensuring that the benefits of today pave the way for a prosperous tomorrow.

BUS SCHOOL BALTICA

The Rail Baltica project provides the context for the educational activities of the Bus School Baltica project, which will explore urban mobility innovations and urban space repurposing across the Baltic region and along the territories impacted by the Rail Baltica high speed train line.

New intermodal mobility hubs will be created in the region which will reshape public and private mobility, reduce air traffic in the region, impact the local economy and offer opportunities for the design of innovative urban spaces and new mobility services. Kimitisik is a Dutch company whose mission is to innovate higher education in Europe through innovative pedagogies and engaging learning experiences. The company offers several

programmes and experiences catered to students and professionals to stimulate hands-on, active learning, whilst fostering an entrepreneurial mindset.

The one-week challenge-based course will be delivered across the Baltic region. Workshops will be held in the morning on public transportation connecting the various cities included in the programme. The itinerary will consist of bus trips between Kaunas, Tartu, Riga and Tallinn. The afternoon will be dedicated to idea validation sessions in the cities and teamwork sessions supported by coaches. This novel learning experience is scheduled to take place between 7th and 12th of September 2024. A cohort of up to 45 participants from RIS regions will participate in the inaugural programme, recruited mainly through the project's academic partners – the University of Tartu, Riga Technical University and Kaunas University of Technology. Participation is free thanks to co-financing provided by EIT Urban Mobility. The Bus School Baltica project is a prime example of Kimitisik's approach towards immersive, engaging and entrepreneurial learning journey.

The format pioneers out of the classroom education and aims to expose participants to the region that will be intersected by the new railway line. These real-world factors enhance students' learning experience and help position Bus School Baltica as a unique learning opportunity. During the programme, participants will ideate and propose solutions to real-world challenges proposed by municipalities in the region and industrial stakeholders in the sustainable mobility industry. These challenges are the pivotal point of the educational experience. Through guided team-work sessions, participants will, over the course of the programme, identify, refine and finally pitch a viable business solution in front of a jury. The process is anything but linear, which is critical to fostering an entrepreneurial mindset. Throughout the programme, coaches are available to offer students on-demand support and business insights from their professional experiences. The unique structure of the programme gives participants the chance to validate their assumptions with “out-of-the building” sessions, thus offering them an opportunity to validate their daily work with potential customers.



Figure 3. Kimitisik B.V. – the lead instructional designer of the Bus School Baltica educational experience.

In out-of-the-classroom educational projects, inclusivity, deep tech, and STEM dimensions play a crucial role in enriching students' experience and ensuring accessibility for all. Inclusive education in out-of-the-classroom settings focuses on accepting and understanding student differences across physical, cognitive, academic, social, and emotional dimensions. It aims to create a learning environment where all students feel welcomed, challenged, and supported. Inclusive education benefits not only students with disabilities but also their peers, leading to better academic performance, improved social skills, and a more positive attitude toward the concept of learning for all. Teachers and parents also play an essential role in supporting and fostering this inclusive environment.

Deep tech in education refers to the integration of deep technologies or advanced tech solutions in the learning process. This includes using artificial intelligence, robotics, virtual reality, and other cutting-edge technologies to enhance educational experiences outside



Figure 4. Going outside the classroom exposes learners to the nature of the universe and constant change, according to Heraclitus.

the classroom. Deep tech can make learning more engaging, interactive, and tailored to individual student needs, providing opportunities for hands-on experience with technology that is shaping the future and encouraging learners to demonstrate innovative technological products to potential target customers.

Out-of-the-classroom programmes bring a different dimension to the traditional education perspective. Learners are immersed into the context of the end-user, thus experiencing the customer journey directly. These experiences allow students to explore STEM fields (Science, Technology, Engineering, and Mathematics) in a more interactive and engaging way, fostering curiosity, creativity, and critical thinking skills. Education outside the classroom involves practical, real-world applications of STEM concepts, which may benefit from the infusion of different disciplines, such as arts and the humanities, pillars of the creative and cultural European industries.

Overall, incorporating inclusivity, deep tech, and STEM into out-of-the-classroom educational projects can significantly enhance the learning experience, making it more equitable, engaging, and aligned with the skills required in the 21st century. It is important for educators to continuously explore and integrate these elements to provide a comprehensive and inclusive educational experience for all students.

IMPACT

Out-of-the-classroom experiences can have a profound impact on learners in several key areas:

- 1 – Engagement:** Participants in out-of-the-classroom activities often exhibit higher levels of engagement. These activities are usually interactive and hands-on, making learning more relatable and exciting. This active engagement helps in maintaining interest and curiosity in the subject matter, fostering a deeper connection with the educational content.
- 2 – Retention:** Educational experiences outside the classroom can enhance knowledge retention. When students are actively involved in learning through practical, real-world applications, they are more likely to remember and internalize the information. This experiential learning approach, where learners ‘learn by doing’, results in better retention of knowledge compared to traditional rote learning methods.

- 3 – Physical Activity:** Out-of-the-classroom learning often involves physical activity, which is beneficial for students' physical health. Activities such as field trips, outdoor experiments, or community projects require physical movement, providing a healthy balance of physical exertion alongside mental exercise. This can be particularly beneficial in today's increasingly sedentary lifestyle.
- 4 – Entrepreneurial Exposure:** These experiences provide exposure to real-world entrepreneurial scenarios. For instance, projects that involve problem-solving, innovation, and creativity can spark an entrepreneurial spirit in students. This exposure is invaluable in teaching practical skills such as risk-taking, leadership, and resilience, which are essential for entrepreneurship.
- 5 – Community Belonging:** Learning outside the classroom often involves community interaction, which can foster a sense of belonging and social responsibility among students. Engaging with different community groups and working on collaborative projects can help students feel connected to their community and understand the importance of civic engagement. Overall, out-of-the-classroom experiences are crucial for developing well-rounded individuals by providing diverse, engaging, and practical learning opportunities that go beyond the traditional classroom setting.

The wider impacts of the Bus School Baltica project include the following:

Environmental Impact

Sustainable Urban Mobility: By focusing on urban mobility, the project drives the transition towards more sustainable cities. Participants will be equipped to design solutions that reduce emissions, optimize public transportation, and encourage green travel alternatives.

Promotion of Green Technologies: Through the curriculum, learners are exposed to the latest in green transportation technologies, fostering innovation in eco-friendly mobility solutions.

Economic Impact

Job Creation: As participants venture into entrepreneurship or join the urban mobility sector, there is potential for job creation, boosting the economy of RIS regions, especially in relation to the sustainable mobility transition accelerated by the Rail Baltica railway.

Stimulating Local Economies: The emphasis on local seminars and workshops will channel funds into local communities, supporting small businesses and venues.

Social Impact

Social Inclusion: The Bus School Baltica project fosters social inclusion as a result of the participation of representatives from local minorities. The project promotes inter-regional exchange among local populations, thus creating a sense of community and boosting the spirit of 'European belonging.' Entrepreneurial education is recognized as a key catalyst to create social impact geared towards the 17 Sustainable Development Goals.

CONCLUSIONS

Education, especially learning experiences focused on entrepreneurship, may benefit significantly from being delivered outside of traditional classrooms. The Bus School Baltica project pioneers out-of-the-classroom education in the Baltic region. Through challenge based learning pedagogy, participants are exposed to real-world challenges infused by mobility stakeholders from the industry and local municipalities. Whilst guided workshops will be held on bus rides, during the afternoons participants explore and validate their entrepreneurial ideas with real customers in the mobility hubs that will be created by the EU Rail Baltic project.

KEY LEARNINGS



Bolsters creativity

Out-of-the-classroom formats bolster creativity and interactivity among learners and stakeholders, thus offering opportunities for idea validation and iteration that are much more effective than traditional homogenous learning environments.

Show, don't teach

Entrepreneurship is shown, not taught, and as such, out of the classroom educational experiences better align with the real ups and downs of entrepreneurial life.

Support inclusivity

Out of the classroom educational experiences support gender diversity and inclusivity by blending STEM learners with other disciplines and exposing learners to social contexts that maybe otherwise be inaccessible within traditional education.

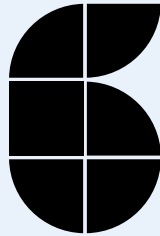
AUTHOR BIOS

Alessandro Tomasi is an engineer, educator, entrepreneur and essentialist. He is Project Leader of the Bus School Baltica project, a collaboration between Kimitisik, Riga Technical University, Kaunas University of Technology, University of Tartu and EIT Urban Mobility. (ale@kimitisik.eu)

References

- Sefton-Green, J. (2013). *Learning at Not-School: A Review of Study, Theory, and Advocacy for Education in Non Formal Settings*. The MIT Press.
- Ries, E. (2011). *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*. Crown Business.
- Claiborne, L., Morrell, J., Bandy, J., Bruff, D., Smith, G. & Fedesco, H. (2020). **Teaching Outside the Classroom**. Vanderbilt University Center for Teaching. Available at: <https://cft.vanderbilt.edu/guides-sub-pages/teaching-outside-the-classroom/> [Accessed 12 April 2024].
- Roberts, J.W. (2015). *Experiential Education in the College Context: What it is, How it Works, and Why it Matters*, 1st ed. Routledge. Available at: <https://doi.org/10.4324/9781315774992>.
- Caplin, A., Chen, F.S., Beauchamp, M.R. & Puterman, E. (2021). The effects of exercise intensity on the cortisol response to a subsequent acute psychosocial stressor. *Psychoneuroendocrinology*, 131, pp.1–10. Available at: <https://doi.org/10.1016/j.psyneuen.2021.105336>
- European Commission, Directorate-General for Research and Innovation, Es-Sadki, N., Khalilova, A., Hollanders, H. (2024). *European Innovation Scoreboard: identification and treatment of outliers*. Publications Office of the European Union. <https://data.europa.eu/doi/10.2777/038677>

Lavina McGahon & Garrett Duffy



THRIVE4WOMEN: EMPOWERING WOMEN TO SUCCEED IN STEM AND DEEP TECH SECTORS

ABSTRACT

THRIVE4women is a holistic entrepreneurship programme that supports women on their STEM/Deep Tech journey from new product development ideation to execution across three pillars – Capability, Connections and Confidence. Female entrepreneurs and intrapreneurs explore a multidisciplinary approach to innovation with the aim of solving global problems. THRIVE4women empowers women by providing them with an introduction to high level STEM/Deep Tech knowledge from industry experts, and by offering follow up 1:1 in-depth mentoring. This learning is further enhanced through self-knowledge and leadership skills to empower women to build on their capability to lead with a sense of belonging in these sectors. The programme exposes women to female peers and role models through networking. In this chapter we discuss why we consider THRIVE4women as a good practice example of preparing non-STEM educated women to lead a team or business within STEM/Deep Tech fields.

Key words: Women in STEM/Deep Tech, STEM/Deep Tech Female pipeline, STEM/Deep Tech Female entrepreneurship



INTRODUCTION

In the past few decades, the role and contribution of women's entrepreneurship to sustained economic growth has been recognised globally (Sajjad, 2020). In Ireland, State agencies such as Enterprise Ireland (EI) and the Department of Enterprise Trade and Employment (DETE), recognise that promoting women's entrepreneurship is increasingly viewed as a key source of job creation and innovation and a necessary step for addressing income inequality and social exclusion (DETE, 2024).

Similarly, the Irish Business and Employers Confederation in the study *Women in Management in Ireland* (2019) states that while women dominate in the areas of HR and Finance/Accounting, their participation in Engineering, Environmental and Materials remains low. Partly in response to these findings, Thrive4Women was developed in 2020 to focus on the inclusivity of women in the STEM area. Its aim was to 1) stimulate women-led entrepreneurship and intrapreneurship and 2) support women's personal and leadership development in this field. These objectives fulfil an urgent call to address Sustainable Development Goals under the 2030 Agenda (UN, 2024), specifically under the categories of SDG 4.4 Quality Education to increase the number of female adults who have relevant skills, 5.5 Gender Equality for full and effective participation for leadership (including 5.b to enhance the use of enabling technology to promote the empowerment of women), and 8.3 Decent Work and Economic Development by encouraging job creation, entrepreneurship, creativity and innovation and encourage the formalisation and growth of micro, small and medium sized enterprises.

The North-East Region (encompassing the counties of Cavan, Louth, and Monaghan) is characterized by a diverse economic landscape. Agriculture is strong with dairy farming being prominent in Monaghan and Cavan, while Louth has a mix of farming and light industry. In recent decades, the region has attracted much foreign investment, especially in the technology and pharmaceutical sectors, with Dundalk, Co. Louth emerging as a hub for multinational companies. Challenges faced in the Region include infrastructure development, balancing economic growth with environmental sustainability and continuing to provide a highly skilled and flexible workforce for industry in the face of close to full employment.

Dundalk Institute of Technology (DkIT) through its Regional Development Centre (RDC) acts as the commercial interface between academic and business communities in the region. From its inception in 1989, the RDC has established productive collaborations with industry, community organisations and agencies from the region and further afield and has become a key component of and influencer on the economic development of the North-East Region in Ireland.

The RDC has successfully managed some 360 industry-academia collaborative projects, supported more than 2,000 entrepreneurs, and incubated over 220 companies. Thus, the RDC and DkIT have become a vital cog in the economic development ecosystem of the region through the supply of highly educated and employment-ready graduates, solving technical challenges for Industry through its research activities, identifying and delivering educational and entrepreneur support programmes for Regional and State Agencies (Enterprise Ireland, Local Enterprise Offices, County Councils, the IDA, etc). DkIT also provides sectoral expertise to support the manufacturing, energy, food and agriculture industries for the region and is a key participant in regional strategy development along with the Local Authorities through organisations such as the North-East Regional Skills Forum (NERSF), North East Lean Network.

BACKGROUND

STEM Entrepreneurship Disparity

Entrepreneurship encompasses the identification of problems and opportunities, as well as the development of suitable solutions and business entities to commercialise these solutions (Eisenmann, 2013). STEM entrepreneurship is thus the act of creating start-ups that use science, technology, engineering, and mathematics in their business models. STEM fields and entrepreneurship go hand-in-hand as both focus on solving complex problems in clever ways, potentially developing new technological products as a result. Entrepreneurship turns these tech solutions into viable businesses, tests the market, and scales products to reach more people. While both males and females are equally capable of taking on these challenges, female engineers and entrepreneurs are still underrepresented in STEM fields. Disparity arises for many reasons including a lack of female role models, accidental/purposeful pressures on women to choose careers in the humanities, and a general lack of awareness in STEM careers overall. While participation rates are increasing for women pursuing STEM careers, there is still a significant lag in gender equity in the field. Research highlights that business and technical skills development along with visible successful women role models are critical to closing the participation gap (McKinsey, 2022).

It is also widely acknowledged (Forbes, 2021; She.Work, 2023) that the main challenges faced by female entrepreneurs are:

- access to finance
- access to information
- access to suitable training
- access to networks for business purposes
- reconciling business and family concerns

Ireland's state agency Enterprise Ireland also published research, suggesting that women:

- are more risk averse;
- perceive they have less access to finance;
- have lower levels of self-confidence;
- have greater fear of failure;
- network differently with less networking opportunities;
- lack visible role models
- have a lack of technical expertise.

Key findings of the 2016 OECD report – Rapid Policy Assessment on Supporting Women Entrepreneurs in Ireland (OECD, 2016) – outlined that progress and investment should continue and more attention should be paid to promoting entrepreneurship in STEM fields in higher education.

STEM Management and Career Disparity

In a STEM context, mixed-gender teams perform better on almost every metric than uniform teams (Crunchbase, 2019) and are more conducive to finding creative solutions. Yet, research conducted by IBEC shows a different evolution of women in management positions between 2001 and 2018 (see Figure 1 below). This suggests that some sectors are growing

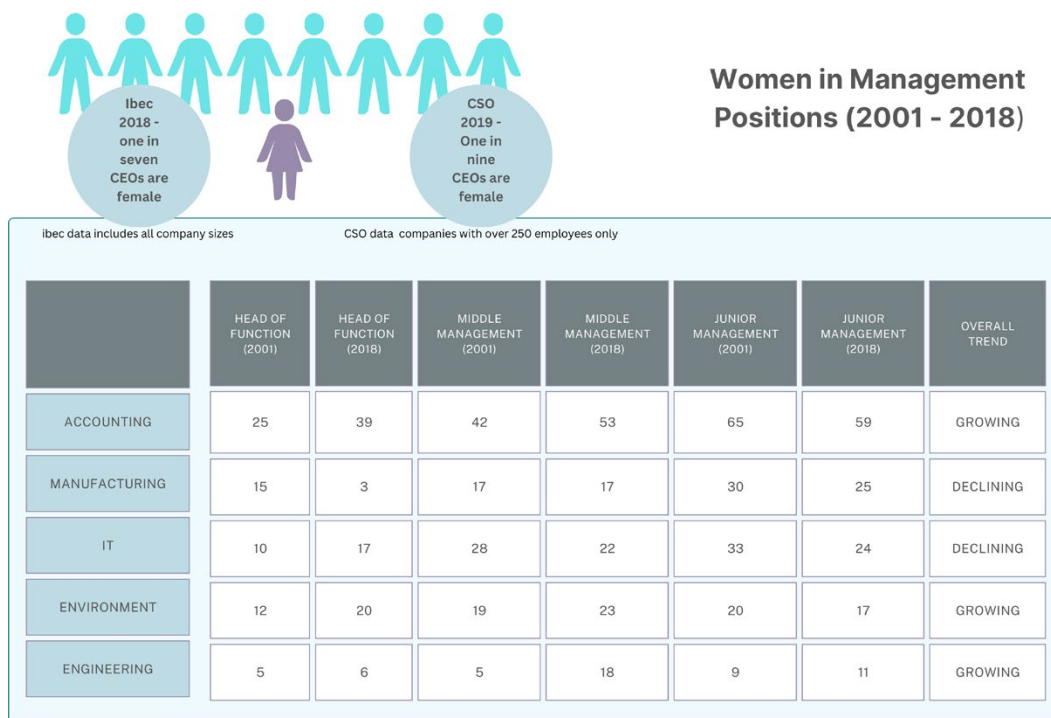


Figure 1. Women in Management Positions in Ireland (IBEC, 2020)

in relation to women's participation, others such as engineering and environment have a low base and manufacturing and IT are in decline.

The Global Gender Gap Report (WEF, 2017) indicates that all sectors need to increase diversity within their talent pools and leadership teams to benefit from the range of perspectives, creative thinking and skills needed for success in their industry. As a result, women will need entrepreneurial skills, technology skills and personal development to achieve workplace gender equality and personal success.

Research also outlines the visibility of inspirational role models that can mitigate negative stereotypes and enhance perceptions of STEM. Likewise, women mentors can build self-confidence, increase STEM aspirations, encourage inclusion, and ultimately motivate young women to pursue STEM careers.

THRIVE4WOMEN

Aside from self-learning or academia, there is no other route for women who are non-STEM/Deep Tech entrants to explore entrepreneurship or career opportunities in this field. The THRIVE4women pilot programme was tasked with providing supports to help non-STEM educated women explore a career transition or start a business in STEM/Deep Tech fields. The programme attempts to respond to the myriad barriers women face in launching and succeeding in STEM/Deep Tech sectors as entrepreneurs or business managers/leaders. THRIVE4women adopts a holistic approach to learning, creating a sustainable and supportive pathway for success. This holistic approach is sensitive to meeting the needs of women who feel excluded from the STEM/Deep Tech sector due to a lack of knowledge, role models, networks, direct experience, or formal education. In addition, it attempts to address some of the challenges for women entrepreneurs¹ that act as barriers to entering STEM fields².

THRIVE4women uses industry experts and experienced professionals to deliver the programme across its three pillars – Capability, Connections and Confidence – to empower women to lead a team or a business in STEM/Deep Tech. To enhance their sustainable

transition into STEM/Deep Tech, the programme offers personal development for confidence and leadership, and a platform to develop a network of women to support their journey. The programme was designed to offer blended learning (online 70%/in-person 30%) to cover a large geographical area of participants and their vulnerability to 'time poverty' that robs parents of success³. This pilot programme is funded by public and private funding over

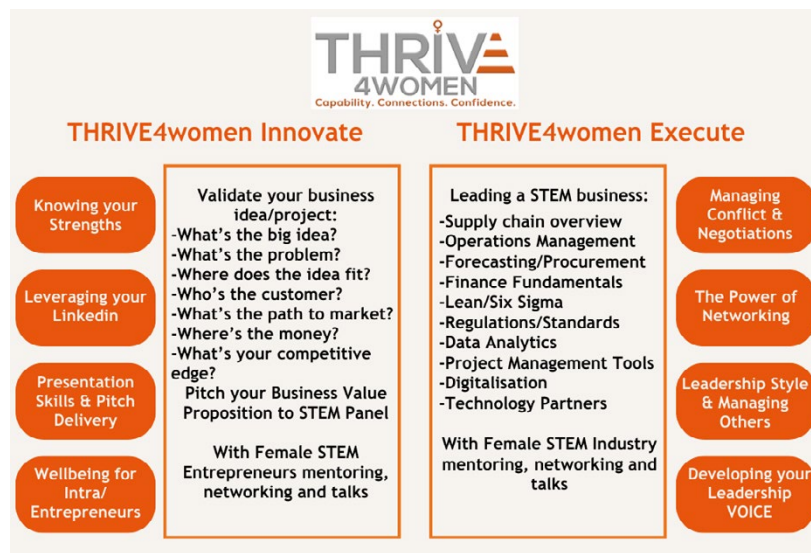


Figure 2. THRIVE4women Innovate & Execute Programme 1 Overview



Figure 3. THRIVE4women Execute Programme 3 overview

a three-year project from 2021–2024. Two full iterations have been run since its launch, with a third programme underway currently focusing on Deep Tech topics. The programmes were continually iterated and customised to meet the needs of participants. This holistic approach offered by THRIVE4women is unique. No other programme addresses a STEM and Deep Tech sector that specifically targets the dual market of women who wish to launch and pursue STEM careers and businesses. THRIVE4women was designed as two discrete modules (Thrive4Women Innovate and Thrive4Women Execute) to allow multiple

entry points for participants. The programme content of each module is outlined below. THRIVE4women: Innovate (6-week module) supports women to explore, validate and articulate the commercial value of a STEM/Deep tech business idea (new product/service) using ideation methodology for deep science and technology ideas culminating in a mock pitch to a STEM panel. This module also develops participants' personal confidence with Presentation Skills, Pitch Delivery, Identifying Strengths, Wellbeing for Entrepreneurs and Leveraging LinkedIn.

THRIVE4women: Execute (10-week programme) demystifies common technical concepts within STEM sector companies to prepare women to lead and manage a team within a STEM field. Leadership development skills include Negotiation & Managing Conflict, Leadership Style & Management Techniques, Developing a Leadership Voice, and Networking. Supporting the educational aspects of the programme, the THRIVE4women Network was developed, meeting every 10–12 weeks to explore key challenging topics of interest and promote women in STEM/Deep Tech from various sectors (entrepreneurs, industry, and academia) to foster learning, engagement, and networking.

IMPACT

The programme has been met with a positive response from ecosystem partners including academic and enterprise support colleagues, participants, contributors, local industry, and business networks. All have shown enthusiasm for supporting women to develop entrepreneurial and career opportunities in STEM/Deep Tech. The THRIVE4women Programme also received national recognition and represented Ireland at the European

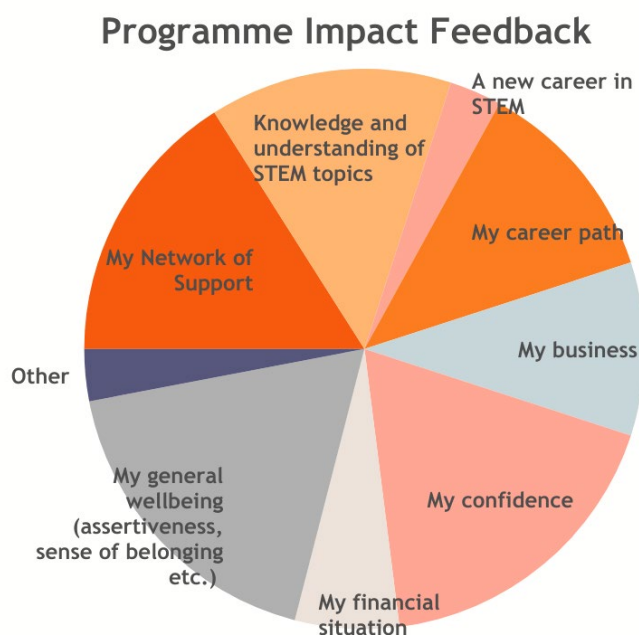


Figure 4. THRIVE4women Participant survey with feedback on impact of programme on respondent

Enterprise Promotion Awards (EEPA) in Bilbao in November 2023. It made the final shortlist of three EU entries for the 'Promoting the Entrepreneurial Spirit'¹⁴ Award.

The holistic content in the programme has contributed significantly to participants' satisfaction and success. Figure 4 below analyses participant feedback regarding the

specific areas of their life where the programme had impacted positively. Despite the fact that THRIVE4women has only been in operation for a short time, 73% of respondents are already reporting a very positive response to its impact on their STEM/Deep Tech careers and businesses. Additionally, respondents reported feeling empowered by the programme (Figure 5) indicating that it helped them in the following ways:

- Has helped develop my self-confidence.
- Helped me develop and explore a STEM business idea/project commercially.
- Inspired me to continue to develop and learn to grow my STEM career/business.
- Enjoyed seeing and learning from other talented women in STEM.
- Opened pathways for me to access experts/mentors in various topics.
- Feel empowered by having access to support.
- Introduced me to STEM topics that are important in my career or business.
- Provided a valuable bridge for non-STEM women to understand complex STEM topics in a safe and comfortable environment.

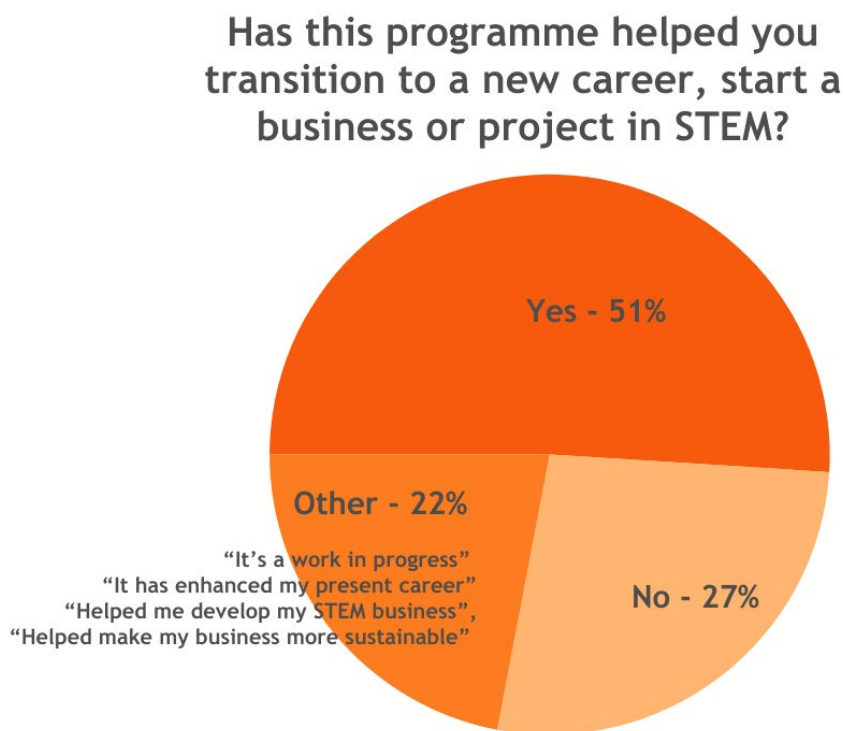


Figure 5. THRIVE4women Participant survey with feedback on impact of programme on respondent

Who benefited? – In just over two years, 58 women have participated in THRIVE4women. This group comprised female entrepreneurs and women seeking to develop a STEM career. Participation levels in the programme so far have exceeded the original target metrics of 30 women. The programme's strategic promotional efforts as well as 'word of mouth' attracted women who were ready, able, and perhaps, needed the programme. Surprisingly, for the pilot programme, almost 40% of participants came from areas outside our geographic target market. Job creation is an important metric for this pilot and is usually measured two to three years post programme completion. However, our evaluation shows that the programme has already supported 15 women to start businesses, five women to enter the workforce, and five women to transition into new promotions within their sector. The programme also engaged

over 260 women in the Thrive4Women networking events. Furthermore, the THRIVE4women LinkedIn online community regularly engages with 644 women interested in STEM/Deep Tech related content.

Programme participants were split 60% female entrepreneurs and 40% women exploring careers in STEM/Deep Tech. This diverse group of women had varying needs and included entrepreneurs from varied sectors, career developers/changers and work returners, as shown

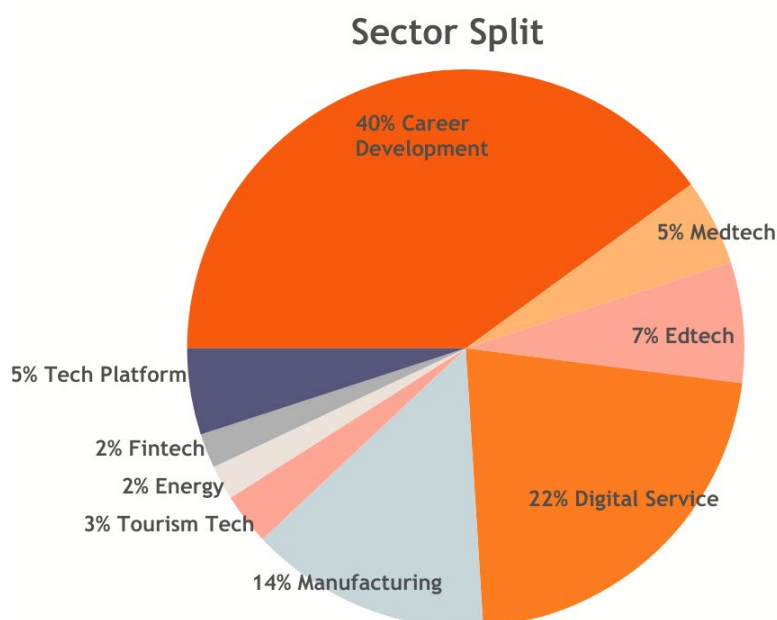


Figure 6. Analysis on sectoral split of female entrepreneur participating on programme

in Figure 6. The sectors represented by participants include Manufacturing, Fintech, Sustainable Energy, Tourism Tech, Digital Services, Tech Platforms, EdTech and Medtech. A large cohort of career development participants were from Biotechnology and Life Science sectors.

While a full qualitative analysis of participant feedback has yet to be completed, positive sentiment for the content of the programme can be gleaned from participant comments such as: “Confidence and networking and the demystifying of STEM were the most valuable things I gained”, “gave me a great introduction into the world of STEM”, “extremely informative condensed course”, “topics covered are very relevant”, “I felt I was in the most capable hands in terms of (STEM) knowledge”, “insightful guidance and mentoring provided by expert speakers and mentors” and “helped me navigate my way through STEM topics related to my business.” Wider impacts were also reported such as: “fortified my spirit with unwavering confidence and resilience”, “the experience of participating has been invaluable”, “invaluable in so many ways”, “a perfect, first step, to future development”, “professional, supportive and empowering”, “illuminating the path with hope and professional camaraderie”, “a journey of learning and personal growth and with a non-judgemental and supportive network” and “given me back some of the confidence I have lost over the last two years.”

Career advancement and Career Changers reported that the programme “opened up a lot of opportunities I didn’t know were even out there for me” and “reintroduced me to further education and has led me to continue upskilling”. Entrepreneurs indicated that it is “helping me to explore my route to market as well as establishing the viability of my business”, “a great asset in helping me build confidence and grow my capabilities in my business”, “a beacon for any woman venturing into the entrepreneurial world”, and “supports women in getting

clear on their business ideas and how to make them a reality.” Network development aspects show it “shattered my sense of isolation”, “made some amazing connections”, “helped me gain support through invaluable mentorship and I have established a fantastic network through the course and networking events”, “a non-judgemental and supportive network” and “opened up valuable networks in this (STEM) area.”

A specific example of feedback demonstrates the depth of impact attributed to the programme from a career changer:

 *“I just wanted to say thank you for all that Thrive did for me. I will begin a new role in November as a Product Manager. Thrive really helped me to take the first steps onto this career path and it has paid off. Not only will I have a substantial pay rise, but I have learned so much about working in Tech. I know how to communicate with software engineers and what is feasible in their world. Even better I know how to drill down to find the problem that customers want solved and what makes for a great product market fit. I am really enjoying Product Management and know it will stand to me when I am ready to create a tech product.”* – a female career changer in Data Analysis sector

KEY LEARNINGS



The pilot phase was beneficial

This allowed a degree of flexibility over the broad range of topics included in programme content, and an opportunity to iterate to better meet individual needs. As the programme progressed from first to final iteration, the content was adapted to include more deep tech topics to reflect the interests and learning needs of the participants. Going forward, it would be worth exploring niche group support with specific content if timing, resources, and budget allowed.

Adopting a holistic approach

This was significant to the success of this programme. Building participant’s confidence and network proved just as important as building their STEM capability for a sustainable future in STEM/Deep tech. Qualitative or Sentiment Analysis should prove useful to measure additional impacts of a holistic programme approach.

Participants felt alienated from STEM/Deep Tech fields

Participants were unfamiliar with the language and terminology; they lacked female role models, STEM/Deep tech experience and exposure to roles in this sector. Even the ‘STEM/Deep Tech’ acronym proved confusing and unfamiliar. When STEM/Deep Tech topics were demystified, participants felt that they did have some experience or skills in these areas. However,

while they lacked the appropriate language/terminology to articulate such experience/skills, they often proved to be more informed, competent, and skilled than they had initially thought.

Building On Existing Research

We found some specific barriers impacting women's progress in entrepreneurship and career development:

Finance – Participants found the cost of the programme a huge consideration when deciding whether they should participate.

We addressed this issue by offering a programme bursary.

Time – We found that attendance, length of sessions, programme duration and location were critical considerations for participants.

Flexibility – Women need flexibility (timing, accessibility) when committing to entrepreneurship programmes, mostly to support caring responsibilities. Most respondents highlighted that “the flexibility of this programme online and in-person made it possible for me to participate.”

Non-directive learning

was exercised over many aspects of the programme and proved to be very effective for participant development and learning. Energies and interest were raised as participants learned and absorbed experiences and information quickly from their peers, real life examples and interaction with role models. Without peers or a supportive STEM/Deep tech network, women may feel isolated.

Designed for non-STEM/non-Deep tech educated women

While the programme was aimed at non-STEM/Deep Tech women, it also attracted STEM/Deep Tech educated women who saw the programme framework as a valuable support to career development and a progression pathway to leadership roles. This support is exercised internally in some larger multinationals, but women in local STEM industries do not have access to these career development supports in this sector. There is an opportunity to offer these women more sector specific career development supports.

CONCLUSIONS

According to feedback received, THRIVE4women successfully demystified a range of deep tech topics and built participants' confidence to grasp these complex concepts for current and future needs. The interim and early-stage indications of THRIVE4women show that the programme has supported 51% of participants to successfully transition to STEM careers or launch STEM businesses. An additional 22% report that the support they received is currently helping them achieve similar aims. The holistic approach adopted in programme design and content and the provision of a mentor and network support are significant factors contributing to enhancing participants' success. Further programmes could build on these learnings and explore the value and impact of holistic supports in helping women launch careers and businesses in STEM/Deep tech fields.

AUTHOR BIOS

Lavina McGahon is the THRIVE4women Programme Manager at Dundalk Institute of Technology (DkIT), Ireland and supports women in both their STEM/Deep Tech careers and entrepreneurship. She focuses on raising the profile of women in STEM and is passionate about building women's confidence through personal development, capability and strong support networks. (lavina.mcgahon@dkit.ie).

Garrett Duffy is Incubation Centre Manager at the Regional Development Centre, Dundalk Institute of Technology (DkIT), Ireland. He has a manufacturing background and been supporting entrepreneurs and enterprise development in the Northeast of Ireland since 2007. (garrett.duffy@dkit.ie).

References

- Bishop, K. (2022). The 'time poverty' that robs parents of success. London: BBC.
- Chem, N. (2022). Dismantling barriers faced by women in STEM. 1203-1206. Retrieved from <https://www.nature.com/articles/s41557-022-01072-2>
- Code Institute. (2023). Delivering Diverse Tech Talent At Scale. UK: Code Institute.
- Henry, C., Hill, F. & Leitch, C. (2017). Entrepreneurship Education and Training. London: Routledge.
- Henry, C., Coleman, S., Orser, B. & Foss, L. (2022). Women's Entrepreneurship Policy and Access to Financial Capital in Different Countries: An Institutional Perspective. Entrepreneurship Research Journal.
- Crunchbase. (2019, November 26). Female Stem Entrepreneurs are Gaining Momentum. Retrieved from [www.crunchbase.com: https://news.crunchbase.com/diversity/female-stem-entrepreneurs-in-latin-american-are-gaining-momentum](https://news.crunchbase.com/diversity/female-stem-entrepreneurs-in-latin-american-are-gaining-momentum)
- DETE. (2024, April 24). Female Entrepreneurship. Retrieved from [enterprise.gov.ie: https://enterprise.gov.ie/en/what-we-do/the-business-environment/entrepreneurship-/female-entrepreneurship/](https://enterprise.gov.ie/en/what-we-do/the-business-environment/entrepreneurship-/female-entrepreneurship/)
- Eisenmann, T. (2013). Entrepreneurship: A Working Definition. Harvard Business Review.
- Elena Prieto-Rodriguez, K. S. (2022). A study of factors affecting women's lived experiences in STEM. Humanites and Social Sciences Communications. Retrieved from <https://www.nature.com/articles/s41599-022-01136-1>
- Forbes. (2021, September 9). Overcoming some of the barriers to women entrepreneurship. Retrieved from [www.forbes.com: https://www.forbes.com/sites/forbesbusinesscouncil/2021/09/21/overcoming-some-of-the-barriers-to-women-entrepreneurship/](https://www.forbes.com/sites/forbesbusinesscouncil/2021/09/21/overcoming-some-of-the-barriers-to-women-entrepreneurship/)
- IBEC. (2020). Women in Management in Ireland. Retrieved from [www.ibec.ie: https://www.bing.com/ck/a?!&p=9141bf0a2be8ec32JmldtHM9MTcxMzKxNjgwMCZpZ3VpZD0zZTliNDM2ZS1hZjlkLTZjZDUtMzg5MS01NzJjYVWVIMjZkMmlmaW5zaWQ9NTlwMw&ptn=3&ver=2&hsh=3&fclid=3e9b436e-af9d-6cd5-3891-572caee26d2b&psq=IBEC+Survey+2019%3a+Women+in+management+in+Ireland](https://www.bing.com/ck/a?!&p=9141bf0a2be8ec32JmldtHM9MTcxMzKxNjgwMCZpZ3VpZD0zZTliNDM2ZS1hZjlkLTZjZDUtMzg5MS01NzJjYVWVIMjZkMmlmaW5zaWQ9NTlwMw&ptn=3&ver=2&hsh=3&fclid=3e9b436e-af9d-6cd5-3891-572caee26d2b&psq=IBEC+Survey+2019%3a+Women+in+management+in+Ireland)
- Ireland, E. (2020). Action Plan for women in Business. Dublin: Enterprise Ireland. Retrieved from <https://www.enterprise-ireland.com/documents/action-plan-for-women-in-business-en-92306.pdf>
- Ireland, I. (2021). Women in STEM, Ireland. IDA.
- Kuschel, K. E.-G. (2020). Stemming the gender gap in STEM entrepreneurship – insights into women's entrepreneurship in science, technology, engineering and mathematics. . Int Entrep Manag J, 16, 1-15.
- M. Sajjad, N. K. (2020). Worldwide role of women entrepreneurs in economic development. Asia Pacific Journal of Innovation and Entrepreneurship, Vol. 14 No. 2, pp. 151-160.
- McKinsey. (2022, March 1). Repairing the broken rung on the career ladder for women in technical roles. Retrieved from [www.mckinsey.com: https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/repairing-the-broken-rung-on-the-career-ladder-for-women-in-technical-roles](https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/repairing-the-broken-rung-on-the-career-ladder-for-women-in-technical-roles)
- OECD. (2016). Supporting Women Entrepreneurs in Ireland . European Commission.
- Rose, A. (2019). The Alison Rose Review of Female Entrepreneurship. London: gov.uk.
- School, J. B. (2022, February 11). Female entrepreneurship: what's holding women back? Retrieved from University of Cambridge: <https://www.jbs.cam.ac.uk/2022/female-entrepreneurship/>

She.Work. (2023, September 14). Understanding Women Entrepreneurs: Challenges, Strengths, and Impact. Retrieved from she.work.com: <https://she.work/women-entrepreneurs-challenges-strengths-impact/>

UN. (2024, April 24). The 17 Goals. Retrieved from United Nations - Make the SDGs a Reality: <https://sdgs.un.org/goals>

WEF. (2017). Global Gender Gap Report. Geneva: World Economic Forum.

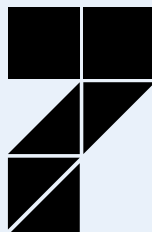
¹ Female entrepreneurship: what's holding women back? – News & insight – Cambridge Judge Business School

² A study of factors affecting women's lived experiences in STEM | Humanities and Social Sciences Communications (nature.com)

³ The 'time poverty' that robs parents of success – BBC Worklife

⁴ EEPA 2023 National Winners – Promoting the Entrepreneurial Spirit – European Commission (europa.eu)

Alexander Spriet, Jolien Coenraets
& Davy Vercruysse



FROM RESEARCH TO MARKET: A NOVEL ENTREPRENEURSHIP TRAINING PROGRAMME FOR RESEARCHERS

ABSTRACT

Research to Market is Ghent University's Entrepreneurial Centre's four-day workshop designed to foster entrepreneurial competencies among researchers at all career stages and to identify opportunities for translating scientific research into viable business ventures. Beginning with a brief introduction to the entrepreneurial ecosystem, this chapter provides a comprehensive overview of the training content, structure, and participant profiles. Finally, we present a summary of our impact, including an example story, and highlight key learnings derived from our experience.

Key words: Researchers, Entrepreneurship, Training, Good Practice, Entrepreneurial Ecosystem



INTRODUCTION

In recent decades, there has been a surge in research focusing on entrepreneurial ecosystems. For instance, Audretsch and Belitski (2017) delve into regional entrepreneurial ecosystems, unveiling a start-up model. Similarly, Fernandes and Ferreira (2022) underscore the significance of entrepreneurial ecosystems in research and political agendas, providing a literature review and research agenda. In addition to scholarly research, universities are increasingly emphasizing support for entrepreneurship among their researchers. The best practice example presented in this chapter exemplifies how Ghent University assists researchers in gaining entrepreneurial competencies and exploring business opportunities early on.

REGIONAL ECOSYSTEM CONTEXT

Ghent University, a research institution with approximately 50,000 students, 5,800 PhD candidates, and 8,100 academic staff, is situated in Flanders, Belgium. It is home to an entrepreneurship center named DO! (See Figure 1), which serves as the main hub for university members considering starting their entrepreneurial ventures. Through a range of support services, such as providing information and coaching, along with offering diverse programs, DO! aims to be the starting point for students and researchers who are interested in becoming entrepreneurs. One such programme offered by DO! is Research to Market, which forms the focal point of this exemplary practice. This programme is dedicated to the pre-spin-off phase, emphasizing the early stages of the entrepreneurial process.



Figure 1. DO! and Ghent University logos

RESEARCH TO MARKET?

Research to Market is a four-day training programme specifically designed for PhD students and researchers. The programme serves a dual purpose: 1) To enhance the entrepreneurial competencies of researchers, and 2) To identify potential spin-offs and business ventures at an early stage. The training delivered in the workshop focuses on leveraging participants' own research, which most often has a deep tech focus. The following section outlines key components of the training, including content, set-up, and participant profiles.

Training Content

The programme commences with an online preparatory course, requiring approximately four hours of commitment, wherein participants learn the theoretical concepts. This preliminary step enables us to concentrate on interactive coursework during the subsequent four-day training session, split into two consecutive days over two weeks. The online component incorporates two case studies, facilitating the translation of theory into practical application,

and offers tangible examples of the steps the researchers need to take. Additionally, there is a two-hour online preparation session scheduled between days two and three of the workshop.

Throughout the programme, encompassing both the online course and workshop days, participants engage with the following topics and materials²:

- Understanding the distinction between the roles of a researcher and an entrepreneur, supplemented by insights from a guest speaker sharing their personal journey.
- Communicating their research effectively to a non-specialist audience.
- Exploring ways to translate research into societal benefits or marketable products/services, employing techniques such as the Research Canvas for opportunity identification.
- Identifying target customer segments and devising strategies to persuade them to adopt their offerings, utilizing the Value Proposition Canvas.
- Evaluating various business models to secure the necessary resources for opportunity execution, employing the Business Model Canvas.
- Familiarizing themselves with Lean Start-up principles and techniques for identifying and (in)validating assumptions.
- Crafting compelling pitches (e.g., one, two, four, and five minutes), with the aid of the Spin-off Opportunity Pitch Canvas.

Training set-up

Alongside content, careful consideration is given to the organization of the training to facilitate the development of entrepreneurial competencies and the generation of ideas. In this section, we provide insights into the coaches' backgrounds, and deliberate exclusions, group size, and preferred team climate.

An essential aspect of Research to Market's set-up is the delivery of the training to participants. Three different coaches facilitate the training. The one who functions as the main lecturer offers instructions and brief theoretical insights between exercises. In our example, the facilitator is a female with a background in computer science engineering who established her start-up during her studies. Subsequently, she worked part-time as a teaching assistant at the University, focusing on entrepreneurial topics such as brainstorming, value proposition, and business model canvas. This unique blend of technical understanding, didactic skills, and personal entrepreneurial experience is instrumental in delivering training with high potential for Deep Tech ideas.

The role of the other two coaches is to coach and support student entrepreneurs and start-ups in the very early phase. Their primary role is to challenge basic assumptions and emphasize the importance of participants' ability to explain their research clearly and concisely. These coaches have firsthand experience in starting a company and have formal training in coaching skills.

It is important to note that, at this stage, personnel from our Tech Transfer Office are deliberately not involved, as the ideas generated are often at a very early stage. Therefore, we prioritize creating a psychologically safe environment, stimulating participants to explore various valorization options through thought experiments. This approach aims to stimulate idea generation, motivation and instill the belief and confidence that entrepreneurship is a learnable skill. Given that the target population comprises researchers, discussions may touch upon Intellectual Property (IP). However, we provide only brief information on IP and



DO! Centre for Entrepreneurship

its transferability to avoid hindering brainstorming processes and thought experiments.

A typical training cohort consists of 12 to a maximum of 16 participants divided into small groups of three to four individuals from diverse backgrounds to facilitate regular discussions and peer feedback. This approach enhances learning by encouraging the application of concepts to various research types and fostering the exchange of insights among participants. Additionally, participants receive feedback from business coaches at specific intervals, and the groups are reconfigured between sessions to maximize peer feedback opportunities. The training culminates in a pitching session, with feedback provided by a panel of start-up scouts representing potential follow-up programmes. Essential here is the fresh perspective of these scouts who have not met or heard from the participants during the workshop itself. This also creates networking opportunities with other partners in the entrepreneurial ecosystem.

Creating a psychologically safe climate to enhance learning is crucial (Newman et al., 2017). Based on our experience, we offer the following two tips:

- Enthusiasm from facilitators and coaches is essential to convey the joy of entrepreneurship to participants. We create an informal atmosphere with participation expectations rather than output expectations.
- Incorporating humor, out-of-the-box exercises, and energizers strengthens an environment where all ideas are welcomed. This approach keeps participants motivated as it fosters group cohesion and the relatedness between them.

Participants

Research to Market typically attracts a diverse range of participants in terms of academic background, gender, and nationality. The only requirement for joining the training is active involvement in research, whether as a PhD candidate, (postdoctoral) researcher, or professor, and the willingness to explore business opportunities within their research. We believe this low barrier to entry means that this programme is often researchers' first experiences with entrepreneurship.

In terms of participant profiles, Research to Market welcomes researchers from all three types of faculties. Specifically, 62% come from Beta faculties (natural sciences, applied sciences /engineering, bio-engineering science), 28% from Gamma faculties (medicine and health sciences, veterinary medicine, pharmaceutical sciences) and 10% from Alpha faculties (arts and philosophy, law, economics and business administration, psychology and educational sciences, political and social sciences). As mentioned earlier, it is crucial for participants to leverage their own research for the exercises in this programme, regardless of whether or not their ideas are tech-related.

Regarding gender distribution, approximately 58% are men and 42% are women. Here, we argue that universities need to draw more attention to the inclusion of female students into accelerator and incubator programmes. For instance, Neumeyer (2020) indicates in their study that fewer female students participate in such programmes but once they join the entrepreneurship programme, they encourage other women to do likewise. Also, although their self-efficacy and intention were lower than those of male students at the beginning of the programme, at the end, their scores for both variables were equal.

Finally, regarding nationality, around 59% of the participants are foreign researchers pursuing a PhD or postdoc in Belgium. This trend can be attributed to the programme being offered in English, thereby attracting a diverse international cohort. These statistics demonstrate that Research to Market attracts a diverse group of researchers.

Most participants join Research to Market during the final two years of their PhD studies, although this is not mandatory. Those in the early stages of their PhD benefit from learning about the entrepreneurial mindset, even though their programme outcomes may be more hypothetical. Conversely, researchers nearing the end of their PhD may have concrete results ready for translation into business ventures but may face time constraints due to concurrent demands of completing their doctoral thesis. Postdoctoral researchers frequently participate as they are already on a trajectory toward spin-off development; they are ideal candidates, given the high likelihood of further business idea development.

In terms of motivation, some of the participants take part because they aspire to start something based on their research, while for others, it is merely an opportunity to gain insights into entrepreneurship. Both mindsets are valid for this type of training where participants can gain valuable knowledge regardless of their motivation. Those willing to start a company are often identified in this programme for potential inclusion in follow-up programmes, which constitutes an essential element of our entrepreneurial ecosystem.

IMPACT

To illustrate the impact of Research to Market, this section offers statistics, quotes from participants, and one concrete example. In terms of numbers, 128 researchers participated in one of the 11 editions since the programme was first launched in 2019. An important aspect to note is that participants often enter the programme with vague ideas or with no idea at all, simply intrigued by entrepreneurship. This means they had no prior contact with business

developers, investors, incubators, or anyone within the entrepreneurial ecosystem. In other words, for many researchers, this training is their first point of entry into the entrepreneurial ecosystem. High-potential ideas may take between three to ten years before they can enter the market.

Below, we share some snippets of feedback from previous participants:



"I liked the positive energy the organizers were putting into the training. Very good advice given as well."

"I have learned new ways to look at my business-to-be and locate possibly dangerous assumptions. The way everyone's business ideas evolved from day 1 to day 4 was really inspiring. This was my last doctoral school's course but also probably the best."

"Very interactive course, reachable lecturers, nice to change groups halfway the process to get to know the other participants as well."

"I very much liked the interactive and practical approach of the course. I had seen the theoretical aspects before in other courses where I thought I understood them. However, after practically trying out some of these aspects during the course, I realized it was very different from what I thought."

"Wonderful programme as it teaches the researchers to go back to the foundation of their research and clearly communicate the potential of the research on the market. The coaches made the entire program feel like a safe space to learn."

To showcase the impact of Research to Market, we highlight one participant. One of the participants of this programme (in the third edition in October 2022), was a female PhD student in Educational Sciences. Like many others, she discovered this training through the Doctoral Schools Newsletter at Ghent University. Her idea was to enhance written feedback using AI, particularly among professionals without an educational background. Upon completion of Research to Market, she applied for and was accepted into our university's 7-month start-up programme, Expedition DO! which ran from March to October 2023. This programme is designed to support Ghent University students and researchers in developing their business ideas into successful start-ups. In October 2023, she officially registered her company named FeedbackAID. Meanwhile, she also publicly defended and received her Doctorate in Educational Sciences, focusing on the use of Artificial Intelligence to improve written feedback.

This story highlights the role and effectiveness of Research to Market and its subsequent start-up programme at Ghent University. Specifically, Research to Market served as the starting point for developing key entrepreneurial skills and exploring business opportunities based on participants' own research. Its function in the ecosystem was to act as a funnel for follow-up programmes, eventually leading, in the example provided, to a PhD student starting her own company after graduation.

KEY LEARNINGS



BLENDED LEARNING APPROACH

By allowing participants to prepare the theoretical component in advance, we create more space for interactive discussions and feedback during the workshop itself. This fosters deeper engagement and facilitates the application of concepts.

INCLUDE DIVERSE COACH PROFILES

Diverse coach profiles are essential, covering technological, social, and business perspectives. This diversity ensures the provision of comprehensive support tailored to participants' varied needs and backgrounds.

EMPHASIS ON PARTICIPANT DIVERSITY

Participant diversity is fundamental, as it enriches discussion and feedback. A varied group composition enhances the clarity of ideas.

UTILIZATION OF EXISTING TEMPLATES

Leveraging well-known templates such as the Value Proposition Canvas and Business Model Canvas proves highly beneficial. These resources streamline the learning process, facilitate structured idea development, and are regularly used in follow-up programmes.

CREATING A PSYCHOLOGICAL SAFETY CLIMATE

Incorporating energizers and humor deliberately cultivates a psychologically safe environment. This approach encourages idea generation and active participation.

INTEGRATION WITHIN THE UNIVERSITY

Research to Market is seamlessly integrated into the University's framework and offered as part of the Doctoral School curriculum. Its regular scheduling enhances visibility among university stakeholders, encouraging recommendations and referrals.

EXCLUSION OF INTELLECTUAL PROPERTY (IP) DISCUSSIONS

At this early stage of entrepreneurial exploration, the focus remains on idea generation and key entrepreneurial competencies. IP discussions are intentionally omitted to prioritize creativity and ideation without constraint.

CONCLUSIONS

This best practice demonstrates a four-day workshop designed specifically for researchers to learn key entrepreneurial skills and discover how to turn their research into marketable products or ideas. In this chapter, we have highlighted important aspects such as the content and organization of the training, where creating a psychologically safe climate plays an important role in learning. We have also stressed the significance of having diverse coaches and participants. By sharing statistics, insights into participants' experiences, and an example story, we illustrate the impact of this training and how it serves as a starting point for researchers to enter the entrepreneurial ecosystem.

AUTHOR BIOS

Alexander Spriet is Project Manager at DO! Center for Entrepreneurship (Start for Future) at Ghent University. (Alexander.Spriet@ugent.be)

Jolien Coenraets is General Manager at DO! Center for Entrepreneurship at Ghent University. (Jolien.Coenraets@ugent.be)

Dr. Davy Vercruysse is a Senior Lecturer and Researcher in Entrepreneurship Education & Gender Entrepreneurship, at Ghent University. (Davy.Vercruysse@ugent.be)

References

- Audretsch, D. B., & Belitski, M. (2017). Entrepreneurial ecosystems in cities: establishing the framework conditions. *The Journal of Technology Transfer*, 42, 1030–1051.
- Fernandes, A. J., & Ferreira, J. J. (2022). Entrepreneurial ecosystems and networks: a literature review and research agenda. *Review of Managerial Science*, 16(1), 189–247.
- Neumeyer, X. (2020). Inclusive high-growth entrepreneurial ecosystems: Fostering female entrepreneurs' participation in incubator and accelerator programs. *IEEE Transactions on Engineering Management*, 69(4), 1728–1737.
- Newman, A., Donohue, R., & Eva, N. (2017). Psychological safety: A systematic review of the literature. *Human Resource Management Review*, 27(3), 521–535.

Footnotes

¹ DO! is the abbreviation for Durf Ondernemen! which translates to Dare to Venture!

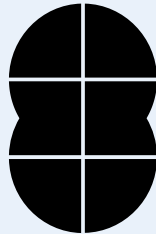
² All video materials created for the course are available on YouTube. These resources, along with all course materials, are freely accessible for use in other courses, thanks to funding from the European Institute of Innovation and Technology (EIT).



III.

Accelerators / Incubators

Sabrina Tomasi, Alessio Cavicchi, Cristiana Barghini,
Rachele Di Maio, Loredana Guarino, Paolo Cannata



CONTAMINATION LAB: ENTREPRENEURSHIP EDUCATION FOR INNOVATION, SUSTAINABILITY, AND INCLUSION

ABSTRACT

Entrepreneurship education is now an integral part of the university didactic offer. It fosters new opportunities for start-up creation and self-employment by focusing on innovation, sustainability, and inclusion in response to compelling local and global challenges. By involving the whole academic community and immersing themselves in their local context, universities can provide students with an entrepreneurial mindset while pursuing their ‘fourth mission.’ In this regard, university Technology Transfer Offices and University Business Incubators play a pivotal role. This chapter presents the case of the Contamination Lab Pisa as a good practice example of entrepreneurship education geared toward sustainability, innovation, and inclusion.

Key words: Entrepreneurship education, University business incubator,
Responsible business models, Universities’ fourth mission



INTRODUCTION

The European Commission recognises that entrepreneurship education is not only about learning how to run a business but also about developing a set of general skills, attitudes and behaviours that can be applied in all areas of life and that can contribute to an “entrepreneurial mindset.” This involves developing skills in critical thinking, initiative-taking and problem-solving, as well as learning how to collaborate with others (European Commission, 2014).

Universities are undergoing a radical shift from a “third” to a “fourth” mission, as they are increasingly expected to involve themselves in processes of “co-creation for sustainability” (Trencher et al., 2014). Their objective is to contribute to sustainable economic and social development by collaborating with different stakeholders at the local level and by involving students as active learners connecting them with real-world challenges. Entrepreneurship and technology transfer are among the strategies universities adopt to pursue this objective. Therefore, the recognition of entrepreneurship education within the university, its integration into its Mission and Strategic Plans, and the development of appropriate reward and incentive systems to increase engagement in these activities are all pivotal elements (Rubens et al., 2017).

Indeed, as pointed out by Tijssen et al. (2021), knowledge-based and market-driven innovations can be co-developed by companies and other organisations involving universities as key partners to promote the establishment of new start-ups or spin-offs. In this context, Technology Transfer Offices (TTOs) and University Business Incubators (UBIs) play a pivotal role in fostering the strategic adaptation of entrepreneurial mindsets throughout the institution. Such mindsets influence both the internal and external environment in terms of organisational growth, productivity, best practice, competitiveness, the knowledge-based economy and society (Yosuf & Jain, 2008). The example of the Contamination Lab Pisa (CLab Pisa) discussed in this chapter represents a good practice example of this phenomenon.

REGIONAL ECOSYSTEM CONTEXT

Since 2014, in line with the Smart Specialisation Strategy (S3), the Tuscany regional technology transfer ecosystem established several Technology Districts. These are open cooperation platforms involving public and private entities, which are aimed at supporting small and medium-sized enterprises in the adoption of digital technologies. Technology districts are made up of companies, research organisations, public administrations, technology transfer centres and infrastructures, digital innovation hubs, competence centres, training organisations, non-profit organisations, and trade associations. They carry out activities for the dissemination and diffusion of digital technologies in production processes and services through the coordinated promotion of technology transfer centres and infrastructures, such as applied research laboratories, technology demonstrators, digital fabrication laboratories (FabLabs), business incubators, coworking spaces, and the exchange and transfer of knowledge and skills. The aim is to shorten the transfer chain and support the cooperation and collaboration of technology transfer actors present in the ecosystem through formalised organisational modules. These have been constructed by outlining development guidelines, namely, priority lines of intervention, in an identified area of research and innovation.

The 11 Tuscany Technology Districts refer to technological areas of research and innovation of specific interest to the Tuscany Region. They have a specific organisational

model (chairman + steering committee + managing body). They cover the following fields, all fostered by technology:

1. Fashion
2. Interior and Design
3. Marble and Ornamental Stone;
4. Life Sciences
5. New Materials
6. Nautical and Port Technology
7. Railway Technology
8. Energy and Green Economy
9. Smart City, Tourism and Cultural Heritage
10. Paper Technology
11. Advanced Manufacturing

The Regional Technology Transfer Office supports the research infrastructures and Technology Transfer Offices (TTOs) of universities and high schools in their third mission activities to define shared strategic actions for the valorisation of research towards small and medium-sized regional enterprises. The University of Pisa (UNIPi) represents a relevant actor in this ecosystem. Among Tuscany's seven universities, UNIPi is one of the three largest (along with Florence and Siena), with a generalist and interdisciplinary profile. In 2020, its academic community comprised 1,943 staff (Full and Associate Professors, Researchers, Research Fellows, etc.) and around 45,000 enrolled students.

The UNIPi TTO's mission is to transfer the findings of scientific research to the productive world through entrepreneurial culture training for students and researchers; support for enterprise creation and spin-offs; protection of intellectual property and valorisation of patents, and collaboration with companies through conventions and projects. Some of these activities are achieved through the Contamination Lab (CLab), which is open to students and researchers of the University of Pisa as well as those from Sant'Anna School of Advanced Studies, Scuola Normale Superiore in Pisa and IMT Altus in Lucca.



Figure 1. CLabbers involved in a Design Thinking exercise

CONTAMINATION LAB PISA

Contamination Lab Pisa (CLab Pisa) was established in 2017 following a three-year grant from the Ministry of University and Research. It was subsequently funded by the University of Pisa to promote and disseminate entrepreneurial culture, innovation, and valorisation of new

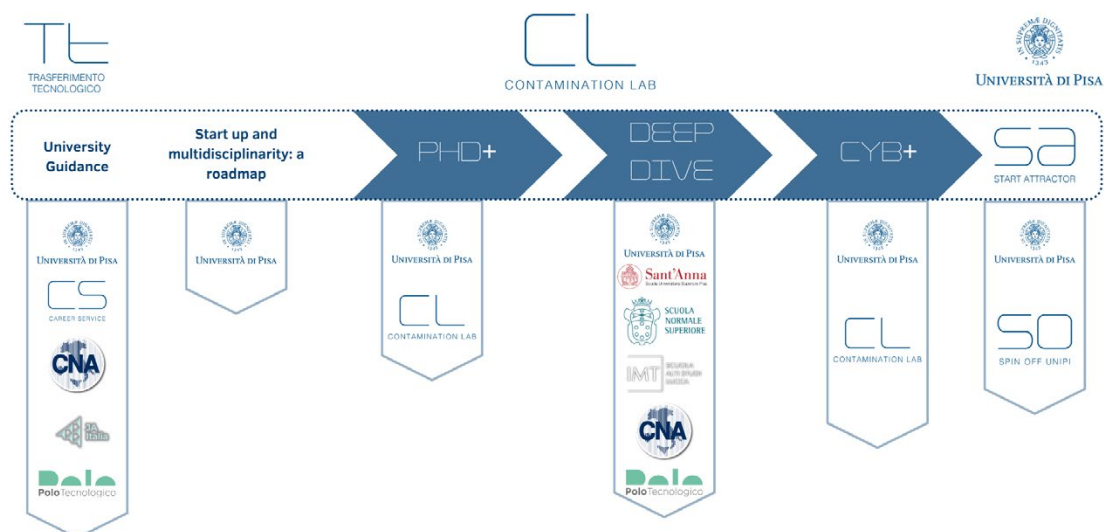


Figure 2. The new structure of the CLab

sustainable business ideas and interdisciplinarity. It acts as a University Business Incubator focusing on pre-incubation activities. Among its aims is the creation of a network of contacts and opportunities for knowledge exchange and research. Through various professional collaborations, CLab also aims to impact positively on employment, workforce training and start-up levels, thus stimulating the transversality of skills.

CLab provides opportunities for participants to explore and validate business models in which the concept and status of innovative products/services are intertwined with principles of sustainability, social responsibility, and inclusion. The Design Thinking approach adopted by CLab offers an environment that favours practical and creative problem-solving, allowing “CLabbers” from different disciplinary backgrounds to get to know each other and work together, acquiring design, organisational and communication tools and soft skills that characterise successful professionals (see Figure 1).

Since 2020, CLab has promoted several rounds of the following entrepreneurship activities:

- **PhD+**: A beginners’ educational programme aimed at students, PhD students, PhDs and researchers with a basic business idea, introducing them to an entrepreneurial mindset, a culture of innovation, business models, business plan creation and team building.
- **CYB+**: An advanced educational programme in the form of action-learning seminars, designed to strengthen the process of building, training and developing the innovative business projects which have been proposed by participants during the course.
- **Soft skills for tomorrow’s businesses (2021)**: A series of online seminars dedicated to the development of soft skills. Seminar topics include public speaking, handling company meetings, handling errors and problems in the company, and conflict management in the team.
- **CONTHACKT**: Since 2020, CONTHACKT has operated as a hackathon targeted at teams of students and PhD students, organised in conjunction with the Start for Future programme and the CircleU European Universities Alliance. Commencing with the launch of a series of local challenges by entrepreneurs and organisations, teams of students are provided with tools and methods to prepare and finally pitch their solutions in the form of a business idea. The first iteration focused on digital journalism, while the second and third focused on sustainable and digital transitions.

In 2024, the structure of the CLab was revised (see Figure 2). The PHD+ initiative has been

shortened and an entrepreneurship course – “Start-up and multidisciplinary: A roadmap” – has been introduced as a transversal course offered to students of every department (currently, 20 departments). The Deep Dive consists of five days of seminars, each one dedicated to a particular sector (e.g., ICT, Agrifood, Pharma, Creative and Cultural Industry, DeepTech). Lecturers and industry experts as well as successful “start-uppers” and spin-offs share key aspects of business creation and development with participants (students, PhD students, researchers, scholars). The CYB+ maintains the same main characteristics.

This new structure includes the University’s Guidance Services, with entrepreneurship education activities addressed to high schools in collaboration with Junior Achievement Italia, the CNA Pisa, and the Navacchio Technology Hub. The Deep Dives are carried out in collaboration with Scuola Normale Superiore, Sant’Anna School of Advanced Studies and IMT Altì Studi Lucca, and involve both academic staff and students from the three institutions. The CNA Pisa and the Navacchio Technology Hub contribute to the DeepDive organisation, by providing speakers and logistical support.

IMPACT

Since its establishment, CLab Pisa has trained 1,200 participants, fostered 120 projects and promoted awards for a total amount of 50,000 euros. Some of CLab’s initiatives have been designed according to sustainable and inclusive principles, with digitalisation and technology advancement as key transversal elements. While CONTHACKT 2021 focused on food, sustainable mobility and digital transformation, CONTHACKT 2022 (see Figure 3) focused on Agrifood, Urban Mobility, Digital Solutions, Health and Climate. In the latter example, business challenges related to transparency and efficiency of food supply chains; urban-rural logistics and food & beverage delivery; food waste reduction and reuse; healthy and sustainable diets; tourism in rural areas and global warming and ecosystems. Sustainability, innovation and gender balance within participating teams were among the key criteria used to select the best solutions put forward.

In terms of impact, CLab’s format supported students to develop business ideas with high social value because the proposed solutions were expected to meet the needs of existing local stakeholders and communities while addressing global challenges. Moreover, participants were asked to learn and reflect on the interconnectedness of the economic, social, and environmental pillars of sustainability by developing systems and critical thinking skills. The interdisciplinary nature of the teams (which included students with different study backgrounds) and the promotion of a gender balance, fostered a more inclusive environment, thus enhancing the under-representation of women in entrepreneurship initiatives.

Similarly, the 2023 edition of the CYB+ promoted the attribution of prizes to start-ups that demonstrated innovativeness, inclusivity and sustainability. More specifically, the Start For Future (SFF) prize was assigned to the best innovative idea in one of the following sectors: Manufacturing, Mobility, Circular Economy, Food, Health and Energy. The CUG Prize “What an enterprise! Designing the enterprise: Equality and sustainability for a competitive cultural entrepreneurship” was assigned by the Unique Guarantee Committee of the University of Pisa (CUG) to the most innovative and sustainable idea promoting gender culture, equity in the economic and contractual treatment of male and female workers, social commitment, and culture as a common good. A recognition by the University’s Commission for Sustainable Development (CoSA) was also included for the best idea developing a social innovation, especially one that addressed the most fragile members of local communities (immigrants and ethnic minorities, or urban populations living in marginal or poor areas). Such initiatives promoted a broader and more interrelated approach to sustainable entrepreneurship at the



Figure. 3. Group picture from the CONTHACKT 2022

university level, as several institutional entities came together to contribute to the integration of innovation, inclusion and social sustainability, thus relaying a strong and positive message to students. This message highlighted the need for a greater responsible approach to business, one that can produce new start-ups willing to contribute to a more sustainable world and, as a result of the learning process, increase awareness and commitment among students as citizens. In line with this approach, the CLab also supports start-ups' deep tech-driven solutions, as a tool to design sustainability and wellbeing-oriented products and services. Most of the start-ups that started their entrepreneurial journey at the CLab (of which, a certain number also attended the Start for Future programme) included IT in their business concepts. Among others, two examples are particularly relevant: One start-up from the Food sector (in the process of being established) focuses on food traceability and blockchain technology addressed to agrifood companies; another one, from the Health sector produces – and has already launched on the market – wearables for sport and health by using fabric AI sensors to measure people's physical parameters.

Sustainability objectives are also pursued through the active involvement of local stakeholders as partners in activities and the creation of bonds between the university and the surrounding entrepreneurial environment. As an example, during the Network Lab networking event (which was open to the 2023 PhD+ participants and dedicated to "Agriculture, Social Inclusion and Sustainability"), some socially committed companies presented their sustainable business models and shared their experiences. One of them also hosted a fieldwork activity dedicated to PhD+ participants in their oil mill, showcasing their sustainable practices and providing examples of their social inclusion initiatives.

Finally, CLab promotes a culture of entrepreneurship among high school students, in line with the specialisation areas identified by the Tuscany Region. As an example, the CLab "Livorno Innovativa" event in 2023 was dedicated to the innovation and research ecosystem for the development of the maritime economy. At this event, students attended a presentation on good practice examples in technological start-ups, which helped promote an entrepreneurial culture. This, in turn, encouraged young students to consider entrepreneurship as an integral and transversal part of their university education, thus supporting university guidance activities. Moreover, it spread the idea of self-employment as a viable professional pathway among young people. In this regard, the role of CLab Ambassadors (former CLab participants engaged in dissemination activities) was pivotal.

KEY LEARNINGS



The CLab Pisa highlights the relevance of entrepreneurship education at the University. It illuminates the role played by TTOs and university business incubators in promoting responsible business management and the development of an entrepreneurial mindset.

There is a need for a holistic approach to entrepreneurship education, which considers the active involvement of the whole academic community and the interconnected actions of several institutional entities committed to promoting entrepreneurship, sustainability, inclusion, and innovation, at the university level.

Entrepreneurship education supports “co-creation for sustainability”, thus enabling universities to pursue their fourth mission by collaborating with the surrounding entrepreneurial environment and expanding its action beyond its walls (e.g., by involving high school students).

CONCLUSIONS

This chapter presented the CLab Pisa as a good practice example of entrepreneurship education geared toward sustainability, innovation, and inclusion. It demonstrates the various ways in which a responsible entrepreneurial culture can be promoted among students. It highlights how this can be achieved most effectively through students’ direct involvement in hands-on and challenge-based activities that require them to address both local and global issues. It draws attention to the importance of exposing students to real-life, concrete and successful examples of sustainable, innovative, and inclusive issues at both the local and global level.

AUTHOR BIOS

Dr. Sabrina Tomasi is a Research Fellow at the Department of Agriculture, Food and Environment at the University of Pisa. She is involved in the Start for Future project and her research interests relate to participatory approaches to rural development, regional innovation, and the civic university paradigm. (sabrina.tomasi@agr.unipi.it)

Professor Alessio Cavicchi is a full Professor in Agricultural Economics at the Department of Agriculture, Food and Environment at the University of Pisa. He is involved in the Start for Future project and is currently the Rector’s delegate to the promotion of the entrepreneurial and innovation culture at UNIPI and Scientific Chief of the Contamination Lab. (alessio.cavicchi@unipi.it)

Cristiana Barghini is the Coordinator for Technology Transfer, Evaluation and Career Services. Her tasks include providing advice on intellectual property, management and

exploitation of the university's patent portfolio, technology transfer projects, development of proof of concept, preparation of research contracts and licencing agreements with industries, support to new business creation, networking and dissemination activities. (cristiana.barghini@unipi.it)

Rachele Di Maio has been working at the Technology Transfer Services Unit of the University of Pisa since 2014. She deals with academic entrepreneurship and supporting the spin-off establishment phase. She drafts and manages both national and regional projects in the field of technology transfer and supports new start-ups in the pre-incubation phase. (rachele.dimaio@unipi.it)

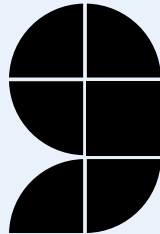
Loredana Guarino works at the Technology Transfer Services Unit at the University of Pisa and provides consultancy and support for the drafting of Business Plans for University Spin Offs and innovative Start-ups. She is also a PhD student in Business Administration and Management at the University of Pisa and author of "Business Plan Smart: a road map for drafting a Business Plan in start-ups". (loredana.guarino@unipi.it)

Paolo Cannata works at the Technology Transfer Services Unit at the University of Pisa, dealing with related communication and dissemination activities. He has a background in Law and his main fields of interest are innovation, patents, intellectual property, patent exploitation agreements, entrepreneurial culture, start-ups, and academic spin-offs. (paolo.cannata@unipi.it)

References

- European Commission, Directorate-General for Enterprise and Industry. (2014). Entrepreneurship education – A guide for educators, Publications Office. Available at: <https://data.europa.eu/doi/10.2769/51003> (last retrieved: 03.03.2024).
- Rubens, A., Spigarelli, F., Cavicchi, A. & Rinaldi, C. (2017). Universities' third mission and the entrepreneurial university and the challenges they bring to higher education institutions. *Journal of Enterprising Communities: People and Places in the Global Economy*, 11(03), 354–372.
- Tijssen, R., Edwards, J. & Jonkers, K. (2021). *Regional innovation impact of Universities*. Edward Elgar Publishing.
- Trencher, G., Yarime, M., McCormick, K. B., Doll, C. N. & Kraines, S. B. (2014). Beyond the third mission: Exploring the emerging university function of co-creation for sustainability. *Science and Public Policy*, 41(2), 151–179.
- Tuscany Region, Smart Specialisation Strategy 2021–2027: <https://www.regione.toscana.it/-/strategia-di-ricerca-e-innovazione-toscana-s3-cos-%C3%A8> (last retrieved 03.03.2024).
- Tuscany Region, Technology Districts: <https://www.regione.toscana.it/-/distretti-tecnologici-tutti-gli-atti-regionali-di-riferimento> (last retrieved 03.03.2024).
- University of Pisa, Contamination Lab, CONTHACKT, 2021. (2021). La sfida degli studenti Unipi per lo sviluppo sostenibile si conclude con quattro idee vincitrici and www.contaminationlab.unipi.it/conthackt-foodmobilitydigital/ (last retrieved: 03.03.2024).
- University of Pisa, Contamination Lab, CONTHACKT, 2022. (2022). Imprenditorialità, innovazione, sostenibilità e relazioni con il territorio al centro delle sfide di CONTHACKT (unipi.it) and <http://contaminationlab.unipi.it/conthackt-edizione-2022/> (last retrieved: 03.03.2024).
- University of Pisa, Contamination Lab, CYB+ 2023. (2023). Hear Again e Fill the Gap vincono a pari merito l'edizione 2023 del CyB+ (unipi.it) and <http://contaminationlab.unipi.it/cyb+2023/> (last retrieved: 03.03.2024).
- University of Pisa, Contamination Lab, Livorno Innovativa. (2023). L'Università di Pisa a "Livorno Innovativa. Il sistema dell'innovazione e della ricerca per lo sviluppo dell'economia del mare" (unipi.it) (last retrieved: 03.03.2024).
- University of Pisa, Contamination Lab, Network Lab, 2023. (2023). NETWORK LAB – Contamination Lab (unipi.it) (last retrieved: 03.03.2024).
- University of Pisa, Contamination Lab: www.contaminationlab.unipi.it (last retrieved 03.03.2024).
- Yusof, M. & Jain, K. K. (2010). Categories of university-level entrepreneurship: a literature survey. *International Entrepreneurship and Management Journal*, 6(1), 81–96.

**Marlene Klotz, Gabriele Paglialonga, Xiaofeng Wang,
Christoph Stoeckmann & Alessandro Narduzzo**



INCLUSIVE AND SUSTAINABLE HARDWARE INNOVATION: THE CASE OF INDUSTRIO

ABSTRACT

The role of regional hardware accelerators is crucial to achieving the EU's global 'twin transition' objective. This is because accelerators promote technological advancement to accelerate sustainability transition. This chapter examines Industrio, Italy's first hardware start-up accelerator, and presents it as a model of inclusive and sustainable entrepreneurship in the domain of deep tech. Industrio is proactive in integrating sustainability into the heart of Italy's manufacturing sector by working towards SDGs 4, 8, 9, 10 and 17. Accordingly, Industrio can be considered as a good example of how accelerators can contribute to a more inclusive and sustainable economic landscape, particularly in deep tech and hardware domains.

Key words: Sustainability, Inclusivity, Deep tech, Accelerator



INTRODUCTION

In the rapidly evolving technology landscape, the drive for hardware innovation is not only about creating smarter, faster devices, it also is about ensuring these advancements are made sustainably, and are accessible to all (Panettieri, 2024). Amidst this paradigm shift, regional hardware accelerators can play pivotal roles in fostering innovations that are both groundbreaking and responsible toward people and planet. They are crucial in promoting sustainable and inclusive growth in the tech sector by supporting start-ups that prioritize these values. Meanwhile, they can drive forward sustainable innovation, impacting local ecosystems and the global technology landscape (Panettieri, 2024; Kite-Powell, 2024). In this chapter, the case of Industrio is used to demonstrate how inclusivity and sustainability can be embedded in hardware innovation.

Industrio is Italy's first hardware accelerator, established in 2015 as a privately funded investment company in Trentino Alto Adige. Its shareholders are private companies, business angels and private investment funds. It invests in tech start-ups in the fields of Industry 4.0 and 5.0, mechatronics, robotics, IoT and similar areas. As such, it invests in innovative product start-ups that are active in leading sectors of the national economy. The accelerator offers investment, cutting-edge entrepreneurial and technological expertise, and an extensive network (Industrio, 2015).

Since 2015, Industrio has made significant strides in nurturing start-ups across Italy, particularly in the region of Trentino Alto Adige. With 15 carefully selected investments, Industrio has demonstrated a keen eye for promising ventures. Its track record boasts six successful exits, yielding an average return on investment three times higher than the initial investment amount. Moreover, Industrio's commitment to fostering innovation extends beyond investment, with approximately 40 start-ups and SMEs engaged in open-innovation initiatives under its guidance.

REGIONAL ECOSYSTEM CONTEXT

Italy is known as one of Europe's largest manufacturing centers and is renowned for its diversity of SMEs and major corporations. The Trentino Alto Adige region, situated in northern Italy, has a diverse mix of industry specializations, which include tourism, agriculture, and manufacturing. The manufacturing ecosystem in the region combines traditional industries with emerging markets. This reflects the regions' important historical strengths, namely



Figure 1. Noi Techpark Bolzano, Alto Adige (Noi AG Webpage, 2024)



Figure 2. Hit Hub Innovazione Trentino
(Ufficio Stampa della Giunta Provinciale, 2022)

innovative craftsmanship. In addition, the region continues to rely on the presence of several social cooperatives.

In 2017, NOI Techpark in Bolzano, the capital of South Tyrol, was established to strengthen the innovation and technology landscape. NOI Techpark also houses an incubator, which supports start-ups in establishing their business models and securing funding. The incubator acts as an intermediary between start-ups and investors. To date, some 3.5 million euros have been invested by private investors in seven incubated start-ups (NOI AG, 2022). In the Trentino Region, the regional innovation hub “HIT” (Hub Innovazione Trentino, 2024) supports these activities by acting as a link between research and innovation. Since 2019, it has supported a total of 110 start-ups in the funding phase, raising over 30 million euros.

However, the region faces several challenges in its attempts to promote inclusivity and sustainability. The fact that three main languages are spoken in the region often leads to systemic barriers. The transition to sustainable practices is characterized by high investment costs, complex regulations, and the need for cultural change. Bureaucratic hurdles combined with the lack of an investor landscape pose a significant challenge. Finding suitable funding sources is another major challenge as supporting start-ups in the region is not common practice. As a result, alongside governmental and regional institutions such as NOI Techpark and HIT, private companies are gradually emerging to address this issue. One such company is Industrio.

INDUSTRIO

Industrio aims to be an accelerator created by entrepreneurs for entrepreneurs. The company scouts and identifies pre-seed and seed teams that could benefit from investment and support to grow their business. Once the start-up is identified, Industrio becomes one of the shareholders. As such, it helps the start-up “accelerate” by focusing on Intellectual Property (IP), prototyping, finding its first customers, and raising additional funds. Industrio’s shareholders aim to create new business opportunities by scouting new technologies in collaboration with start-ups.

As a private company, sustainability and inclusivity are important for Industrio on three levels: financial, environmental, and social. Environmental and social sustainability issues are addressed in two ways during the investment phase: 1) at the early investment stage, and 2) at the growth investment stage.

The accelerator's support for start-ups' growth and scaling-up depends on financial sustainability. Becoming financially stable influences the achievement of the other sustainability goals. However, introducing environmental and sustainability principles into technology-focused industries is a major challenge. The overarching goal of financial stability often overshadows environmental sustainability. Accordingly, Industrio includes environmental and social sustainability as part of its strategy to achieve its primary goal of investment growth. In this sense it encourages its start-ups to incorporate sustainability and inclusivity into their own strategies. This is important to build credit-worthy reputation with customers, suppliers, banks and other financiers. And in the long term, the inclusion of these topics is important for financial stability.

At the growth stage, the start-ups not only need financial support but also “hands-on” support. Accordingly, Industrio offers coaching – rather than teaching – opportunities to the start-ups. To help fill the start-ups' skills gaps, the company draws on the support of its shareholders' network. The coaching sessions range from developing financial skills to understanding the pivotal role of embedding sustainability and corporate social responsibility (CSR) within the start-up rationale. The sustainability aspect is generally of interest to shareholders (investors) who often seek to make investments that focus on sustainability.

By collaborating with other key ecosystem stakeholders, Industrio helps bring these topics to the fore. It organizes several sustainability activities, including an annual social innovation event. Moreover, the company participates in nationally- or European-funded projects, which also focus on sustainability or inclusivity.

For instance, Industrio has been actively involved in an international cooperation project with Tripoli's entrepreneurial ecosystem in Lebanon. This project included collaboration with local partners such as Oxfam, Industrio's Lebanese counterparts – TEC and Shift – and the local Chamber of Commerce. As part of this initiative, Industrio and its partners organized online and in-person seminars on various important topics. These included a seminar on gender equality aimed at female founders and employees of start-ups. Other seminars focused on how start-ups can incorporate sustainability strategies at the early stages of their development. In total, Industrio dedicated over 30 hours on these issues during the cooperation.

While Industrio makes its investment decisions based on merit, skills, and technology, irrespective of gender, there is evidence that most of the project proposals they receive from start-ups are mostly founded by male entrepreneurs, with less than 25% of projects including at least one female founder. To address this gender gap, Industrio organises training sessions for existing and potential female founders as part of an EU-Interreg ITA-AT project called “Mozart”. The aim of this training is to provide insights into entrepreneurship in terms of salary expectations, security, work-life balance (including work-family issues), and autonomy.

IMPACT

Industrio's alignment with inclusivity facilitates various sustainability goals. Its most important regional and ecosystem impact is the financing of start-ups. This creates jobs, technology and other positive externalities in the region. Accordingly, Industrio helps create an environment for decent work and economic growth (UN SDG 8). Participation in the organization of events focused on sustainability and/or inclusivity is another example of how incubators can spread the word about the UN SDGs.

By offering equitable opportunities to diverse entrepreneurs, Industrio's approach to inclusivity in hardware innovation resonates with SDG 10 (Reduced Inequalities). Its commitment to sustainable innovation aligns with SDG 9 (Industry, Innovation and Infrastructure), showcasing responsible and environmentally conscious manufacturing practices.



Figure 3. Industrio Coffee & Pitch (pitching event)

Industrio also brings new sustainability and inclusivity knowledge to the region by being part of funded nationwide and European-wide projects. These funded initiatives are linked to EU policy strategies, and thus help prepare stakeholders for practices that may become “mandatory” in the future. Industrio not only creates valuable partnerships but also spreads the word about sustainability and inclusivity. In addition, it creates important connections with other institutions and actors in the sector across borders.

Industrio also addresses SDG 17 (Partnerships for the goals) when connecting its start-ups to experts in the field to help them advance progress towards sustainability and inclusivity. Finally, by collaborating with universities and regional incubators, Industrio also addresses SDG 4 (Quality Education).

KEY LEARNINGS

Accelerators and investor companies can create impact by financing start-ups with sustainability-related goals.

Sustainability and inclusivity can sometimes only be pursued once financial sustainability has been achieved.

Partnerships and collaborations are important facilitators for including sustainability and inclusivity in business strategies and practices.

Accelerators and investor companies can support start-ups both directly and indirectly by building sustainability and inclusivity into their strategies and practices, even if these aspects are not their primary focus.

CONCLUSIONS

Industrio adopts a proactive approach to integrating global sustainable development goals into Italy’s manufacturing sector. We consider it to be a good example of how accelerators can contribute to a more inclusive and sustainable economic landscape, particularly in deep tech and hardware domains. In the Trentino Region, Industrio supports high-tech logics and

fast-growing new ventures. It organizes events to legitimize and disseminate sustainability-related topics throughout the ecosystem.

Industrio's approach illustrates how inclusivity, sustainability, and deep tech can be built into the objectives of a) an accelerator, despite its primary objective of creating and supporting new ventures, and b) start-ups, despite their need for financial sustainability. Hence, Industrio's approach could be a valuable lesson for other accelerators.

AUTHOR BIOS

Marlene Klotz graduated with a master's degree in Entrepreneurship and Innovation from the Free University of Bolzano in 2021. She subsequently worked as a Research Assistant, focusing on social innovation and entrepreneurship, and now holds a research position in projects related to innovation promotion and entrepreneurship in regional deep tech valleys in Europe. (marlene.klotz@unibz.it)

Gabriele Paglialonga is General Director of Industrio. His background is in marketing and communications. He specializes in Innovation Management and holds an MBA from HULT International Business School in Boston. He has always worked in entrepreneurial and managerial roles in the field of open innovation in the corporate and SME world. (gp@industrio.co)

Dr. Xiaofeng Wang is an associate professor at the Faculty of Engineering, Free University of Bolzano, Italy. She has many years of experience in the research areas of agile and lean software development, software start-ups, and human aspects in software engineering. (xiaofeng.wang@unibz.it)

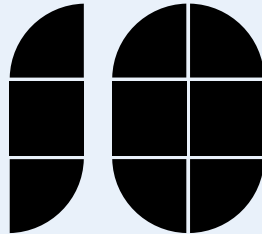
Professor Christoph Stoeckmann was a full professor of innovation and entrepreneurship, specifically digital business at Seeburg Castle University (Austria), while holding the position of the rector of the university from 2019 to 2022. He is now a full professor of entrepreneurship and digital transformation at the Free University of Bolzano. (christoph.stoeckmann@unibz.it)

Professor Alessandro Narduzzo is Professor of Strategy and Innovation at the Faculty of Economics and Management, Free University of Bozen-Bolzano, Italy, where he is also the Director of the Master of Science in Entrepreneurship and Innovation. (alessandro.narduzzo@unibz.it)

References

- HIT Webpage. (2024). trentinoinnovation.eu. <https://www.trentinoinnovation.eu/en/about-us/> [last accessed: 19.04.2024]
- Industrio Webpage, (2015): Industrio.co. <https://industrio.co/> [last accessed: 28/02/24]
- Noi AG. Webpage. (2024). noi.bz.it/de. <https://noi.bz.it/de> [last accessed: 18.04.2024]
- Noi AG. (2023). Noi Techpark Jahresbericht 2022, Bozen: Noi Techpark
- Kite-Powell, J. (2024). This Accelerator Says Ireland Will Be A Sustainable Innovation Hub. Forbes. <https://www.forbes.com/sites/jenniferkitepowell/2024/01/23/this-accelerator-says-ireland-will-be-a-sustainable-innovation-hub/?sh=33ea72a032f2> [last accessed: 28/02/2024]
- Panettieri, J. (2024). List: 39 Technology Accelerators for Sustainability, Green IT and Climate Tech Start-ups. Sustainable Tech Partner. <https://sustainabletechpartner.com/topics/funding/list-of-technology-accelerators-for-sustainability-start-ups/> [last accessed: 28/02/2024]
- Ufficio Stampa della Giunta Provinciale. (2022). Fondazione Hub Innovazione Trentino: approvato il piano di attività e il budget per il triennio. <https://www.ufficiostampa.provincia.tn.it/Comunicati/Fondazione-Hub-Innovazione-Trentino-approvato-il-piano-di-attivita-e-il-budget-per-il-triennio> [last accessed: 18.04.2024]
- Witty Power Webpage. (2024): Witty keep in power. <https://wittypower.com/> [last accessed 28/02/2024]

Jeroen Bourgonjon, Bastiaan Baccarne, Dorien Goubert,
Ben Robaeyst, Nell Van hansewyck & Pauline De Wolf



COMON: CATALYSING INNOVATIVE SOLUTIONS TO COMPLEX SOCIETAL PROBLEMS THROUGH TRANSDISCIPLINARY EXPERIMENTATION

ABSTRACT

This chapter presents an in-depth exploration of Comon, an initiative by Ghent University, the City of Ghent, imec, and Ghent Public Library. Comon embodies an innovative approach to address societal challenges, such as miscommunication between patients and medical personnel, and sedentary and unhealthy lifestyles. This approach activates diverse, transdisciplinary networks and builds on a five-phase design-thinking process that facilitates the development of tangible prototypes. These prototypes serve as boundary objects that bridge the gap between academic and practical expertise as they stimulate discussions amongst a diverse range of participants. The approach has proven effective in cultivating an environment rich in innovation, entrepreneurship, and active participation.

Key words: Design Thinking, Wicked Problems, Ecosystems, Innovation Management



INTRODUCTION

Comon is an initiative that developed through a bottom-up process when personnel of the City of Ghent, Ghent University, R&D center imec, and Ghent Public Library relocated to a new building. These organizations shared a common mission – to create impact at the intersection of complex societal challenges, technology, and innovation. However, what they did not share was a common approach. After a few years of trial and error and organizing an incredible number of ad-hoc projects, in 2021, a goal-driven, structural innovation programme was founded: Comon. Since then, Comon has served as an open laboratory where scientists, technologists, and creative minds develop technological solutions for tackling ‘wicked problems’ in the local ecosystem, thus making the city of Ghent a better place. In this chapter, we discuss the key features of this programme that, in our view, make it a good practice example.

REGIONAL ECOSYSTEM CONTEXT

Ghent is a city where the past and future converge, creating a unique ecosystem for innovation and technology. As a historical city, it not only respects its heritage but also embraces the new, fostering a culture of creativity and forward-thinking. It is home to a dynamic community of tech start-ups, incubators such as imec iStart and the Winter Circus, and research institutions such as Ghent University, which act as catalysts for cutting-edge developments. The city’s investment in sustainable technology, smart city initiatives, and a vibrant digital economy underscores its commitment to progress. Within a world in flux, Ghent has chosen to be a “City of People” rather than a “City of Things”. Initiatives such as Comon, which actively engages citizens in problem-solving, clearly exemplify how urban spaces can incubate technology for societal betterment by activating the entire ecosystem.

COMON

Thematic approach

Comon adopts a thematic, cyclic approach. During its first cycle, Comon brought together people to tackle the challenge: “How can we make health care more understandable for all citizens of Ghent?” This challenge comprised two perspectives. How can we ensure that patients comprehend the information and actions communicated by their doctors, nurses, and other caregivers? And how can we make sure that caregivers understand the needs and concerns of their patients, e.g., when they do not speak the same language, or when clients struggle to find words to describe what they feel and experience? Given the increasing levels of immigration, integration and diversity, clear and trustworthy communication between patients and caregivers has become increasingly important, not just in the city of Ghent, but all over the world. Currently, Comon is engaged in a second cycle, with the team collaborating on the societal challenge of promoting an active and healthy lifestyle by making active movements throughout the city more pleasurable.

Design Thinking tailored to the local context (solutions and awareness)

At Comon, we develop and use a methodology structured around a five-phase design thinking innovation process; our solutions trajectory (Figure 2). The first phase involves identifying a societal challenge that has garnered support among Ghent’s citizens and



Figure 1. The development of a watch to support chronic pain patients in patient-doctor communication.



Figure 2. A schematic overview of a Comon solutions trajectory

determining where our expertise can make a difference (defining a focal point for our lens). The second explores the problem: Who experiences it, who is already working on it, which solutions exist, and why are these solutions not (sufficiently) effective? In the third phase, we develop innovative technical solutions. This phase goes beyond brainstorming because we build tangible prototypes. In the fourth phase (experimentation), interdisciplinary teams can apply for funding to develop, test, and refine prototypes, to maximise leverage and impact. The success of these efforts is assessed in the fifth phase (evaluation). Throughout the process, we facilitate iterative work, enabling the integration of insights gathered at various stages of the project into the final design.

This solutions trajectory is accompanied by an educational and awareness trajectory, for which we organize activities such as dialogue tables, philosophy bars, and experimentation workshops. For this we often used the public library as a platform (Figure 3).

Tangible Solutions

Our approach results in tangible, testable prototypes that serve as conversation starters that bridge the gap between academic expertise, practical expertise, and experts' knowledge and experience. By transforming knowledge into solutions for societal needs, we lay the groundwork for policy recommendations, stimulate further research, and create business opportunities. As the process of creating physical prototypes engages all stakeholders, it becomes a catalyst for social engagement and awareness, while building digital innovation capacity amongst all stakeholders.

Activities: From Co-creation to Prototyping

Many of our activities aim to develop prototypes. We organize co-creation sessions, 'makeathons', and micro-labs. Co-creation sessions unite experts from Ghent University, civil society, industry, and the city of Ghent to devise solutions. Our 'makeathons' immerse a diverse group of students in design thinking, fast prototyping, and elevator pitching, resulting in innovative technological solutions. In our micro-labs, carefully assembled transdisciplinary teams get 12,000 euros in funding and guidance during a five-day design sprint to develop working prototypes. We support these teams from formation to drafting intellectual property agreements and look for further leverage through start-up programmes and related opportunities. For instance, a multidisciplinary team of a medical entrepreneur, a doctor, an IT student, a web developer, and a physiotherapist shaped an app to translate medical jargon into language that is understandable by everybody (Figure 4).

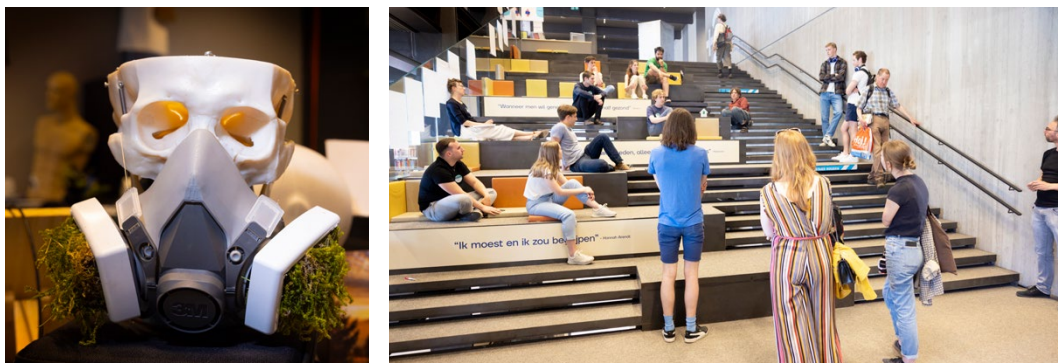


Figure 3. Experimentation and reflection, the public library as a platform

Multi-perspectivism

In all phases of both solution and educational trajectory, we ensure diverse team compositions. Where possible, we endeavour to pair researchers, entrepreneurs, students, experts, and practitioners (e.g., during the micro-labs). We believe in the power of diverse teams to create solutions for complex problems. Even more so when it comes to developing technological solutions. Just because a technological solution is possible, does not mean it is also desirable. Therefore, we organize Philosophy Cafés and Dialogue Tables. During the Philosophy Cafés, Ghentians can come and discuss pressing questions, guided by our in-house philosopher. Together, we explore diverse viewpoints. Everyone is invited to discuss or simply absorb the conversation. In the Dialogue Tables, we explicitly explore people's own experiences with the particular societal problems we want to tackle.



Figure 4. Shaping an app to translate medical jargon into understandable language

(Student) Entrepreneurship

Our impact extends beyond prototype development. We purposefully work with individuals who have not previously considered entrepreneurship, ranging from a physiotherapy student to a patient care manager, from a computer science student to a librarian. We encourage people who have not yet considered entrepreneurship to transform their ideas into reality. This positions us uniquely in the innovation landscape, where ideas crystallize even before they reach existing incubators.

Inclusivity

People-centred – At the core of Comon's philosophy is the conviction that technology must always serve people and society, and not the other way around. This is why it is important to ensure innovation processes allocate sufficient time for problem analysis. Such analysis needs to consider as many factors as possible: Political, economic, socio-cultural, etc. Additionally, it is crucial to listen carefully to end users and include other relevant perspectives and voices in society. This does not only apply to problem analysis, but also to all subsequent steps in the process.

Vulnerable and hard-to-reach groups (shadow populations) – We strive to listen to all perspectives, even those from hard-to-reach groups. This includes people who are less socially active, speak different languages, or have lower educational attainment levels. In short, people who are sometimes overlooked or forgotten in impact and innovation

processes. Diversity is, therefore, one of the structural touchstones in all phases of the Comon plan, in the development of our educational offerings, and in our communication. To accomplish this, we have surrounded ourselves with people working for organizations focussing on migration and diversity, and they have supported our decision making. We constantly ask: What are the needs of their target groups? How and when do we organize an event if we want to reach people in vulnerable situations? How do we engage in a dialogue that is beneficial for all parties involved? The key takeaway here was that we needed to invest the effort to make this work. In every step of the Comon trajectory, we ensure the involvement of these hard-to-reach groups: We distribute a broad survey for Ghent citizens, pursue the engagement of interested organizations, provide support to articulate challenges for a better city, use a cargo bike to reach the outskirts of Ghent to reach people who have difficulty finding their way to our events, embark on empathy missions, organize events in multiple languages (such as Turkish, Arabic, English), and invite vulnerable people not only as audience members, but also as speakers for our events.

A cornerstone in reaching people, whether it concerns easy-to-reach or hard-to-reach groups, is effective communication. We invest in copywriting that ensures active, engaging, and understandable language. We use our own digital platforms, such as the project website and newsletter, and different social media channels. To optimize our outreach, we also collaborate with external partners, such as the local radio station, newspapers, and magazines.

Without a Degree Among a Team of Whiz Kids

Through accessible communication and by ‘going the extra mile’, we manage to involve people from hard-to-reach groups. To quote pain patient and inventor, Dirk:

 **VLAD** — *“Sometimes I pinch myself to wake up. I didn’t graduate because my parents wanted me to work right away. That’s just how it was. But look at me now. A Ghentian without a degree, among a team of whiz kids. I admit it’s quite a challenge. But with Comon’s support, I was always able to keep up with the team. To develop Dolox together. And to offer a helping hand to pain patients like me.”*

Sustainability

Comon’s work notably aligns with the pursuit of sustainability by addressing some of the most complex “wicked problems” identified by the UN Sustainable Development Goals. This initiative’s commitment to fostering healthier and more inclusive communities in Ghent reflects its dedication to improving health outcomes (SDG 3), reducing inequalities (SDG 10), and promoting sustainable cities and communities (SDG 11). By focusing on enhancing patient-doctor communication and encouraging active lifestyles, Comon not only improves immediate well-being but also contributes to long-term societal resilience. Through its innovative use of technology and its transdisciplinary approach, Comon aims to create scalable solutions that could potentially be adapted for broader applications, thus paving the way for a more equitable and sustainable future on a global scale.

Deep tech

Comon’s partnership with Ghent University and imec, a leading research center in deep technology, underscores its commitment to integrating cutting-edge technological

advancements into its initiatives. This is challenging, as Comon often has to navigate the complex dynamics between bottom-up citizen-driven approaches and the top-down technology push typical of deep tech fields. Although Comon has decisively chosen to prioritize bottom-up methodologies, this approach sometimes limits the scope of deep tech research that can be pursued. However, this strategy has the advantage of making sophisticated technologies more accessible and comprehensible to the public, thus fostering a closer connection between citizens and the technological missions of organizations such as Ghent University, imec, and the City of Ghent. This balance allows Comon to serve as a bridge, bringing deep technology to a broader audience and integrating it into community-focused projects.

IMPACT

To answer the question – “Does Comon create value for the people involved, the partners, the citizens of Ghent, and, by extension, the Ghent healthcare ecosystem?” – we can take a look at the prototypes that were developed during the pilot phase, focusing on “understandable care” (Bourgonjon et al., 2024). Four viable prototypes emerged: Dolox, a smartwatch for pain tracking (Figure 1), is being advanced by a master’s student in Industrial Design and is the subject of their master’s thesis. RingMe, a phone bot for non-native speakers to prepare for doctor visits, concluded successful tests in AZ Sint Lucas, and is now actively searching for extra development funding. It also garnered interest from policy makers in other hospitals. Spexter, an app translating medical reports into layman’s language, has received €286,000 in additional development funding, and MIA, a matchmaking app for patients seeking psychological care, is now in the process of starting a company, actively addressing potential investors.

In addition, we can also analyse the results of four evaluation workshops and stakeholder interviews (n=20) that we conducted at the end of the first Comon-trajectory (Robaeyst et al., 2023; Bourgonjon et al., 2023). Below, we list five ways in which Comon has created added value, as illustrated by our stakeholders.

1. Working prototypes

At Comon, we believe prototyping is a vital step towards creating a better Ghent. It is the bridge between ideation and real-world impact, allowing us to transform abstract concepts into concrete solutions. By embracing a hands-on approach, we not only think and do, but also learn through failing within a safe, experimental space. This design thinking method empowers stakeholders to iteratively refine their ideas, ensuring that the solutions we craft are both innovative and practically attuned to the societal challenges at hand. Our commitment to prototyping is our commitment to making a tangible difference.

2. Personal development

Comon tackles complex challenges, requiring specific knowledge, skills, and attitudes from all participants. This is why Comon provides a safe environment for people to acquire knowledge and practice these skills. We also offer support and guidance. During the various workshops, participants are introduced to brainstorming, paper, and rapid prototyping, and pitching methods, and engage in exercises related to entrepreneurship. This allows individuals to fully develop their ideas. Some participants indicated that they wanted to embark on entrepreneurship thanks to their experience in the micro-labs. Others shared

how they take the acquired knowledge and skills to their own organizations, while others testified to the personal growth they experienced during the Comon project.

 **TESSA KERRE** — *“Personally, I found participating in Comon enriching. I’m someone who enjoys collaboration and looking beyond my own field. I always find it fascinating to see things from a different perspective and hear from others who are engaged in completely different areas, how they perceive and approach things. This has been personally enriching for me, and undoubtedly it will continue to be.”* – Tessa Kerre, haematologist at Ghent University Hospital and Ghent University

3. Domain & methodological expertise

At Comon, domain and methodological expertise converge to foster new insights and innovative solutions. By engaging with diverse people and organizations, we delve into new technologies and co-creation, from idea generation to tangible prototypes. This process encourages critical conversations across varied backgrounds, enriching knowledge sharing and insight development. Our methodological acumen spans citizen participation, living labs, urban development, and digital innovation. Leveraging years of smart city projects, Comon experiments with scientifically grounded methods, aiming to share this methodological knowledge and collaborative approach with participating organizations.

 **PETER PYPE** — *“Comon is more than just exchanging knowledge. It’s also about creating new knowledge. I observed this during the presentation of the makeathon. I was impressed. What we organize ourselves is limited to collaboration between students in healthcare and welfare education, where there’s still much room for improvement in terms of collaboration between the healthcare and welfare sectors. But this mainly remains limited to the exchange of knowledge and insights within frameworks and paradigms that are variations of one another.”* (Peter Pype, Ghent University).

4. New collaborations

Comon stimulates the initiation of new projects by attracting people and organizations with common goals. The connections established among individuals and organizations during the Comon project can form the foundation for future collaborations. Comon provides an excellent platform for partners to highlight aspects such as citizen participation, innovation, and co-creation. Comon is a compelling example of how collaboration between urban actors can be realized, as illustrated below:

 **KRIST BIEBAUW** — *“Comon makes it easy for us to explain on a European level what the library is doing and why we are in a partnership with Ghent University and imec. This can be challenging to explain internationally, but through the Comon project, I was able to make it very tangible. It has helped us in terms of communication. Moreover, it has led us to join an Erasmus+ project with Aarhus and Lisbon. That’s a direct positive effect of Comon.”* (Krist Biebauw, Director of the De Krook Library).

5. Fun and well-being

Feeling safe is an absolute requirement for innovation. When people feel secure enough to take risks and embrace the possibility of failure, they are more likely to explore and

experiment with novel ideas and concepts. This is our belief, and this is why we pay attention to the well-being of all participants in every Comon activity. We create a positive, enjoyable, and safe atmosphere in which people can share their experiences, knowledge, and expertise optimally, as the feedback from one participant illustrates:

 **WOUTER VAN DEN BOSCH** — *“Another unique added value was the approach with a pleasant, slightly unconventional touch. The circus-like atmosphere makes a dry subject rather pleasant, quirky, and fun.” (Wouter Van den Bosch, imec).*

KEY LEARNINGS



Clear focus

Comon starts with a clear focus: One societal challenge that keeps the citizens of Ghent awake at night. A challenge that is relevant to a broad group of citizens and for which a solution could really improve our society.

Tangible solutions through an energetic step by step approach

Comon develops solutions that are tangible and testable; ones that involve not just thinking but also doing, including failing in a safe and experimental environment. By conducting a design thinking approach, we give stakeholders hands-on, and step-by-step guidance to make a difference.

Collaboration (in person)

As a matchmaker, Comon facilitates meaningful connections among researchers, entrepreneurs, policymakers, and the citizens of Ghent. This unconventional collaboration brings together diverse perspectives and disciplines, sparking innovation and pushing boundaries. By providing a physical space for interaction, Comon ensures that this collaboration is not just theoretical but tangible and in person.

Empowering partners

Different partners help Comon move forward. Backed up by their expertise, we can move mountains. In this way, Comon helps its partners to achieve their goals.

Broad communication

Comon aims to reach as many people as possible, to inform them and give them a voice. This is why we keep our communication accessible.

CONCLUSIONS

In conclusion, Comon has emerged as a pioneering force in addressing complex societal challenges through its innovative, transdisciplinary approach that intertwines design thinking with active citizen and stakeholder engagement. This initiative has not only fostered the creation of practical, impactful prototypes but has also cultivated a rich ecosystem of collaboration and creativity. By bridging the gap between theoretical knowledge and practical application, Comon effectively amplifies the voices of diverse community members, including those often marginalized, thereby enhancing inclusivity, and understanding across the board. Its ongoing cycles of problem identification, prototype development, and rigorous evaluation underscore its commitment to continuous improvement and sustainable impact, making it a model of innovation in urban ecosystems.

AUTHOR BIOS

Jeroen Bourgonjon is Impact Coordinator for UGent Delta, a group of researchers who want to ensure digital innovation serves both individuals and society.
(jeroen.bourgonjon@ugent.be)

Professor Bastiaan Baccarne is Professor of Design Methodology at imec-mict-UGent and design.nexus. Bas shapes the technology of tomorrow through a unique combination of social science research, innovation management and product design.
(bastiaan.baccarne@ugent.be)

Dorien Goubert works at imec, focusing on projects addressing wicked problems in the healthcare domain, emphasizing data reuse, fair data principles, data spaces, and AI. All from a citizen-centric perspective. (dorien.goubert@imec.be)

Ben Robaeyst is an expert in living lab and design-thinking methodologies. His current research focuses on promoting futures literacy and ethical frameworks for decision making.
(ben.robaeyst@ugent.be)

Nell Van hansewyck is Innovation Analyst, specialized in advancing health technology through application and research projects about health data and AI. Her expertise lies in conducting ‘voice of the customer’ studies, user research, and co-creation workshops to drive innovation and meet the evolving needs of the healthcare industry.
(nell.vanhansewyck@imec.be)

Pauline De Wolf is the founder and former coordinator of the Comon initiative. Her expertise lies in strategic development and translation of vision & strategy into methodological processes. (pauline.dewolf@district09.gent)

References

- Bourgonjon, J., De Wolf, P., Windey, L., Van Hansewyck, N., Baccarne, B., Goubert, D., Robaeyst, B., Mortier, F. & Ruysschaert, T. (2023). Comon: Understandable Healthcare. Gent: CVBA De Krook. <https://comon.gent/en/downloads>
- Robaeyst, B., Van Hansewyck, N., Baccarne, B. & Schuurman, D. (2023). A qualitative analysis of the value creation of Urban Living Labs. *International Journal of Innovation Management*, 27(5), 2340007. <https://doi.org/10.1142/s1363919623400078>
- Bourgonjon, J., Demeester, P., Crombez, G., De Marez, L., Sterckx, S. & wyffels, F. (2024). Evaluatie UGent Delta. IDC Evaluatierapport 2024. Gent: Ghent University.

Malvina Ilieva & Iglia Milosheva



BEYOND: A SUSTAINABLE AND INCLUSIVE PRE-ACCELERATOR PROGRAMME IN DEEP TECH

ABSTRACT

This chapter discusses the role and impact of Beyond – a pre-accelerator programme designed to promote, foster and support sustainability and inclusivity in entrepreneurship and innovation for deep tech. Beyond has two key objectives: 1) to equip individuals with the knowledge, skills, and mindset needed to develop innovative solutions that address societal and environmental challenges; 2) to create and promote an environment for inclusivity with access to opportunities for entrepreneurs and innovators.

Key words: Entrepreneurship, Innovation, Inclusivity, Sustainability



INTRODUCTION

In times of rapid technological advancement and increasing global challenges, the role of entrepreneurship and innovation has never been more critical (Singh, 2023). Deep tech domains have significant potential to address pressing societal, economic, and environmental issues. Besides the required technological skills and expertise, realizing this potential requires the development of an entrepreneurial mindset and entrepreneurial competencies, as well as a commitment to sustainability, inclusivity, and social impact (EIC, 2022).

Pre-accelerator and accelerator programmes have emerged as powerful catalysts for driving entrepreneurship and innovation, especially within deep tech domains (Hello Tomorrow, 2019). They are designed to support early-stage start-ups through mentorship, funding, and networking opportunities, and have a unique ability to shape the trajectory of emerging technologies towards positive societal outcomes. By embracing a mission-driven approach and prioritizing sustainability and inclusivity, accelerator programmes can amplify the impact of deep tech innovations and pave the way for a more equitable and sustainable future.

In this chapter, we explore the role and approach of the pre-accelerator programme Beyond, and explain how it is promoting sustainable, inclusive, and innovative entrepreneurship in of deep tech domains. From raising awareness and sharing knowledge, to developing skills that foster collaboration and start-up creation, we delve into the various ways in which Beyond acts as a catalyst for positive impact on the entrepreneurial ecosystem.

REGIONAL ECOSYSTEM CONTEXT

The Bulgarian ecosystem has developed dynamically in recent years. It is ranked 38th worldwide according to the Global Startup Ecosystem Index (StartupBlink, The Startup Ecosystem of Bulgaria). It is characterized by a well-developed digital infrastructure, the growing presence of incubators, accelerators, tech parks and other spaces with resources for start-ups and a strong talent pool that includes talent in technical domains (StartupUniversal, Country Guide Bulgaria, Yovchev). Some of the Bulgarian most notable start-ups include: Payhawk – a fintech start-up and the first Bulgarian unicorn, Dronamics – a company for unmanned cargo and commercial aircraft, Imagga – a platform for image recognition based on artificial intelligence (AI) and its spin-off Kelvin Health – applying Imagga's AI technology for screening and monitoring medical conditions with the help of thermal imaging.

Recent EU funding initiatives focusing on deep tech, such as the Horizon Europe European Innovation Ecosystems (EIE) programme, the European Innovation Council (EIC) Fund and the EIT Deep Tech Talent Initiative, are important factors in supporting research, innovation, and entrepreneurship. Government policies, initiatives and various incentives have been developed to support deep tech innovations and start-ups working in areas such as AI, healthcare and biotechnology, clean energy and technologies. Traditionally, Bulgaria has several academic and research institutions that contribute to the Research & Innovation (R&I) field and which collaborate with industry and business. Finally, the growing awareness, good practices, and culture of entrepreneurship and innovation inspire more people to dive into start-up creation, including within deep tech domains.

Despite these drivers, there are still challenges to be addressed. The Bulgarian market is relatively small and can limit the start-up scaling process. In addition, the process of developing and commercializing deep tech innovations requires resilience, perseverance and strong sense of purpose on the part of the deep tech start-up founders and innovators.

Although there is active support by venture capital and investment organizations, the longer development cycles that characterize deep tech solutions can often limit funding access. There is also scope to increase the number of investors on a local level in major cities in the country. Currently, there are over 500 active start-ups in Bulgaria, however, only about 30% of them are female-founded.

BEYOND

Aims and structure

Beyond is a pre-accelerator programme managed by JA Bulgaria and its spin-off company – The Edge: R&BD. The programme aims to develop and support innovation (including scientific R&D) and the creation of technology start-ups. Many of the start-up ideas we work with include elements of strong social and environmental impact. The programme also helps participants with social projects to develop viable and sustainable models.

Beyond has three major tracks to generate, develop and support innovative ideas: Medicine and Healthcare (Health tech); Smart Cities and Urban Mobility; Culture and Creative Industries. We encourage scientists to adopt a multidisciplinary approach to develop their innovations. We work with participants from medical, technical, and business universities. The programme aims to bridge the gap between research and commercialization, foster innovation, and contribute to the growth of a deep tech ecosystem. To date, all winning teams from the programme have shown a successful pattern of multidisciplinary, comprising founders with different academic backgrounds and complimentary knowledge and skills.

Participants

The programme is open to a wide range of participants: Students, professors, scientists, entrepreneurs, and people with an interest in innovation and creating their own business. Beyond offers educational webinars to encourage participants' role as potential innovation-drivers and change-makers. Professors can act as academic mentors and advisors to the student teams, or even join the start-up teams themselves.

The programme includes participants from different age and socioeconomic groups, from different cities and countries, with different backgrounds and different levels of experience in entrepreneurship. Beyond uses a progressive model "From ABC to PhD" – a spiral approach to education that builds on participants' previous levels – to create sustainable entrepreneurial competencies. Thus, the programme also encourages JA alumni, who have participated in entrepreneurial programmes and initiatives in school, to join and further upgrade their skills and start-up ideas. The programme also attracts international start-up teams and participants, many of them via the Start for Future alliance and network. In addition, there is growing interest among Bulgarian current or former expats in entrepreneurship as a viable career trajectory and development path. Leveraging their international and multicultural experiences these teams typically exhibit excellent results within the programme.

Based on our medicine and healthcare track, we work with students from medical and pharmaceutical disciplines, where innovation and start-up creation are not yet fully recognized as popular career options. We collaborate especially with representatives of international companies in the field of health and pharmacy to focus on developing challenges related to women's health issues. Programme participants are encouraged to work on innovative and sustainable solutions with the help of company mentors. They begin

with idea generation and then join the programme to further develop their solutions. The exposure to entrepreneurial and innovation topics and approaches, new models and successful examples of innovative start-ups in their chosen domain encourages students to develop an entrepreneurial attitude and apply their valuable academic knowledge to create high-impact innovations.

A supportive community

Beyond collaborates with industry partners, successful start-up founders, investors, and other stakeholders who contribute to the programme by providing innovation challenges, mentorship, knowledge and experience. As a pre-accelerator working with early-stage start-ups we bridge the financing gap by providing access to other opportunities for development. In its final phase, the programme provides financial support to at least one start-up project and offers opportunities to connect start-ups with investors and business partners. In addition, teams completing the programme can rely on post-programme support in their further start-up activities.

The process of matching teams with mentors is achieved by considering participants' needs and experiences to enable a fruitful collaboration. We focus on creating a supportive community and an inclusive environment for all participants to stimulate their learning and development. Participants are encouraged to build networks and collaborate, sharing knowledge, feedback and experience. Beyond believes in the impact of education and 'learning by doing' on fostering knowledge and developing Innovation & Entrepreneurship (I&E) skills. Given the programme's SDG focus, it aims to provide quality education to participants to develop their entrepreneurial mindset and skills, encourage female entrepreneurship, support the development of innovations in Medicine and Healthcare, Smart Cities, Mobility, Green and social solutions with a promising impact on people, society and planet. During ideation, opportunity recognition, value creation and problem-solving steps, we introduce teams to the Sustainable Development Goals (SDGs), adopted by the United Nations. The SDGs provide a great means of identifying challenges and seeking innovative solutions with a balanced focus on social, environmental and economic impact. Teams can come up with a new solution or, add value to their existing idea by following the concept of the triple bottom line (People, Planet, Profit).

Gender balance

Since Beyond started in 2019, three out of the four (75%) annual winning teams that received micro-investment from the programme have female founders or co-founders. Two of these teams were building health and healthcare related solutions, the third was developing an idea in the circular economy. These women entrepreneurs were from various academic and professional backgrounds (Architecture, Medicine, Business) with little or no previous start-up experience. What they have in common is their strong motivation to solve real problems from their educational, work or life experience. Beyond encouraged them to use all their academic and work knowledge, skills, available resources, opportunities, and contacts to build new competencies and develop their projects. They interacted with a variety of stakeholders and were extremely confident when pitching their ideas at the end of the programme. As successful Beyond alumni, we regularly invite them to Beyond events, educational activities, and webinars as keynote speakers or lecturers to share their entrepreneurship experience and advice, and to act as role models to inspire the next cohort of female entrepreneurs. Being part of the JA Europe network also provides great

opportunities for female founders and co-founders through awards for encouraging and recognizing women entrepreneurs and leaders, providing mentorship and other supports, as well as international publicity and visibility.

The Beyond management team is gender-balanced, age-balanced and interdisciplinary. This allows for different perspectives, insights and complementary contributions in the programme's development and implementation. The team also includes Beyond alumni and female entrepreneurs with practical experience who have first-hand experience of participants' and start-ups' needs. They assist with practical lectures, mentoring and connecting the teams with other start-ups, successful entrepreneurs and potential partners from the community. They are also great programme ambassadors who connect and invite successful female founders from the ecosystem to join as guest-speakers, mentors and panel members.

From its inception, the programme has strived to include female start-up founders, entrepreneurs and investors as motivational speakers, lecturers, mentors and panel members. These have included inspiring female founders and CEOs of internationally acknowledged start-ups in the field of MedTech, GreenTech, software solutions who share their valuable perspectives, experiences and insights in the field of innovation and business creation.

Guest speakers and mentors

At the beginning of each Beyond programme, the team sets clear goals for involving guest-speakers and mentors. Participant feedback from the previous programme is taken into account, together with the profiles of the new participants and their start-up needs and ideas. Beyond focuses on developing networks and partnerships from which to invite leaders and experts. In the process of selecting guest speakers and lecturers, consideration is given to their domain expertise, their track record as successful founders, their ability to deliver compelling and inspirational stories and their readiness to offer practical advice to new start-ups. It is essential that speakers' narratives resonate with participants, inspiring and motivating them. These individuals serve as exemplars, showcasing the feasibility of success and offering practical insights on how to navigate the challenging entrepreneurial journey. During these sessions Beyond participants are encouraged to present their projects on specific start-up topics and receive constructive feedback.

Speakers are usually open to staying in touch with participants beyond their particular session, fostering connections and providing further support. Beyond's culmination is 'Demo' Day, when the start-ups pitch their projects to a panel of investors and domain experts. These panels always include female experts in entrepreneurship, innovation and/or a specific industry sector. This approach provides an additional valuable perspective and raises awareness about the female investors.

Continued support

Once each Beyond programme has been completed, we stay in touch with the teams and support their work with additional consultation and mentorship, connect them with new partners or investors according to their development stage, and provide opportunities for participation in international events, competitions and projects. This is especially important for start-ups working on deep tech solutions, as their development continues long after the programme has finished.



Beyond opening session 2023, inspirational talk by Elena Nikolova

IMPACT

Beyond contributes to building a supportive ecosystem for inclusive and sustainable entrepreneurship by fostering collaboration, knowledge sharing experiences, and mentorship among start-ups, entrepreneurs, academia, corporate partners, industry experts, and investors. The goal is for the ecosystem to provide ongoing support to start-ups as they navigate challenges and scale their impact-driven ventures.

Programme outcomes for the past five years include:

- Over 1,000 programme applicants
- More than 60 start-ups successfully completing the programme
- More than 50 mentors (experienced start-up founders and domain experts) supporting the participants
- 8 investments in Beyond start-ups
- 420k Euro investment secured by Beyond start-ups

Some of Beyond's most successful start-ups include: WHISP (a platform helping expats join local healthcare systems, created by a female founder), Wasteful (pavers made of recycled plastic and construction waste), AMIRA MEDITECH (digital healthcare solution for fighting antimicrobial resistance, created by a female medical doctor, My Captain Dad (a mobile app for first time fathers, created by a female founder, a MD in Gynecology and obstetrics), GYNie.ai (AI solution for cervical precancer detection, founded by a MD in Gynecology), Xtatic (content marketing solution in healthcare, founded by a medical student). As participants in Beyond, WHISP, AMIRA and GYNie.ai were also recognized in international competitions and received awards and additional support from global technology companies like Intel and Microsoft.

These founders go on to become active participants in the regional ecosystem and ambassadors of entrepreneurship and innovation in their professional and personal networks. They set examples, provide practical advice and ignite the spark of entrepreneurship and innovation in the next generation of leaders and innovators. Finally, over 90% of Beyond participants said they would recommend the programme to their peers, raising awareness and attracting more people to the field of entrepreneurship and innovation.

KEY LEARNINGS



Diversity and inclusion in entrepreneurship, innovation, and deep tech are key success factors and should be systematically encouraged to leverage diverse backgrounds, perspectives, and experiences in driving innovation and addressing complex challenges.

Entrepreneurial education should be accessible to people from all backgrounds. Domain experts (in science, medicine, etc.) should be encouraged to engage in the entrepreneurship support process.

Multidisciplinarity and female entrepreneurship are important to the success of the programme. All start-up teams who won top places in Beyond's 'Demo Day' and received additional investments and international awards were multidisciplinary and most had female founders/co-founders.

The benefits of collaborative ecosystems that bring together start-ups, academia, business and industry, and investors to support deep tech entrepreneurship and innovation should be showcased and continuously developed.

Active alumni involvement in the pre-accelerator activities and in the programme itself allows for better knowledge/experience exchange among participants. Alumni engagement plays a vital role in promoting entrepreneurship, providing support, motivation and role-models in the innovation ecosystem.

CONCLUSIONS

Promoting inclusivity and sustainability in deep tech innovation and entrepreneurship offers profound opportunities for transformative change. Embracing diverse perspectives and fostering an inclusive ecosystem should be priorities in all future entrepreneurship support programmes. Prioritizing inclusivity and sustainability in entrepreneurship could promote innovations that are not only groundbreaking but also responsible and equitable, thus benefitting both society and planet.

The Beyond programme adopts a multifaceted approach to fostering innovation and facilitating the emergence of more technology-driven start-ups. The programme's collaborative principles, emphasized by strategic partnerships, open interaction and community building, create a supportive ecosystem conducive to knowledge sharing, collaboration, and mentorship. By offering quality education and experiential learning activities, Beyond instills an entrepreneurial mindset and equips participants with the skills needed to navigate the complexities of entrepreneurship. The programme's commitment to gender equality and the

promotion of female entrepreneurship also underscores its dedication to fostering diversity and inclusivity within the ecosystem. As Beyond continues to evolve and expand its reach, it is poised to serve as a catalyst for inclusive and sustainable entrepreneurship, empowering a new generation of innovators to effect positive change on a regional and global scale.

AUTHOR BIOS

Malvina Ilieva is Managing Director and Co-Founder, The Edge: Research & Business Development. (malvina.ilieva@theedge.solutions)

Iglika Milosheva is Education and Training Manager, The Edge: Research & Business Development. (iglika.milosheva@theedge.solutions)

References

Singh, P. (2023). Innovation and Entrepreneurship to Address the UN Sustainable Development Goals. Available at: https://www.researchgate.net/publication/369896852_Innovation_and_Entrepreneurship_to_Address_the_UN_Sustainable_Development_Goals (Accessed: 23.04.2024)

European Innovation Council. (2022). Backing visionary entrepreneurs: Realising the Deep-Tech Entrepreneurial Talent of Europe. Available at: <https://eic.ec.europa.eu/system/files/2022-04/Realising%20the%20Deep-Tech%20Entrepreneurial%20Talent%20of%20Europe.pdf> (Accessed: 23.04.2024)

Hello Tomorrow. (2019). What makes a good deep tech acceleration program? Available at: <https://medium.com/hello-tomorrow/what-makes-a-good-deep-tech-acceleration-program-c8fad5491dd7> (Accessed: 23.04.2024)

StartupBlink, The Startup Ecosystem of Bulgaria, Available at: <https://www.startupblink.com/startup-ecosystem/bulgaria> (Accessed: 23.04.2024)

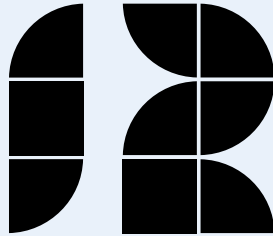
StartupUniversal, Country Guide Bulgaria, Yovchev, E., Available at: <https://startupuniversal.com/country/bulgaria/> (Accessed: 23.04.2024)



IV.

Other Innovative Initiatives

Philip Davies, Will Shepherd, Alan Martin & Alan Murray



LIGHTBULB MOMENTS: THE IMPACT OF SMALL LIGHTBULB GRANTS ON ENTREPRENEURIAL INTENTION

ABSTRACT

Lightbulb Grants was an experiment with easy-to-access, relatively low-value ‘idea grants’ with no specific requirements around the type of idea. The objective was to remove any focus on ‘tech’ to encourage marginalised and non-traditional entrepreneurs to engage with innovation and help them look for entrepreneurial ‘lightbulb moments.’ Our experience with this experiment suggests that many of the business ideas fostered and encouraged by this process will naturally gravitate towards a tech-focus. Accordingly, our hypothesis is that the language around ‘deep tech innovation’, ‘pitching’ and ‘scale-ups’ is a barrier to many entrepreneurial individuals who do not necessarily see themselves reflected in these terms. To counter this we suggest that encouraging innovation in deep tech starts with encouraging innovation, full stop.

Key words: Entrepreneurial intention, Inclusivity in entrepreneurship, Innovation grants, Student entrepreneurship



INTRODUCTION

“What if we are inadvertently turning students away from entrepreneurship?” This was the question that ignited discussions within the University of the West of Scotland (UWS) Enterprise Centre in late 2023. Despite the enterprise team’s significant efforts and resources dedicated to fostering student entrepreneurial activity, there was a sense that their initiatives were yielding familiar results. While successful enterprise competitions had been organized, participation seemed concentrated within a particular enthusiastic subset. This subset was often centered within the business school rather than encompassing the entire student body of over 19,000 individuals across five campuses. As a result, the number of entries into existing business competitions hovered at around 50, suggesting that broader engagement was needed.

This limited scope of engagement also corresponded to the nature of ideas being proposed, with the majority being conventional and risk averse. The potential that deep tech could offer for pioneering business concepts seemed somewhat neglected. There is recognition that traditional business innovation processes and models frequently hinder the commercialisation of technologically advanced concepts. Moreover, the hesitation to delve into deep tech ideas appears to be influenced by the perceived challenge of accessing initial funding to support the exploration and implementation of such ventures, further contributing to the prevalence of conventional and risk averse business approaches.

During an impromptu ideation session, we uncovered concerns regarding our standard operating procedure which followed a bureaucratic linear model akin to traditional university pedagogy, requiring oversight from experienced practitioners. The existing processes involved navigating through a series of stage gates before access to funding could even be attained.

Research indicates that initiatives such as the Exist Business Start-up Grant in Germany (BMWK, n.d) provide a method to alleviate the paperwork burden on entrepreneurs, thereby enhancing inclusivity and shifting away from traditional due diligence selection processes. Additionally, we recognised that the concept of ‘pitching’ ideas to experts could limit our audience as could predefined criteria regarding the types of businesses deemed suitable for pitching.

Our proposed solution to address this was to pilot a grant programme that provided a modest amount of funding with minimal conditions attached. By simplifying the application process, reducing eligibility requirements, and eliminating any competitive element or judging we aimed to eliminate inadvertent biases that could perpetuate inequalities within the system. Removing judgment allowed grants to be allocated to ideas that we might have instinctively dismissed as unlikely to succeed, but upon reflection, may not have had a solid basis for doing so.

This approach can seem a little counter-intuitive at first, removing a focus on deep tech in innovation as a mechanism to try to increase the rate of deep tech innovation in our ecosystem. We believe that this ‘lightbulb moment’ approach offers an opportunity to encourage deep tech entrepreneurship and innovation in a way that is both inclusive and sustainable. An emphasis on deep tech too early in an entrepreneurial journey is a potential barrier to inclusivity that we do not feel is necessary, and our experience suggests that removing any narrow remit around technology can help increase the number of tech-specific or tech-adjacent start-up ideas being generated.

Building on the Entrepreneurial Thought and Action approach that leading entrepreneurship scholars are increasingly suggesting is the most important element of entrepreneurial education, where entrepreneurship is ‘non-linear and unpredictable; it is

ill-defined, unstructured and complex’ (Neck et al., 2023), we have removed the process-focus on deep tech to let potential entrepreneurs focus on the needs of customers first. We think that the ‘lightbulb moment’ of a potential entrepreneurial venture will often involve a deep tech solution to those needs – but that we should not be prescriptive at the early stages and insist that it must do so.

REGIONAL ECOSYSTEM CONTEXT

UWS plays a significant role within multiple and varied regional ecosystems that span a vast geographical area from Glasgow to Dumfries, with campuses situated in areas ranging from post-industrial to rural settings. Additionally, beyond its conventional Scottish domain, UWS has extended its footprint to London, marked by a vibrant campus environment attracting a diverse cohort of international students.

As delineated in the Scottish Technology Ecosystem Review (STER), a pivotal aspiration is to propel the region beyond the ‘tipping point’ by fostering innovation and scaling technology businesses (Scottish Government, 2020). The strategy articulated in the STER Report aims to enhance company survival and growth rates across all stages of the technology ecosystem ‘funnel,’ with the objective of generating more ‘unicorn’ companies (see Figure 1.) However, we believe the report underestimates the quantity of start-up companies needed to achieve this goal. While we recognise the critical importance of interventions throughout the funnel, we also assert that simply increasing the number of companies entering the funnel should not be underestimated. Consequently, we focus on the ‘pre-start’ stage of the funnel, aiming to stimulate as many start-ups as possible, whether tech-focused or not.

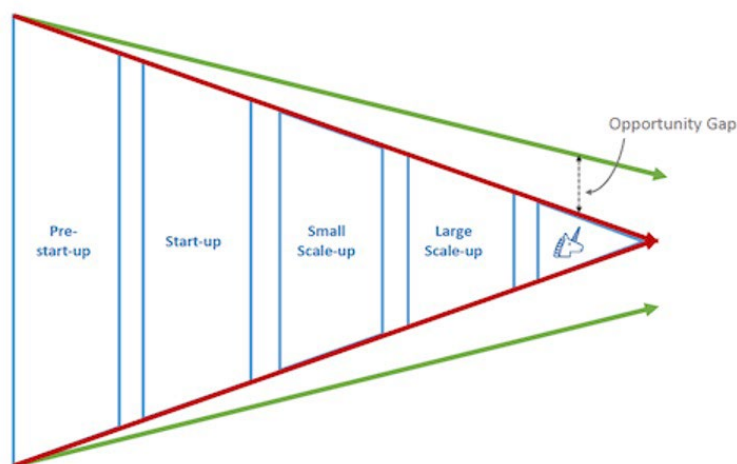


Figure 1. Opportunity for growth in the Scottish Tech Ecosystem (STER) (Scottish Government, 2020)

The experience of starting (and potentially failing) should not be underestimated as a valuable tool in entrepreneurial development (Eklund et al., 2020). Our model encourages potential entrepreneurs to ‘go-again.’ We are not judging them on success or failure as can sometimes be the case. Rather, we are encouraging them to keep developing new ideas and trying them out in the market. We believe that this ‘recycling’ effect between start and pre-start can play an important role in increasing the number of businesses that successfully pass through the start-up stage of the funnel (see Figure 2).

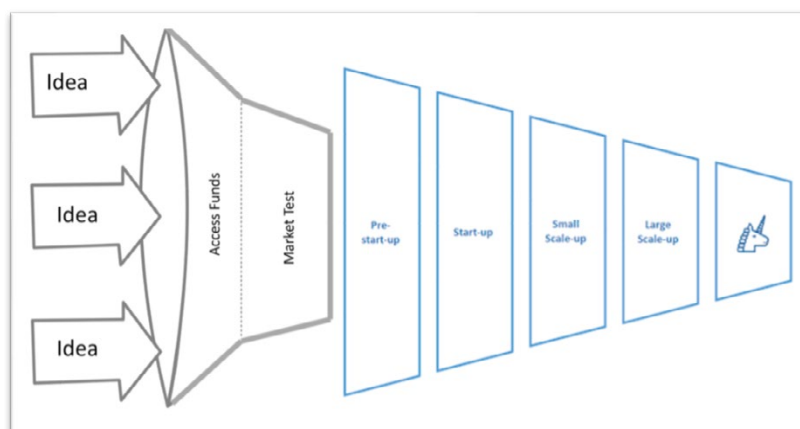


Figure 2. Increasing the volume of pre-start businesses through idea stimulation

The links between entrepreneurial intention and entrepreneurial activity are well-established, even if they are still being explored (Krueger, 2017). Our objective with this initiative is to surmount barriers to diversity in entrepreneurial intention by implementing small-scale, non-intimidating, and genuinely inclusive incentives. This initiative prompts crucial inquiries into how such accessible programmes can bolster Scotland’s ambition to cultivate a world-class, genuinely inclusive technology-driven economy. We simply asked ourselves the question – could addressing inclusivity at early stages catalyse innovative outcomes and foster growth in deep tech start-ups?

We strive to ensure that entrepreneurial endeavours at UWS align with the UN Sustainable Development Goals (SDGs). Lightbulb Grants were designed with alignment to Goal 8 (Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all), specifically Target 8.3, by promoting the formalisation and expansion of micro, small, and medium-sized enterprises (UN, 2012). However, strictly adhering to traditional funding procedures risks excluding aspiring entrepreneurs who possess innovative ideas but lack the resources or capacity to navigate complex administrative processes (Patel & Wolfe, 2022). This exclusionary dynamic contradicts the inclusive and diverse ethos that we aim to cultivate within our academic community.

As a result, it is crucial to reevaluate our support mechanisms to ensure they are more accessible and supportive of a wider range of entrepreneurial talent (Hanlon & Saunders, 2007). This could involve simplifying application procedures, providing tailored support services for individuals with diverse needs or exploring alternative funding models that prioritise innovation and merit over bureaucratic processes. By eliminating these barriers, we can empower a more inclusive group of entrepreneurs to pursue their goals, thereby cultivating a more dynamic and equitable entrepreneurial environment within our institution.

LIGHTBULB GRANTS

To tackle these challenges, we initiated a trial programme in the form of Lightbulb Grants offering small, easily accessible cash grants to two targeted groups – university students and university staff – who, we believe, possess significant latent entrepreneurial intent. Our goal was to determine whether providing straightforward funding could stimulate pre-start activity, effectively transforming intent into action. The application process for these Lightbulb Grants was intentionally designed to contrast with traditional innovation

competitions or grant structures – simple, transparent, and swift. The objective was to demystify entrepreneurship and remove any barriers or intimidation for applicants less acquainted with the enterprise landscape.

We wanted to see if removing a ‘tech’ focus or any expectation of immediate commercial viability would unleash entrepreneurial energy that is not currently being encouraged, which we thought of as encouraging people to have a ‘lightbulb moment’ leading to a new business idea. This highlights the potential of initiatives such as Lightbulb Grants to tap into new and diverse pools of entrepreneurial talent, aligning with the broader regional ecosystem’s strategic emphasis on inclusivity. Furthermore, the introduction of such grants prompts critical examination of accessibility concerns surrounding access to funding, particularly the question of whether existing bureaucratic procedures inadvertently hinder non-traditional entrepreneurs. Specifically, the requirement for a detailed business plan may deter individuals facing linguistic barriers or time constraints due to caregiving responsibilities.

With only 40 grants available, each at just £250, our interest lay in exploring whether small amounts of money with no strings attached could serve as a catalyst for entrepreneurial activity (exploration), leading to further investigation of the impact of these grants on entrepreneurial or intrapreneurial outcomes (exploitation). This chapter focuses solely on the exploration outcomes, examining the entrepreneurial activity sparked by these modest sums, i.e., how many ‘Lightbulb moments’ occurred that transformed ideas into entrepreneurial endeavours that might not have otherwise materialised. We created very simple programme branding and literature (see Figures 3 and 4). We gave ourselves a three-week deadline to allocate the funding, so time spent on design and promotion was minimal, but we did not find that this detracted from the attractiveness of the grant.

While our research into the outcomes of the grants is still at an early stage, initial indications are promising. Both applications and interviews suggest that the grants prompted activity to commence earlier than planned, fostering entrepreneurial endeavours that may not have occurred otherwise. Furthermore, our findings suggest that small grants have the potential to stimulate both entrepreneurial and intrapreneurial activities. The process we adopted was as follows:

- Students were approached via their course lecturers from across the university as well as within the Business School. For the pilot programme, cohorts were selected across different schools. Information about the grants was distributed via email, VLE and by short 10-minute presentations in lectures (see Figure 5).
- The application process was a simple online form. The link to the form was shared by email and a QR code was distributed during lectures. The form captured the minimum information required and could be completed in under five minutes. From a pool of around 100 students approached, 50 applications were received within one week.
- The application forms were checked against two criteria: Eligibility for the grant (that they were currently a UWS student or member of staff) and whether an actual business idea had been presented (several students asked for the money for other causes like donating to charity which fell outside the scope of the grant).
- The second stage of the process involved an online interview to discuss the business idea and ask applicants what they would use the grant for. It is important to note that this interview was not scored or judged and was intended only to create engagement with the applicant, discuss their idea and understand how they were proposing to use the grant. Interviews were scheduled using calendly.com with 15-minute zoom calls available throughout the week. It is also worth noting that even these very low barriers



Figure 3. Lightbulb Grant Logo

LIGHTBULB
GRANTS FOR BUSINESS IDEAS

- Got an idea that you think could be a way to make money?
- Want to try it out but can't afford to?
- **APPLY FOR A UWS LIGHTBULB GRANT!**

£250 grants available for business ideas

The grants are a £250 one off payment that can be used to test your idea in the marketplace. It can be used for anything that will help you test your idea, whether that be market research, paying for consultancy or buying a key piece of equipment. The grants available on a first come first served approach. There are a limited number available for this round and any UWS student or member of staff can apply for a grant.

Apply Online: <https://forms.office.com/e/qsTQWEwccC>

Figure 4: Simple marketing collateral for the grant

to participation were too much for some participants and we experienced around a 10% drop off at this stage.

- We primed the students that there would be an opportunity to take part in research about the impact of the grant on their business idea. We stressed that participation in the research was not a condition of the grant and that students would be free to choose whether to engage further.
- We also discussed other avenues of support that students might find useful for their business. This process highlighted some clear gaps in provision but also some communication issues as much of the support being requested was already available through the University even though students were unaware of it.
- An analysis of the business ideas presented in the application and discussed in the interviews helped us gain an understanding of the barriers to action that the grant was addressing. Many of the start-up ideas were inherently tech focused. The importance of sustainability to students was reflected both in the actual ideas presented and in the way they intended to run their business.

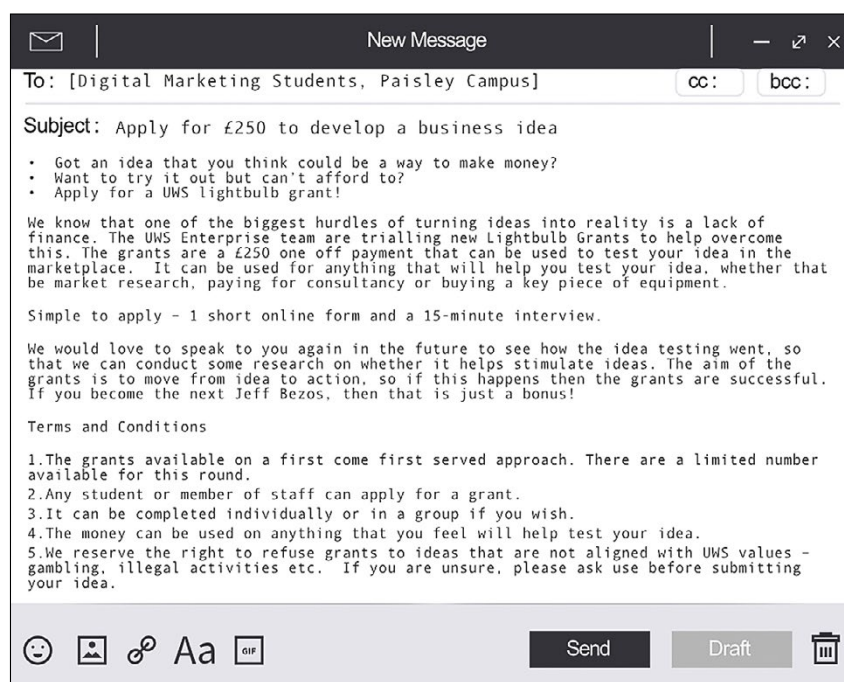


Figure 5. Email invitation to apply

We aimed to foster inclusivity from the initial marketing for our Lightbulb Grants. Efforts centred on targeting creative industries courses, those with high female participation such as digital marketing and reaching our international student population. We believe initiatives that prioritise equity can be overlooked if the messaging feels inaccessible to targeted groups.

Lightbulb Grants were crafted to eliminate barriers for entrepreneurs of all kinds without specifically targeting 'deep tech' innovations. This approach allowed anyone with a promising idea to apply without being concerned about having to fit into a specific category, thereby making entrepreneurship more accessible to individuals regardless of their background or the type of innovation they wished to pursue. Despite this broad focus, a significant majority

(of ideas (33 of 50 applications) had some tech aspect, even if relatively low-tech (such as starting a voiceover agency). A reasonable number of proposed ideas within that sample (9 of 50 applications) seemed to fit one or more of the definitions of deep tech (EIT, n.d) (see Figure 6). Examples include a bill-point application aimed at aggregating utility bill payments (Big Data), using blockchain, artificial intelligence, and IoT to improve supply chain efficiency (Web 3.0), and the use of 3D filming and VR to promote wellbeing in a care setting (Metaverse). This incorporation of technology, despite it not being explicitly specified as a criterion for the grants, underscores how technology has become a fundamental component

Stage	Definition	Number of applications	Examples
Applied	Completed online form	50	Questions included 'Idea in 1 sentence', 'What would you use the money for?' and 'What results would you like to see from this grant?'
Eligible	Currently UWS staff or student; a business idea	47	Disallowed applications included personal spending and charitable donations
Classified as 'tech'	Is the business tech-focussed, or does the proposal include a tech or digital element?	23	Starting a new digital radio channel Live streaming Video production SaaS version of academic integrity software Digital reproduction of physical archives Digital marketing agency Online community for London-based students
Classified as 'Deep tech'	Linked to one of the 15 definitions given by EIT Tech Talent (EIT, n.d.)	9	"Using blockchain, artificial intelligence, and IoT to improve supply chain efficiency" (Web 3.0) "New research in the relationship between language, site, accessibility of digital performance and decolonising Shakespeare" (Metaverse) "360-degree filming [of natural environments] for wellbeing and mindfulness in care settings" (Metaverse) "Developing a bill point application" (Big Data)

Figure 6. Proportion of applications classified as 'tech' or 'deep tech'

of business ideas offering opportunities to reduce costs or attain sustainable competitive advantages.

While applications required some thought around the core business idea, they were radically simplified compared to traditional funding programmes. Our focus was on stimulating action, recognising that it can often be the first step, not the perfect idea, which holds many individuals back. However, initial delays in releasing these low-value payments created an unexpected barrier with some students losing enthusiasm or momentum for their project. Our experience highlights the significance of streamlining even minimal administrative bottlenecks when the aim is to lower hurdles to action.

IMPACT

The impact of the Lightbulb Grants process is demonstrated by the types of ideas that were proposed which showcase the initiative's success in stimulating activity. Beyond this broader engagement, the 'Lightbulb Grants' demonstrated how minimal financial backing can overcome obstacles of inequality and unlock entrepreneurial activity in a broader audience.

Overcoming Barriers

For students facing financial constraints, even modest start-up expenses can pose significant hurdles. One international MBA student, drawing from their own struggles with housing issues, conceived a compelling business idea. However, limited resources prevented any progress. The Lightbulb Grant offered essential financial support enabling them to test their idea. This not only spurred action but also instilled confidence. As the Lightbulb Grants project expands, it underscores how inclusivity nurtures untapped entrepreneurial potential often driven by social needs as much as profit motives.

Promoting Sustainability and Deep Tech Business Ideas

Beyond addressing individual constraints, initiatives such as Lightbulb Grants have the potential to inspire solutions aimed at broader societal and environmental needs. For example, one student's idea focuses on a pressing sustainability issue proposing a disruptive e-mobility product with significant implications for carbon reduction and urban transportation. This highlights how modest interventions can nurture the beginnings of deep tech initiatives aimed at addressing global challenges. In this and other examples, technology plays a crucial role in business ideas, emphasising the importance of innovation around technology in response to genuine customer needs rather than adopting a 'tech for tech's sake' approach often observed in more formal start-up and accelerator environments.

Unexpected Intrapreneurship

An unforeseen advantage arose from our decision to include university staff as eligible participants in the grant programme. The accessibility of a small funding pool and interaction with the enterprise team sparked intrapreneurial initiatives resulting in projects that may not have otherwise materialised without this low-barrier stimulation. For example, one staff member recognised the opportunity to digitise and monetise archival materials for a local theatre group, creating a potentially sustainable revenue stream while also preserving history through technology, whilst a digital project to decolonise Shakespearean performance shows the potential impact of the metaverse in the cultural space. University settings abound with untapped expertise, and even minor incentives can yield transformative benefits for their immediate surroundings and beyond.

Reduction of bias

One of our primary goals with this grant was to mitigate potential biases in the selection process. Typically, grant applications involve an element of competition or judgment often by individuals fitting a middle-aged, white, male profile, as was the case in this instance. If we had evaluated or scored each application, some may not have received the grant. There is a risk that this judgmental process, common in start-up settings, perpetuates inequalities in the types of businesses launched and the entrepreneurs supported. While we are generally satisfied with the results of the Lightbulb Grant initiative, the pilot phase has shed light on some flaws and limitations. For example, there were administrative issues that resulted in delays in payments to successful applicants, which was not only frustrating for the programme team and participants but also led to a loss of enthusiasm and motivation among some students. We believe it is crucial to maintain momentum as part of the encouragement to act. In this regard, reducing administrative delays is essential.

KEY LEARNINGS



Small grants can be a ‘trigger’ for action, bringing entrepreneurial action forward rather than initiating it. These grants are about quantity; quality comes later.

Low barrier to entry is essential. By focussing on stimulating action through accessible amounts in the £250 range, it may be possible to drive initial action, before using larger amounts in the £5,000 – £10,000 range to create better sustainability and potential growth.

Every effort should be made to simplify everything at all stages. Administrative processes must support inclusion and reduce bureaucratic barriers even when small amounts are involved. Confirm funding, administrative requirements and timescales in advance and have all parties firmly commit to their role.

Language is important, and inclusivity must extend to marketing materials. Therefore, consider partnering with student groups or university diversity units to craft non-exclusionary messaging. It is also important to collect and analyse data on inclusion as part of programme design.

Look out for unexpected wins. For example, a late decision to extend eligibility to staff revealed this to be a powerful trigger point for ‘intrapreneurial’ activity within the university.

CONCLUSIONS

Although not explicitly focused on deep tech, the Lightbulb Grants process significantly impacts nascent deep tech innovation. While many ideas stimulated through this ‘lightbulb moment’ approach lean towards technology, the primary importance lies in potentially catalysing widespread entrepreneurial activity through cost-effective interventions. This approach might delay the need to select deep tech “winners” until they have progressed further in their growth cycle and reduces the risk of new ways of thinking being suppressed by a narrow focus on existing technologies and approaches. With the Lightbulb Grants we try to stimulate new ideas and ways of thinking, which may well draw from the established deep tech toolbox but might be something genuinely new that we, as funders, educators, facilitators, and prompters of the entrepreneurial process, can’t even imagine. Our approach to this suggests that sustainable and impactful deep tech innovations are likely to emerge when we foster a broader and more inclusive entrepreneurial ecosystem.

AUTHOR BIOS

Philip Davies is an Associate Lecturer and PhD candidate at the University of West of Scotland. He has run a marketing and strategy consultancy since 2007, helping small businesses and charities start and grow. He has also worked as a consultant on funded business growth programmes since 2011, supporting more than 700 small businesses and start-ups with their marketing strategy and planning. (philip.davies@uws.ac.uk)

William Shepherd is an Enterprise Lecturer at the University of West of Scotland, with a background in blue chip FMCG marketing and innovation. He has spent the last decade blending his lecturing with running his own management consultancy. A passion for innovation led him to spend time in Cambodia, working with over 15 different NGOs and projects, including developing financial models that adjusted for pig pregnancy and leading an innovation project focused on delivering food security through microentrepreneurs working on frog farms. (will.shepherd@uws.ac.uk)

Alan Martin is an Enterprise Lecturer at the University of West of Scotland, with a background in FTSE 100 project management and productivity. After over a decade as a serial entrepreneur with parallel activity in consultancy to SMEs in the speciality food sector, he has, over the last five years, transitioned to educator where his focus is on the wider societal impact of enterprise education. (alan.martin@uws.ac.uk)

Dr. Alan Murray is a Reader in Enterprise at the University of the West of Scotland and the Enterprise Lead for the School of Business and Creative Industries. Prior to joining the Business School, he worked as a business adviser with Scotland's two leading enterprise agencies – Business Gateway and the Prince's Scottish Youth Business Trust. He has had a long career in business management in both small businesses and large organisations including as an entrepreneur in his own right – having his own outdoor adventure business for 20 years. (alan.murray@uws.ac.uk)

References

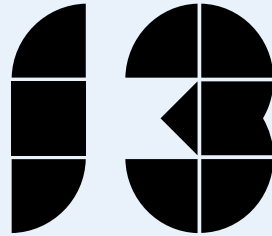
- BMWK (German Federal Ministry for Economic Affairs and Climate Action), (n.d.) EXIST business start-up grant. Available at: <https://www.exist.de/EXIST/Navigation/EN/Start-upFunding/EXIST-Business-Start-up-Grant/exist-business-start-up-grant.html> (Accessed 28/02/24)
- EIT (n.d.) 'What is deep tech?', EIT Tech Talent, Available at: <https://www.eitdeeptechtalent.eu/the-initiative/what-is-deep-tech/> (Accessed 28/02/24)
- Eklund, J., Levratto, N. & Ramello, G.B. (2020). 'Entrepreneurship and failure: two sides of the same coin?', *Small Bus Econ*, 54, pp. 373–382.
- Hanlon, D. & Saunders, C. (2007). Marshaling resources to form small new ventures: toward a more holistic understanding of entrepreneurial support. *Entrepreneurship Theory and Practice*, 31(4), pp. 619–641.
- Krueger, N.F. (2017). Entrepreneurial Intentions Are Dead: Long Live Entrepreneurial Intentions, in Brännback, M. & Carsrud, A. (eds), *Revisiting the entrepreneurial mind: Inside the black box*. Springer International Publishing, pp. 13–34
- Lourenço, F. & Jones, O. (2006). Developing entrepreneurship education: comparing traditional and alternative teaching approaches. *International Journal of Entrepreneurship Education*, 4(1), pp.111–140.
- Neck, H. M., Neck, C. P. & Murray, E. L. (2023). *Entrepreneurship: The practice and mindset*. Sage publications.
- Patel, P. C. & Wolfe, M. T. (2022). Public administration and new venture startups: The association between economic development and the role of bureaucracy in startup activity. *Journal of Small Business Management*, 61(6), pp. 3255–3283.

The Scottish Government. (2020). Scottish Technology Ecosystem Review. Available from: <https://www.gov.scot/publications/scottish-technology-ecosystem-review/> (Accessed 28/02/24)

The Scottish Government. (2023). National innovation strategy 2023 to 2033. Available from: <https://www.gov.scot/publications/scotlands-national-innovation-strategy/pages/3/> (Accessed 28/02/24)

UN. (2012). United Nations Sustainable Development Goals. Available from: <https://sdgs.un.org/goals> (Accessed 28/02/24)

**Elke Decrock, Elisa Van Kenhove, Margot Vanden Bossche,
Sofie Vanassche, Pedro De Bruyckere & Geert De Meyer**



ASKFORCE.ONE: FROM RESEARCH TO REAL IMPACT

ABSTRACT

Artevelde University of Applied Sciences in Ghent is a practice-oriented scientific research University. Our research addresses important questions generated by industry and society. We aim to create new knowledge and develop concrete applications for and with our stakeholders by focusing on specific themes such as talent-oriented organizations, diversity and inclusion in education, and policy (Arteveldehogeschool.be). Our goal is to ensure that this knowledge is made widely available. By establishing our first spin-off company, Askforce.one, we make a positive impact on our regional economy. This chapter presents Askforce.one as a good practice example of giving people a voice through technology by asking what they need and want from society and their organization.

Key words: Spin-off, Strategic Valorisation, Impact, Practice-oriented Scientific Research, Innovation, Entrepreneurship, Sustainability, Deep Tech



INTRODUCTION

Practice-oriented scientific research is the basis of the knowledge and expertise developed at Artevelde University of Applied Sciences. Our research addresses important questions generated by industry and society. We have five research centers focusing on specific research themes: Business & Management, Communication, Media & Design, Health & Care, Education, and People & Society. From our research, we create new knowledge and develop concrete applications for and with our stakeholders, aiming to address pressing societal challenges where we have relevant knowledge and expertise. In choosing how we present our research results, we aim for the greatest possible added value for both our stakeholders and society. Choosing the right valorisation approach ensures that research results are adopted by education and professional fields, thus stimulating innovation and evidencing the broader social relevance of science. Within our University of Applied Sciences, we have a dedicated valorisation cell that guides researchers through important stages of the valorisation process, including supporting them in decisions relating to the business model, market share, willingness-to-pay, product-market fit, intellectual property and further funding possibilities. Valorisation coaches support our researchers with a personalized approach. There is a strong connection with our student entrepreneurship center, Idea Factory, offering complementary coaching and we have a strong partnership with the University of Ghent that offers a 'research to market' programme for our researchers.

As a result of these efforts, in 2022, the University of Applied Sciences founded the spin-off Askforce.one to market a tool to help organizations work on long-term participation and community building. This chapter discusses the background to this spin-off.

REGIONAL ECOSYSTEM CONTEXT

Artevelde University of Applied Sciences is based in Ghent, Belgium, and offers various bachelor's and graduate programmes, postgraduate study opportunities, and lifelong learning programmes under the name Artevelde Academy. The University of Applied Sciences is an expert centre for education, research, and services where students, staff, and partners collaborate in a stimulating environment. Artevelde University of Applied Sciences is committed to innovation and quality and prepares students for the world of tomorrow.

Valorisation, the goal of applied research, is a core task of higher education institutions (HEIs), such as Artevelde University of Applied Sciences, and is embedded in their legal documentation. Codex Higher Education¹ sets out guidelines for valorisation to which universities of applied sciences are legally bound. These regulations are further specified in the General Research and Cooperation Regulations of Association of Ghent University (AUGent).

Research at Artevelde University of Applied Sciences has experienced significant growth in recent years, both in terms of the number of research projects and the type of output, with research activities ranging from the publication of textbooks and building websites through to commercialization via a licensing deal and launching a spin-off company. The University has invested in diverse labs, each focusing on the desires and needs of a specific knowledge area that allow students and researchers to discover the latest technologies and innovations. From developing custom prototypes to offering guidance on an innovative idea, our labs welcome co-creation, creativity and experiments in open spaces for staff, students and the local community. We work on the principle of – 'neighbourhood in the campus, campus in the neighbourhood' – an approach welcomed by the city of Ghent.

However, applied or practice-oriented research is no longer the sole prerogative of Universities of Applied Sciences. Universities, governments, and private organizations are equally aware of the diversity of research approaches, the importance of valorisation and the corresponding opportunities that emerge as a result. This is partly due to two reasons: 1) Social relevance and impact have become central to Flemish and European research policy over the past decade, and 2) Social accountability and the translation of research to the general public have become more important for policymakers and research funders, necessitating sustainable and inclusive practices as well as deep tech innovations. By cooperating in transdisciplinary consortia (knowledge institutions, companies, governments, and citizens, i.e., the Quadruple Helix), universities can make research results available and demonstrate the added value of these results for the target group.

Not only has there been increased awareness and investment in valorisation from government, but the important role Universities of Applied Sciences play as research and innovation partners for companies and organizations is now being recognized, particularly in areas related to Artevelde's expertise, including sustainable economic models, human-centered design, circular economy, and sustainable packaging. Each year we publish, together with Comeos, the SMI barometer which measures the impact of social media and influencer marketing in Belgium. This tool has been successful for the past five years and is welcomed by industry. This is just one example of many successful valorisation results at Artevelde University of Applied Sciences.

In Belgium, the Flemish government is pushing for an “outside-in” view and more demand-driven operation of knowledge institutions, emphasizing the need for sustainable and inclusive innovation driven by technology. Based on HEInnovate, a self-reflection tool for HEIs that helps them explore their innovative potential, we scored strongly in the area of ‘Entrepreneurial Ecosystem and Networks’ which resonates with our continuous research output.

ASKFORCE.ONE

From research project to spin-off: How did it all start?

On the 5th of October 2020, Artevelde University of Applied Sciences rolled out Teacher Tapp in Flanders, Belgium, an app that keeps track of what is happening daily within the Flemish educational landscape. This was achieved in collaboration with Education Intelligence, a British company that was the first to roll out Teacher Tapp in the UK. Similar to in the UK, the application soon proved a huge success in Flanders. Through the Teacher Tapp Flanders application, those working in education are invited to answer three multiple-choice questions every day that tie in with their daily practice.

Autumn 2020 witnessed yet another Corona Virus lockdown. Many high school students were homeschooled during that period and their social lives were once again put on hold. This lockdown context made us realize how little we knew about young people – about what they were thinking and how they felt. We shared our observations with De Ambrassade², the Youth Work umbrella organization in Flanders and Brussels. These discussions led to the idea of us developing a tool together, building on the success of Teacher Tapp Flanders. This seemed to fit perfectly with De Ambrassade's plans to develop a youth barometer. Based on our shared ambition to make young people's voices heard, within the space of just a few months we developed a completely new tool (including application, dashboard, questions tips, and a communication strategy) focusing specifically on young people; we called this tool Waddist (see Figure 1).

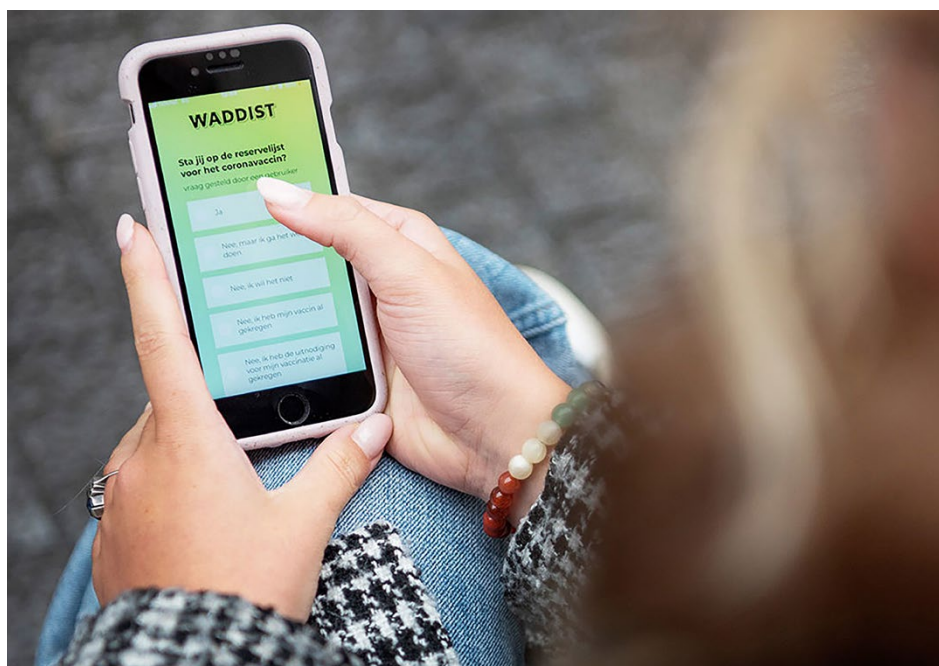


Figure 1. Waddist app focusing on young people

Waddist is a tool focusing on young people, promoting inclusivity by giving them a voice and a platform to express their thoughts and feelings. Its accessibility and built-in gamification (such as badges and streaks) are its key success factors, encouraging sustained engagement and participation among young users. In this app, young people receive three or four new questions daily that are relevant to them. After participating, users can compare their answers with their peers and receive tips to promote their well-being. Questions are answered anonymously, and the answers are used to provide feedback to teachers.

We have reached thousands of young people with the Waddist app and we keep this large group of young people on board while reaching out to new users. Realizing that the concept worked well for two very different target groups – young people and teachers – we believed there were still many possibilities to develop the concept further. And that is how the very first Artevelde University of Applied Sciences' spin-off was born: Askforce.one, a sustainable and inclusive platform aimed at empowering individuals and organizations to make informed decisions and foster community engagement.

The decision to set up a spin-off company typically depends on the particular problem's setting, demand articulation and user expectations. The aim of a spin-off should be to generate impact, with a focus on being relevant in the marketplace, and seeking a strong product-market fit. Establishing Askforce.one has had a positive impact on regional economic development and enhances our reputation as an entrepreneurial University of Applied Sciences, prioritizing inclusivity by giving a voice to society.

With the help of external consultants and a critical peer group, a business plan was drafted and approved by the University of Applied Sciences' governing body. The Askforce.one team spent months crafting a software package and related services that could be tailored to HR applications within companies. The resulting tool emphasises the importance of easy solutions that are available for everyone; solutions that address organizational needs in an inclusive way and motivate everyone to participate. For example, the application can be branded in the customer's house style, and questions can be asked in multiple languages, ensuring accessibility and inclusivity.

IMPACT

Askforce.one's mission

Teacher Tapp Flanders and Waddist were not available for two target groups – 1) businesses and 2) organizations – which is why Askforce.one was created. Accordingly, Geert, Pedro, and Sofie, three employees from Artevelde University of Applied Sciences, started to develop a tool to help organizations work on long-term participation and community building where inclusivity is one of the main drivers. Askforce.one developed an application to allow personnel services to quickly and easily organize surveys within their companies. Rather than use traditional long, and generic questionnaires, it poses daily, short and recognizable questions on users' smartphones. In this way, employees' concerns can be assessed regularly and addressed in a timely manner. The technology is built in a way that constantly engages users, motivating them to answer questionnaires on a daily basis. This is the core of the application.

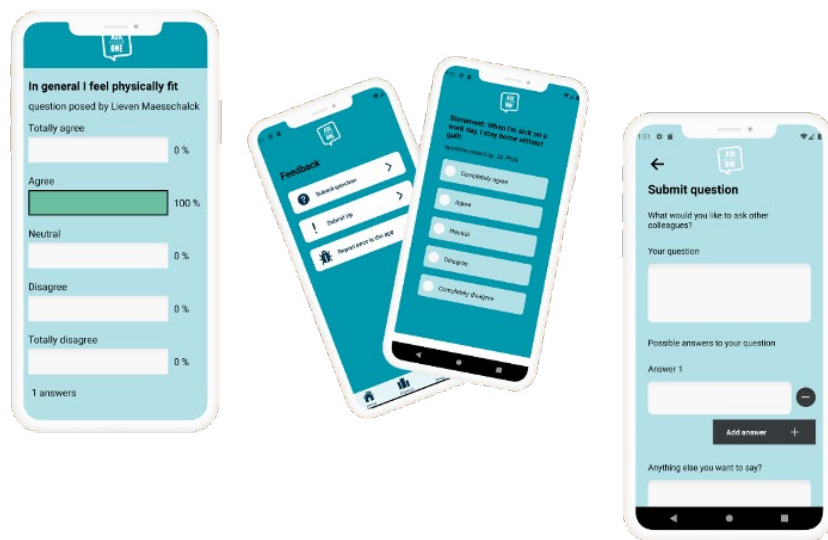


Figure 2. Look and feel of the Askforce.one app, focusing on businesses and organisations

Askforce.one offers expertise in asking, drafting, and timing questions. The team at Askforce.one is experienced in bringing difficult issues to bear in a comprehensible way, prioritizing clear communication and user engagement. Rather than use long statements with multiple answer options, Askforce.one uses clear, simple questions and statements that are “no fuss, just easy to relate to, and easy to answer,” while also ensuring sustainable and inclusive outcomes. The tool is based on in-house longitudinal and low-threshold research, promoting community engagement and participation. It aims to make participation in workplace surveys so simple that it requires little effort and creates added value for both employee and employer.

Deep tech, inclusivity and sustainability as core elements of Askforce.one

Deep tech refers to technologies that are based on substantial scientific or engineering work and offer innovative solutions to complex problems. The following are key deep tech features of the Askforce.one tool:

1. **Big Data Analysis:** The tool processes and analyzes large amounts of data to generate insights. The ability to handle big data requires advanced techniques and infrastructure for data storage, management, and analysis.
2. **Real-time Processing:** The technology behind the application can process and analyze data in real time, enabling quick and accurate responses. This requires advanced software architecture and fast processing capabilities.

These deep tech elements enable the tool to offer innovative solutions to data challenges, making it more than a standard application. It requires a substantial amount of research, development, and technical expertise to effectively implement these features.

The tool also offers various features that contribute to sustainability, including:

1. **Digital transformation:** By digitalizing processes, the tool reduces the need for physical documents and paper consumption, contributing to environmental friendliness.
2. **Efficiency:** The tool improves communication processes, which can lead to reduced energy and resource consumption within organizations and businesses.

Inclusivity is one of the cornerstones of Askforce.one because of its:

1. **Accessibility:** The tool is designed to be accessible to a wide range of users, including people from different backgrounds and skill levels. This means that people with diverse abilities can use and benefit from the technology.
2. **Personalization:** The tool can be customized to meet the specific needs and preferences of individual users, helping to create a more inclusive user experience.
3. **Educational opportunities:** By enhancing users' communication capabilities, the tool can contribute to personal development.
4. **Broad application scope:** The tool can be used in various sectors such as, for example, education, event management, and business, ensuring that diverse groups within society have access to the benefits of the technology.

Through these sustainability and inclusivity features, the Askforce.one tool aims to be not only technologically advanced but also socially responsible and environmentally friendly.



Main Campus of Artevelde University of Applied Sciences: Kantienberg

The team

The Askforce.one team comprises three employees from the education expert network at Artevelde University of Applied Sciences: Pedro De Bruyckere, Geert De Meyer, and Sofie Vanassche. Pedro helps keep Askforce.one's mission at the forefront with his years of expertise as a researcher and communicator. He can determine what questions to ask, how to ask them, and what an organization can do with the results.

Geert combines his skills as a teacher with his analytical aptitude to fine-tune questions and make difficult ones easy (at least on the surface), prioritizing clear communication and user engagement. Sofie asks the right questions in the right way at the right time. She enjoys digging into data and finding out where the challenges lie for organizations striving for sustainable and inclusive outcomes.



Figure 3. The founding team of Askforce.one.

Entrepreneurship with impact

The Askforce.one tool offers an effective way for us to reach our target groups in organizational practices. The University of Applied Sciences uses the data gathered by the tool for further research and education within different research themes.

As a University of Applied Sciences, we aim to establish more spin-off companies, provided they are the most suitable pathway towards societal impact. For each valorisation case, we must first consider when we keep the expertise in-house and when we take it to the market and turn it into a business, prioritizing sustainable and inclusive practices.

Establishing Artevelde University of Applied Sciences' first spin-off company contributes to our social role as a university of applied sciences. Askforce.one helps companies make decisions and gives employees a louder voice, promoting sustainability, inclusivity, and deep tech integration. Through Askforce.one, we make a positive impact on economic development within our region.

KEY LEARNINGS



Impact through spin-off

Maximum societal impact is achieved by choosing the most suitable valorisation approach, in this case founding a spin-off company focusing on sustainability, inclusivity, and deep tech integration.

The right tools capture the data

The developed tool is a means to reach our target group, promoting sustainability, inclusivity, and deep tech integration in organizational practices.

Data is key

The University of Applied Sciences has benefitted by using the data gathered by the spin-off company for further research and education, focusing on sustainable and inclusive outcomes.

Clear communication fosters engagement

Askforce.one's success is attributed in part to its clear and user-friendly interface, highlighting the importance of effective communication and design in engaging target audiences, while also promoting sustainable and inclusive practices.

Research informs practice and vice versa

The development of Askforce.one demonstrates the iterative relationship between research and practice, with insights from one informing the other to create practical solutions, with a focus on sustainability, inclusivity, and deep tech integration.

Longitudinal research adds value

Askforce.one's focus on longitudinal research adds depth to its insights, emphasizing the value of ongoing data collection and analysis for informing decision-making.

Expertise drives impact

The expertise of the Askforce.one team in asking relevant questions and interpreting data enhances the tool's effectiveness, highlighting the importance of specialized knowledge in driving impact.

CONCLUSIONS

This chapter has outlined the journey of Artevelde University of Applied Sciences from conducting practice-oriented scientific research to establishing Askforce.one – a spin-off company aimed at strategic valorisation with an emphasis on building strong partnerships with companies and organisations. The University of Applied Sciences' research approach focuses on addressing industry and societal needs, with the goal of creating new knowledge and applications for stakeholders, while prioritizing sustainable and inclusive practices. This emphasis on practical application is aligned with broader trends in research policy, emphasizing social relevance and impact.

Askforce.one was developed as a tool to facilitate long-term participation and community building within organizations, filling a gap in the market and addressing the need for timely and relevant data collection. Its founding team leverages their expertise to ensure the tool's effectiveness and accessibility, with a commitment to a more engaged audience. As the University of Applied Sciences' first spin-off company, Askforce.one exemplifies the institution's commitment to entrepreneurship and societal impact, promoting sustainable and inclusive practices driven by deep tech innovations. By utilizing the data gathered by Askforce.one for further research and education, Artevelde University of Applied Sciences demonstrates a holistic approach to maximizing societal benefit from its research endeavors.

AUTHOR BIOS

Dr. Elke Decrock is Head of Department of Research and Development at Artevelde University of Applied Sciences. (onderzoek.impact@arteveldehs.be)

Dr. Elisa Van Kenhove is Policy Officer for Valorisation at Artevelde University of Applied Sciences (onderzoek.impact@arteveldehs.be).

Margot Vanden Bossche is Entrepreneurship Coordinator and Business Coach at Artevelde University of Applied Sciences (onderzoek.impact@arteveldehs.be).

Dr. Sofie Vanassche is a Postdoctoral Researcher at the University of Antwerp and CEO and Co-founder of Askforce.one (info@askforce.one).

Dr. Pedro De Bruyckere is an Educational Scientist at Artevelde University of Applied Sciences & Utrecht University, and Co-founder of Askforce.one (info@askforce.one).

Geert De Meyer is a Researcher at Ghent University and Co-founder of Askforce.one (info@askforce.one).

References

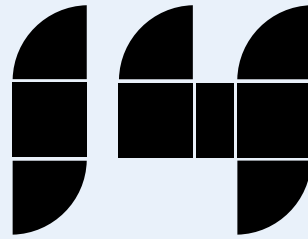
- Artevelde University of Applied Sciences. (n.d.). Research. Retrieved from <https://www.arteveldehogeschool.be/en/research-and-partnerships/research>
- Teacher Tapp. (n.d.). Teacher Tapp. Retrieved from <https://teachertapp.co.uk/>
- Artevelde University of Applied Sciences. (n.d.). De Jongere Denkt. Retrieved from <https://sites.arteveldehogeschool.be/dejongeredenkt/>
- Artevelde University of Applied Sciences. (n.d.). Askforce.one, spin-off van Arteveldehogeschool, helpt werknemers makkelijker hun mening te geven. Retrieved from <https://www.arteveldehogeschool.be/nl/nieuws/askforceone-spin-van-arteveldehogeschool-helpt-werknemers-makkelijker-hun-mening-te-geven>
- Knack. (n.d.). Askforce.one is eerste spin-off van Arteveldehogeschool. Retrieved from <https://trends.knack.be/>

kanaal-z/z-nieuws/askforce-one-is-eerste-spin-off-van-arteveldhogeschool/

Askforce.one. (n.d.). Retrieved from <https://askforce.one/>

¹ Codex Higher Education is a legal text that describes the statutory provision for higher education in Flanders.

² The Ambrassade is an expertise center for everything related to youth work, youth information, and youth policy; a support and networking organization for all youth work in Flanders and Brussels; the coordinator for youth information in Flanders; the intermediary organization between youth work, other policy domains that impact children and young people (education, welfare, employment, etc.), and policymakers; the catalyst behind the Flemish Youth Council, the official advisory body to the Flemish Government on all domains concerning children, young people, and their organizations in Flanders.



NA.BI: DRIVING SUSTAINABLE ENTREPRENEURSHIP THROUGH SOCIAL MEDIA COMMUNICATION

ABSTRACT

The goal of sustainable entrepreneurship is to develop solutions that benefit society. Hence, fostering social-environmental and social sustainability business initiatives is important for the natural environment, the community, and the economy (Patzelt & Shepherd, 2011). However, the benefits and impact of regional sustainable entrepreneurial activities are not fully understood. Therefore, this chapter attempts to unpack the concept of sustainable entrepreneurship by presenting a specific good practice example – na.bi – “nachhaltig. bitte” (sustainable, please), a student-led podcast series featuring more than 90 sustainable entrepreneurs and their activities in rural areas. Na.bi demonstrates how businesses use technology to make the world more sustainable, and highlights how these special types of entrepreneurs overcome their ecosystem challenges. By using the na.bi example, we aim to highlight the value of sustainable entrepreneurship in the rural context using citizen science. This chapter should be of value to ecosystem actors seeking to raise public awareness and interest in creating sustainable impact in their region. This good practice example should help inspire immediate action and participation.

Key words: Impact, Sustainable Entrepreneurship, Social Media



INTRODUCTION

The need to create inclusive digital and sustainable solutions, especially within European rural and suburban areas, has never been greater; this is because the majority of today's population lives in such areas. According to the European Commission, inclusive digital and sustainable solutions are particularly relevant in the context of regional living spaces, agriculture, sustainable mobility, and energy as well as water supply (European Commission, 2021).

While the potential for co-creative sustainability processes with citizens has already been recognized by many cities, rural regions often lag behind as awareness and ecosystem infrastructures are not fully developed. To enhance the innovativeness and robustness of sustainable rural entrepreneurial ecosystems, capital (financial resource), capability (entrepreneur and owner skillset), connection (resource and relationship network), culture (local communities), and climate (regulatory, economic development, and policy environment), as well as companies, universities, and service providers (Macke et al., 2014; Mason & Brown, 2014) need to be aligned.

Simple technologies such as social media communication can help spread the word about sustainable products, solutions, and services, improving the level of sustainability-oriented entrepreneurial intentions among rural citizens. Social media can also help create positive images and role models among communities. From a research perspective, podcasts have been proven to be particularly promising social media communication vehicles, spreading innovative content and creating beneficial effects on citizens. This is important because understanding how sustainable products, services, and initiatives are adopted in regional and cross-regional contexts can offer valuable insights into the interplay between technology, sustainability practices, and social dynamics in regions. Through initiatives such as the one presented in this chapter, we can gain a multistakeholder perspective on regional sustainability, highlighting the divergence of sustainability practices.

The remainder of this chapter is structured as follows: First, we discuss regional ecosystems and their impact, then we introduce the na.bi initiative and highlight its most important benefits. Finally, we conclude with key learnings.

REGIONAL ECOSYSTEM

The imperative for advancing social-environmental and social sustainability has never been more pressing (De Villiers & Maroun, 2018). Regional ecosystems play a pivotal role in this quest. Regional ecosystems encompass the natural environment, socio-economic structures, cultural contexts, and political frameworks. They provide a unique vantage point for understanding sustainability. The interplay of these elements within ecosystems fosters the resilience and adaptability essential for sustainable development (Folke et al., 2010). Austria, Germany, and Switzerland, within the context of the European Commission's governance, exemplify the critical role of regional ecosystems in driving change towards sustainability.

These (mostly) German-speaking countries – Austria, Germany, and Switzerland – have an opportunity to become a 'Triad of Sustainability' that exemplifies environmental stewardship and social welfare. Their concerted efforts in renewable energy, waste management, and social equity set benchmarks for sustainability (Wehrmeyer & Mulugetta, 2013). The following are some examples of regional sustainability activities to underline this:

- Germany's Energiewende (energy transition) is a paradigm shift in energy policies. It focuses on de-carbonization and sustainable energy, influencing European and global energy policies (Jacobsson & Lauber, 2006).

- Switzerland excels in balancing economic prosperity with environmental preservation. Initiatives such as the Swiss Resource Efficiency and Climate Change Mitigation Strategy exemplify this balance (Swiss Federal Council, 2019).
- Austria's investment in green technology and renewable energy sources is particularly noteworthy. The country's approach to sustainability integrates economic growth with environmental responsibility (Gruber & Brand, 2018).

NA.BI

To have a positive impact on society, entrepreneurial ecosystems need to be established on three different levels. Firstly, the micro-entrepreneur level, secondly, the meso-organizations' level, and thirdly, the macro-communities' level. The good practice example discussed in this chapter – na.bi – focuses on the micro-entrepreneur level as very often regional sustainable business initiatives and communities are not known beyond the region in which they operate. Indeed, many regions have tried to start similar activities without knowing and learning from each other.

To increase awareness of existing sustainable initiatives and businesses in rural Austria, and to help create a positive sustainable impact, the University of Applied Sciences Upper Austria started a free podcast series covering sustainability projects and businesses in sectors ranging from sustainable healthcare to sustainable agriculture and sustainable IT. These projects demonstrate how sustainability can be developed. They highlight the different challenges that can arise during the process and they help connect the disconnected sustainable regional ecosystem parties.

na.bi – nachhaltig bitte (sustainable please) – is a student-led podcast series for anyone seeking inspiration and advice and wanting to take sustainability activities into their own hands. The 90+ episodes feature people, start-ups, initiatives, and organizations who have founded sustainable businesses in rural areas and have overcome various challenges. All of these businesses are small and medium-sized enterprises (SMEs). They represent various industries including agriculture, IT, retail, food, mobility, healthcare, and the social sector. The social media communication drive for na.bi started in June 2022 and is ongoing. All podcasts are in German and were recorded by students during their studies. The topics addressed by these podcasts cover the following SDGs: Good Health & Well-being (SDG 3), Quality Education (SDG 4), Reduced Inequalities (SDG 10), Sustainable Cities & Communities (SDG 11), Responsible consumption & production (SDG 12), Climate Action (SDG 13), Life below Water (SDG 14) and Life on Land (SDG 15).



Figure 1. na.bi – nachhaltig bitte on spotify

IMPACT

In the past one and a half years, our na.bi management students have created more than 90 podcasts with regional sustainable businesses in Austria and Germany.

- Impact 1** These podcasts are used by regional governments and businesses to attract customers to their shops and regions, and by schools and universities to raise awareness.
- Impact 2** na.bi was featured in September 2022 by der Standard, one of the most prominent daily newspapers in Austria.
- Impact 3** A learning programme was initiated that uses na.bi podcasts to demonstrate the challenges of sustainable entrepreneurs.
- Impact 4** Diverse students reported that participating in the podcast series helped them get a particular job they had applied for.
- Impact 5** In 2022, the na.bi podcast series was among the top 10 shared Spotify podcasts worldwide in the business category.

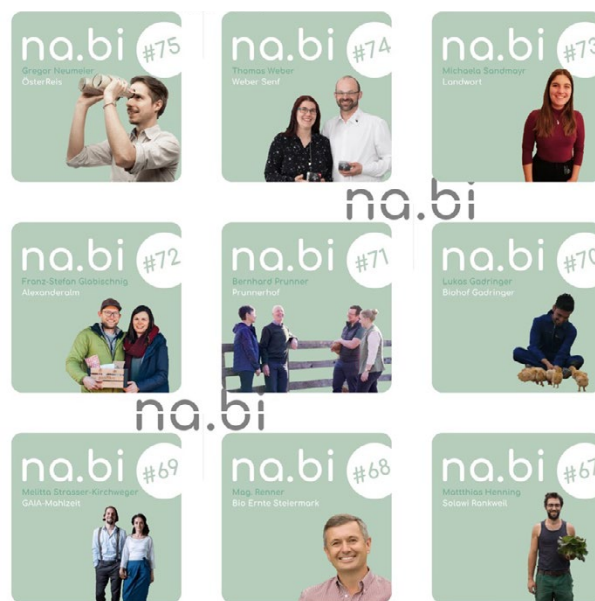


Figure 2. na.bi Instagram page



Figure 3. na.bi Instagram Analytics 2022: na.bi was among the top 10 shared Spotify podcasts worldwide in the business category.

KEY LEARNINGS



1. – Podcasts are an impactful tool

Podcasts create positive word-of-mouth communication between various actors in and between sustainable entrepreneurial ecosystems.

2. – Follow a clear path

Most sustainable entrepreneurs follow a clear communitarian and missionary path, focusing not only on income but also on the greater good for all. In addition, they focus on creating a strong community around their business.

3. – Work with people who share your values

Sustainable entrepreneurs prefer to work with individuals who share their values of sustainability, even if it means higher costs or limited business networks.

4. – Use sustainable production methods

Sustainable entrepreneurs are committed to using sustainable production methods and materials, even if it means higher costs or more complex logistics.

CONCLUSIONS

All in all, most sustainable entrepreneurs face the challenge of balancing sustainability with profitability. They often accept lower profits to maintain their commitment. They deal with the tensions by staying committed to their values and missions and by prioritizing transparency, education, and community engagement. Further studies should aim to focus on the dynamics these organizations go through and how these organizations alter their identity along the way. Such focus could provide a useful starting point for introducing na.bi to other parts of the world.

AUTHOR BIOS

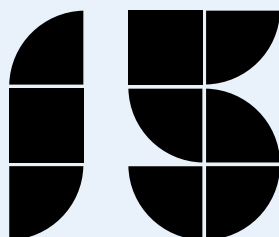
Professor Johanna Anzengruber is a Professor of Strategy and Innovation, Vice Dean at the University of Applied Sciences Upper Austria, and Head of the Master Study Programme “Leading Transformation for Impact Organizations.” She also holds an Affiliated Research Scientist position at the Center for Effective Organizations at the University of Southern California. (Johanna.Anzengruber@fh-linz.at)

Professor Bettina Maisch is a Professor of Entrepreneurship at Munich University of Applied Sciences and Head of Digital Entrepreneurship Education at the Strascheg Center for Entrepreneurship. Her research focuses on Entrepreneurial Life Design, Digital, and Responsible Entrepreneurship Education. She is the Track Chair for “Sustainable Entrepreneurship Education and Educator” at EURAM. (Bettina.Maisch@hm.edu)

References

- De Villiers, C. & Maroun, W. (2018). Sustainability Accounting and Integrated Reporting. Routledge.
- European Commission. (2021). 'European capacities for citizen deliberation and participation for the Green Deal'. Available at <https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/lc-gd-10-1-2020>.
- Folke, C., Hahn, T., Olsson, P. & Norberg, J. (2010). 'Adaptive governance of social-ecological systems', Annual Review of Environment and Resources, 35, pp. 441–473.
- Gruber, V. & Brand, M. (2018). 'Green innovations in Austria: A case study approach', Journal of Cleaner Production, 18(5), pp. 463–470.
- Jacobsson, S. & Lauber, V. (2006). 'The politics and policy of energy system transformation—explaining the German diffusion of renewable energy technology', Energy Policy, 34(3), pp. 256–276.
- Macke, D., Markley, D. & Fulwider, J. (2014). Energizing Entrepreneurial Communities: A Pathway to Prosperity, Center for Rural Entrepreneurship: Lincoln.
- Mason, C. & Brown, R. (2014). 'Entrepreneurial ecosystems and growth-oriented entrepreneurship', available at: www.oecd.org/cfe/leed/Entrepreneurial-ecosystems.pdf.
- Patzelt, H. & Shepherd, D.A. (2010). 'Recognizing opportunities for sustainable development', Entrepreneurship Theory and Practice, 35(4), pp. 631–652.
- Schaltegger, S. & Wagner, M. (2011) 'Sustainable entrepreneurship and sustainability innovation: categories and interactions', Business Strategy and the Environment, 20(4), pp. 222–237.
- Swiss Federal Council. (2019). Swiss Resource Efficiency and Climate Change Mitigation Strategy. Bern: Swiss Federal Council.
- Wehrmeyer, W. & Mulugetta, Y. (2013). 'Growing green: The environmental sustainability of the German car industry', Journal of Cleaner Production, 31, pp. 106–115.

Maria Høegh Beierholm & Simone Stilling



COURAGE FOR DIGITAL ENTERPRISE

ABSTRACT

This chapter highlights four didactic concepts used at Via University College, Denmark, to help students move from social and health programmes into the field of deep tech. The majority of these students are women who have low self-efficacy in relation to digital technology. We discover that, through the application of these four concepts, both the students' digital courage and digital knowledge are awakened. Students possess strong integrator skills to invent innovative solutions to implementations and opportunities within their professional field. By using the four concepts in TechEd, teaching is characterized by play, silliness, imagination, and recognition. The courage and confidence these students develop lead to digital entrepreneurship.

Key words: Courage, Imagination, TechEd, Inclusion



INTRODUCTION

In this chapter we present two narratives from Via University College, Denmark, that demonstrate how students with low self-efficacy in digital technology overcome their reservations to come up with innovative solutions for their practice. From these narratives we derive four didactic concepts that aim to increase students' 'digital courage' and innovative skills. We demonstrate how our perspective on TechEd (Technology comprehension) can stimulate digital entrepreneurship among students enrolled in a social or health education programme. Through implementation of the four concepts; "Connect!", "Play Along!", "Do something silly!", and "Credit!", barriers related to digital technologies have been successfully broken down. The didactic concept, "Connect!", encourages finding links between TechEd and the particular technology the students are already utilizing. "Play Along!" signifies students' exploration of technology as a natural progression into advanced professional fields. "Do Something Silly!" advocates for building courage by starting with rudimentary prototypes. Lastly, "Credit!" emphasizes the importance of acknowledging students' creative expressions, even if they seem nonsensical, to foster the growth of their digital imagination. By sharing our experiences we aim to inspire those teachers seeking to bring students – who do not see themselves as digitally enterprising – into the field of deep tech.



Figure 1. Via University College Logo

In both the social and healthcare sectors, the majority of professionals are female. They often experience a loss of autonomy when implementing smart digital solutions that have been developed and created by male-dominated large technology companies. The professionals' experience of digital technology is that it appears in their professions as a top-down management decision which leads to a sense of alienation and deprofessionalization among these practitioners (Giddens, 1991:150). This gendered dynamic naturally adds to the existing inequality between men and women, where women tend to shy away from unknown technologies and miss out on valuable knowledge and empowerment opportunities. This is regrettable given that social and healthcare professionals possess valuable expertise and have considerable potential for creating innovative solutions. To prevent loss of autonomy, we develop educational ways to encourage social and healthcare professionals' possibilities to act entrepreneurially and think innovatively through digital technology. Our interest in digital empowerment is motivated by a concern for the professions' autonomy. Our aim is to include social and healthcare professionals in ongoing digital development (OECD, 2021).

The purpose of our interventions is not to educate digital specialists, but rather to educate professionals who dare to think and act innovatively with digital technology. Such competence can be described as digital integrator competence. This integrator competence is in demand across professional fields (Digital Dogme, 2022:11). A digital integrator, unlike the digital specialist, can connect digital technology with challenges and possibilities within their profession. Firstly, digital integrators are professionals, and secondly, they have digital

imagination and empowerment to innovate their profession using digital technology. If we wish to advance this digital integrator competence in social and healthcare professional education, then we must support students in developing the necessary knowledge and courage to investigate digital technologies related to their specific profession. This approach prioritises the exploration of profession-specific opportunities and challenges and, thus, is in contrast to the business models of large technology companies.

REGIONAL ECOSYSTEM CONTEXT

VIA University College is one of six professional colleges located in the middle region of Jutland with campuses in eight different cities including Aarhus, which is the second biggest city in Denmark. VIA offers the majority of Denmark's medium-length higher education (professional Bachelor's programmes). The variety of locations offers considerable job and internship opportunities for the students.

Our experience as teachers in these digital entrepreneurship courses tells us that students in social and healthcare educations often have fixed ideas of what their future job requires. They do not see themselves as individuals who necessarily need to innovate in their profession. When it comes to digital technologies, these are mostly understood as tools that they must learn to use properly. The idea that these students have the professional and critical judgment to decide how they use the technology, or perhaps even develop it themselves, seems to be non-existent.

Our students' self-efficacy (Bandura, 1997) towards digital technology is low. Students in social and healthcare education programmes do not necessarily learn to think and act with digital technology during their course. If they do, it is mostly the instructive use of ready-made digital tools that they need to master in order to practice their profession. Technology comprehension at a deeper level is not part of the curriculum. This is something we want to change.



Figure 2. VIA University College and its region

FOUR CONCEPTS TO INCREASE DIGITAL COURAGE

At VIA University College in Denmark, we have designed a hands-on workshop framework tailored for students in nursing and teaching programmes. These workshops are based on four didactic concepts that aim to develop students' courage and creativity in relation to deep tech. These four concepts can be integrated into any subject.

Below we present the four concepts that collectively support students' digital entrepreneurship. Each concept contains a description, a piece of advice and an example.

1. CONNECT!

User experiences – connecting the backend with the frontend

Our students are heavy consumers of digital technology. They can be characterized as digital natives with a limited understanding of technology beyond the surface. By integrating students' personal user experience from their leisure time into the educational process we can ignite curiosity and enthusiasm for exploring technology. When students realize they already have some user-experience with the technology, they become more curious and eager to investigate what is beneath the user interface. When they recognize their own experience with different technologies, it is easier to connect the knowledge of the technology with the practice technicalities.

Our advice: Let your students create something they already use, for example an app, a pedometer or a SoMe advertisement. When they recognize what they are building in the backend, they begin to interpret their technologies differently – more critically.

An example: Podcast in the ears and soundtracks behind closed eyes.

A student who consumes lots of podcasts, produced a podcast by herself in a workshop.



"Listening to a podcast will never be the same again. I constantly visualize the editor's interface."

The student now has two perspectives with which to interpret podcast technology – the producer's perspective and the user's perspective. She now registers the cuts, sound effects, storyboard and out-tones in a different way. This is a sign of empowerment.

2. PLAY ALONG!

Playful attitude towards technologies

Students who are not used to creating with digital technology encounter unknown and foreign materials, such as ones and zeros, block programming and flowcharts. They assess it as something that is not particularly relevant to their studies. We have learned that this situation mobilizes a playful approach that makes them overcome their reservations and throw themselves into the unknown. In the playful approach, the students are not very reflective and rarely attempt to connect the technologies to their profession. For the teacher it may seem wild and unprofessional, but in this playfulness there also lies creative, investigative and innovative potential.

Our advice: Let them! Stay calm or play along and be patient when your students start

playing with digital technology. It is a natural sign that they are in the process of leaning into an advanced professional field.

An example: Pedometer on a microcomputer

Two students who are usually quiet girls, programme a pedometer on a microcomputer, which they integrate into a shoe. While creating it, they laugh loudly and swear more than usual, when the programme code fails. When it finally succeeds and they discover that it works, they are almost euphoric. They do a TikTok dance to count how many steps it takes. They overcome the struggle and celebrate their digital empowerment.

3. DO SOMETHING SILLY!

Cultivating digital courage through ‘silly’ prototypes

When we want to strengthen students’ self-efficacy we need to see the educational potential in creating ‘silly’ things. The fact that it is ‘silly’ creates the necessary courage to think creatively in a technology you have not (yet) mastered. That potential is also described by the Queen of Shitty Robots Simone Giertz. In her TED Talk she says:



“Building stupid things was quite smart ... I did not have to deal with my performance anxiety. As soon as I removed all pressure and expectations from myself, that pressure quickly got replaced by enthusiasm and it allowed me to just play” (Giertz, 2019).

The basic technology comprehension students gain while creating ‘silly’ things can be transferred to more serious and relevant solutions later on. The courage and self-confidence they build is, at the very least, important for their digital entrepreneurship.

Our advice: Before solving the world’s wicked problems (Biggs, 2007) with digital technology, build up the necessary courage. It pays to make small stupid prototypes that solve ‘silly’ problems in the beginning.

An example: ‘Shitty’ Robot

Our challenge to students: Optimize your study habits with a shitty robot. One student build a small a robot that drives in with soda everytime he has been reading three pages of his lectures. Input: An accelerometer mounted on the arm that counts every time he flips through the book. Code: If 3 is the output, a small vehicle with a soda glass moves 2 meters from one side of the table to the student.

4. CREDIT!

Semantic innovation as a manifestation of digital imagination

It is important to recognise that when students use premature technical terms this represents an exploration of uncharted digital realms. It is through the creation of new linguistic constructs that students may encounter and articulate concepts not yet realized. So, when students start inventing gibberish and nonsense words about digital technology, it is actually a sign of their digital imagination. The words they invent are characterized by premature technical jargon, such as sensor gizmo, accelerator-whatever, algorithm thingy ect. The students use some of the new concepts to explain or talk about the digital prototypes they imagine. As the words are new, they are often merged with words like -gizmo, -whatever, or -thingy. These are words that can be added to a word that you are not quite sure about. The

students' language reveals insights about their digital imagination. Imagination can have a synthesized function between absent and present objects. The power of imagination (Lakoff & Johnson, 1980) is productive because it makes it possible to experience something that has not yet been realized.

Our advice: Be sensitive and appreciative of students' use of gibberish and nonsense words and support them in developing their digital imagination. This is often where fledgling ideas take shape.

An example: A student nurse fantasizes about whether a light sensor can be used as an input so that a flash- or a beep-tingy can warn her when the stack of protective equipment is about to run out. She imagines solutions with digital technologies and thinks in terms of input, output and algorithms.

Two narratives describing how studens can develop digital entrepreneurship

1 – A nurse student was introduced to microcomputers and block programming during a hands-on workshop, where she created a 'silly' pedometer with a fellow student. Through an adaptive learning process, she translated her technological literacy into a relevant solution for a problem she encountered during her internship in the post-anesthesia care unit at a hospital. Discover her learning process in this short Danish film. <https://youtu.be/OVQb4t61Uxo>

2 – A teacher student was introduced to Augmented Reality. The introduction took place in a hands-on workshop, where he created a silly scene with The Grinch being fried on a pan. While creating this scene he engages in playful exploration to develop categories for technological literacy. He applies these categories during his internship, where he designs an Augmented Reality treasure hunt that scaffolds his pupil's way of using the school library. You can see this student' learning process in this short Danish film. <https://youtu.be/IS1fytn92ug>

IMPACT

The impact of using these four concepts has proven to be transformative in many ways. Most importantly, our approach offers empowerment, courage and curiosity to the students involved. By making it 'okay' to create silly objects and describe them with gibberish and nonsense words, the four concepts have succesfully broken down barriers to unknown technologies and boosted students' self-efficacy (Bandura, 1997), making them confident that they can learn and work with these unknown technologies. The effect of this transformation is students who have the digital imagination and empowerment to develop and experiment with ideas that are innovative and are in the realm of digital entrepreneurship. By specifically targetting students enrolled in social and healthcare programmes, the new ideas and experiments generated are directed towards making a positive change or improvement for other citizens and patients within those fields. As a result, this approach also contributes to SDG 3 because students create better health solutions and gain better comprehension of tomorrow's health-tech world. We also contribute to SDG 4 as students enrolled in teaching programmes create new ways to teach childeren with technology, and acquire competencies to develop techED. As the majority of the students are female, this initiative contributes to SDG 5 by creating more empowered women who are curious about technology and have the expertise and courage to act on ideas, creating more diversity within in digital entrepreneurship. By making their technology easy to comprehend, the professions can

leverage students' critical thinking and expertise to transform innovative ideas into reality. This pivotal step not only makes digital entrepreneurship more inclusive across gender gaps but also extends to embrace diverse professional backgrounds and socio-economic contexts. This approach not only transforms digital entrepreneurship but also contributes meaningfully to a more inclusive, diverse and innovative future.

KEY LEARNINGS



1. — Connect! TechEd to the technology your students are already using. When they recognize what they are building in the backend of the technologies they are currently using, they begin to interpret their technologies differently – more critically.

2. — Play along! and be patient when your students start playing with digital technology. It is a natural sign that they are in the process of leaning into a new advanced professional field.

3. — Do something silly! Before trying to solve the world's wicked problems with digital technology, help students build up the necessary courage. That's why it pays to make small 'shitty' prototypes that solve silly problems in the beginning.

4. — Credit! Credit students' use of gibberish and nonsense words and support them in developing their digital imagination. This is often where fledgling ideas take shape.

CONCLUSIONS

The four didactic concepts have proven to be transformative in fostering digital courage, knowledge and entrepreneurship among students, particularly women from social and health programmes. These concepts characterized by play, "silliness", imagination and recognition, have successfully bridged the between students personal user experiences and their understanding of new technology beyond the surface. The playful approach and the creation of "silly" things have not only helped students overcome their reservations about digital technology but also sparked their creativity, curiosity and innovative potential. The approach not only transforms digital entrepreneurship but also contributes to a more inclusive, diverse and innovative future.

AUTHOR BIOS

Maria Høegh Beierholm is Associate Professor at the teacher education and Research

Programme for Learning and Digital Technologies at VIA University College. (MADH@via.dk)

Simone Stilling is Officer of Inclusive and Digital Entrepreneurship and founder of the Network for Entrepreneurial Female Students at VIA University College. (SSMN@via.dk)

References

Bandura, A. (1997). Self-Efficacy. The exercise of Control. New York. W.H Freeman and Company.

Beierholm, M. H., & Engberg-Sønderskov, M. (2023). Når studerende tør, gør og tænker professionelt med digitale teknologier : Empirisk studie af professionsstuderendes måde at skabe med digital teknologi på studiet og i praktikken . Tidsskriftet Læring Og Medier (LOM), 16(28). <https://doi.org/10.7146/lom.v16i28.136353>

Briggs, L. (2007). Tackling Wicked Problems: A public policy perspective, s.l.: Commonwealth of Australia.

Digital Dogme, (2022), Det Digitale Kompetencebarometer

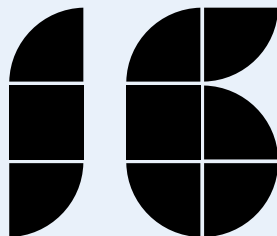
Giddens, A (1991) The Consequences of Modernity, Cambridge: Polity Press.

Giertz, 2019. Why you should make useless things. TedTalk. https://www.youtube.com/watch?v=c0bsKcfourtiuY&ab_channel=TED

Lakoff G. & Johnson M. (1980). Metaphors We Live By. Chicago: University of Chicago Press.

OECD/European Commission (2021), The Missing Entrepreneurs 2021: Policies for Inclusive Entrepreneurship and Self-Employment, OECD Publishing, Paris, <https://doi.org/10.1787/71b7a9bb-en>

Egoitz Astigarraga & Urko Muzquiz, Betternestic



ONKOMICS: SHAPING THE FUTURE OF CANCER DETECTION

ABSTRACT

ONKOMICS is a novel healthcare initiative that leverages AI and lipidomic biomarkers for groundbreaking oncological diagnostics. By uniting comparative oncology with cutting-edge technology, this project aims to revolutionize early cancer detection. Supported by a consortium including Betternestic, NavarraBioMed, UPNA, and CIMA/UNAV, it embodies a collaborative approach towards innovative, non-invasive diagnostics. Highlighting inclusivity, diversity, and sustainability, ONKOMICS is poised to significantly impact cancer care, emphasizing a holistic integration of human, animal, and environmental health principles.

Key words: Artificial Intelligence, Lipidomics, Comparative Oncology, Early Cancer Detection



INTRODUCTION

ONKOMICS – an initiative led by Betternestic (www.betternestic.com) – is a pioneering venture, which started in November 2023, aiming to revolutionize oncological diagnostics through the novel integration of artificial intelligence (AI) and lipidic biomarkers. Grounded in the principles of comparative oncology, this approach leverages insights from veterinary science to advance human medicine, specifically breast cancer diagnostics. This initiative not only showcases the innovative use of technology in healthcare but also emphasizes the interconnectedness of human, animal, and environmental health, aligning with the One Health concept. Through its inclusive and interdisciplinary framework, Betternestic's work represents a significant step forward in making early and accurate cancer detection more accessible and efficient. Set against the backdrop of Navarra, Spain (www.investinspain.org), a region known for its strong institutional support for sustainability and inclusivity in entrepreneurship and innovation, this initiative leverages and contributes to the area's rich collaborative networks, educational prowess, and cultural commitment to health and well-being. However, it also navigates the challenges inherent in the region, such as access to finance, regulatory complexities, and the need for continuous technological adaptation and skilled workforce development. These dynamics underscore the initiative's role not just in advancing healthcare but in furthering regional goals for sustainable and inclusive economic growth.

REGIONAL ECOSYSTEM CONTEXT

The regional ecosystem of Navarra, Spain, is characterized by robust institutional support, a thriving educational and research landscape, and a strong culture of collaboration, driving innovation and entrepreneurship in areas like sustainability and inclusivity (investinnavarra.com). However, challenges such as access to finance, regulatory complexities, technological adaptation, and the development of a skilled workforce present hurdles. Navarra's ecosystem, supported by entities like CEIN, the European Centre for Business and Innovation in Navarra (www.cein.es), fosters a conducive environment for initiatives like ONKOMICS, leveraging regional strengths to overcome obstacles and promote economic growth through high-impact, innovative projects. CEIN, is a public, non-profit company dedicated to stimulating entrepreneurship and supporting the creation of new businesses in Navarra. It focuses on entrepreneurship, innovation, growth, and collaboration, offering innovative services for start-ups and aiding their market consolidation and growth. CEIN is committed to gender equality and ethical business practices, playing a key role in regional economic development by fostering unique, growth-oriented companies and promoting entrepreneurial values among students. By being part of an ecosystem that fosters the creation and development of innovative companies, Betternestic gains access to a wealth of resources, networks, and expertise provided by CEIN. This environment not only enhances Betternestic's capacity to develop its cutting-edge oncological diagnostics but also aligns with CEIN's commitment to driving economic development through high-impact entrepreneurship in Navarra.

ONKOMICS

ONKOMICS is a pioneering force within the realm of oncological diagnostics, encapsulating a forward-thinking approach by intertwining artificial intelligence (AI) with lipidic biomarkers to elevate the precision and timeliness of cancer detection (Figure 1). This innovative venture draws its roots from comparative oncology, employing veterinary science discoveries to

enrich human medical strategies, with a particular focus on breast cancer research. At the heart of this endeavor is the sophisticated amalgamation of AI analytics and cutting-edge lipidomics, a combination poised to redefine the landscape of non-invasive cancer diagnostics by identifying disease-indicative lipidic biomarkers at an early stage.

The core of Betternestic's approach lies in its application of AI-driven analysis combined with advanced lipidomics (Figure 2). This dual strategy allows for a more nuanced, accurate, and non-invasive detection of cancer at its early stages. By analyzing lipidic biomarkers – molecules that can signal the presence of disease – Betternestic's technology promises to significantly improve the speed and accuracy of cancer diagnostics. The project's methodology is distinguished by its comprehensive analysis framework. This involves collecting and analyzing vast datasets of lipidomic profiles, which AI algorithms



Figure 1: ONKOMICS logo

then process to identify patterns and biomarkers indicative of cancer. The inclusion of AI not only amplifies the capacity to process and interpret complex biological data but also enhances the predictive accuracy of the diagnostics. (Koh et al., 2022; Huergo-Baños et al., 2024; Perez-Valle et al., 2021).

Betternestic's initiative is deeply aligned with the One Health concept, which acknowledges the interconnectedness of human, animal, and environmental health. This interdisciplinary approach not only widens the scope of potential research and application but also hastens the development of effective treatments and diagnostics. It signifies a paradigm shift in how medical research and diagnostics are approached, emphasizing a holistic view of health that spans species and ecosystems. Moreover, the initiative's focus extends beyond mere technological innovation to embrace inclusivity and diversity. By integrating perspectives from various disciplines and ensuring a diverse range of inputs in the research process, Betternestic fosters a more inclusive approach to health innovation. This inclusivity is not only evident in the team's composition but also in the broader applicability of their research findings, which have the potential to benefit a wide spectrum of the population.

ONKOMICS benefits significantly from the support and incubation facilities provided by CEIN. It is enriched by the collaboration between Betternestic and its consortium partners, embodies a multifaceted approach to the early and non-invasive detection of cancer, underpinned by principles of inclusivity, diversity, and sustainability. This collaborative effort synergizes diverse expertise to pioneer advancements in oncological diagnostics, ensuring the project not only pushes the boundaries of innovation but also adheres to values that promote broad societal impact and environmental stewardship. In the following paragraphs, the contribution of each partner to this initiative is described.

NavarraBioMed contributes its extensive expertise in biomedical research to this project, leveraging its connection to the Navarra Health Service to translate scientific discoveries into practical clinical applications. This partnership underscores the initiative's dedication to inclusivity, ensuring that advancements in diagnostics are readily available to all segments of the population, and highlights the importance of sustainability by

streamlining the path from research to clinical application, minimizing environmental impact through the efficient use of resources.

The Public University of Navarra (UPNA) contributes a solid foundation in basic research, enriching the initiative with academic diversity and fostering an environment where educational and research objectives intersect with societal needs. UPNA's involvement ensures that the project not only benefits from cutting-edge scientific insights but also contributes to the education and formation of future researchers, emphasizing diversity and inclusivity in the scientific community.

CIMA/UNAV's (Center for Applied Medical Research/University of Navarra) comprehensive cancer research expertise, ranging from molecular studies to patient care, ensures the initiative is informed by a holistic understanding of cancer. This approach embodies sustainability, as it seeks to develop non-invasive, early diagnostic methods that reduce the environmental footprint associated with traditional diagnostic techniques. Furthermore, CIMA/UNAV's contribution highlights the initiative's commitment to inclusivity by ensuring that diagnostic advancements are tailored to meet the needs of diverse patient populations.

Collectively, these entities weave inclusivity, diversity, and sustainability into the fabric of the Onkomics initiative. Through their collaborative efforts, they not only aim to transform the landscape of cancer diagnostics but also to do so in a manner that is inclusive, accessible, and mindful of the broader impact on society and the environment. This approach not only accelerates the pace of innovation in healthcare but also ensures that the benefits of such advancements are shared widely and sustainably.

In the context of Navarra, Spain, the initiative navigates a unique landscape enriched by robust institutional support and a vibrant collaborative ecosystem, fostering sustainability and inclusivity in innovation. However, it also faces challenges such as financial accessibility, regulatory complexities, and the ongoing need for technological and workforce advancements. By addressing these hurdles and leveraging regional strengths, the Betternestic project embodies a model of innovation that not only aims to transform oncological diagnostics but also contributes to the broader goals of sustainable and inclusive economic development in Navarra.

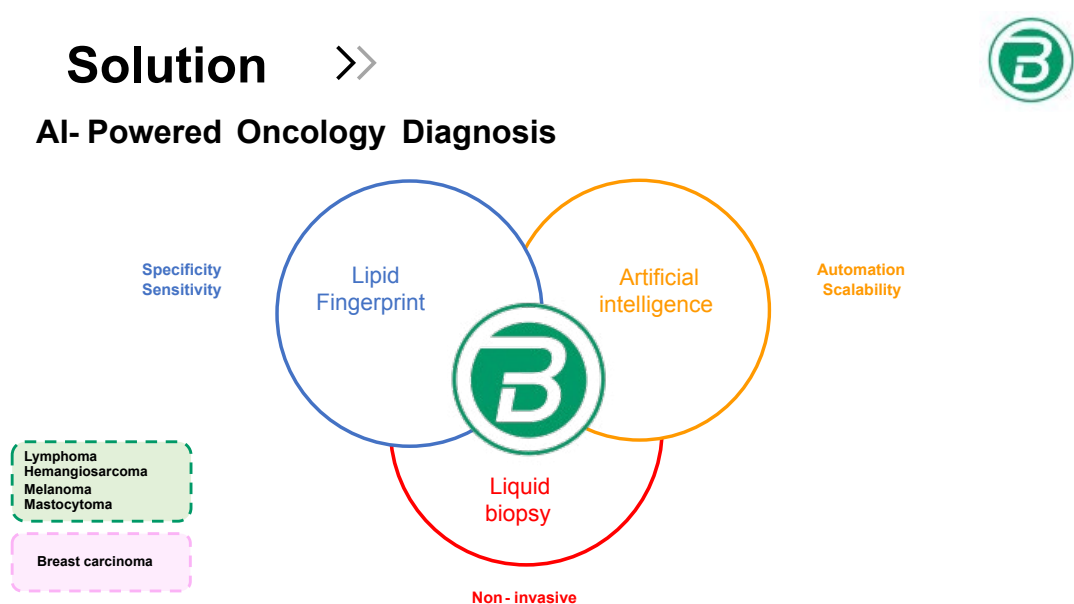


Figure 2. Betternestic's technology key points

IMPACT

The ONKOMICS initiative has had a profound impact across multiple dimensions:

- **Health Outcomes:** The initiative's precision in early cancer detection not only saves lives but also embodies inclusivity by ensuring these advanced diagnostics are accessible across varied demographics, reducing disparities in healthcare outcomes. The emphasis on early intervention aligns with sustainable health practices by minimizing long-term healthcare burdens.
- **Research and Development:** By fostering cross-disciplinary collaboration, Betternestic accelerates innovation in cancer diagnostics, ensuring that its advancements are shared widely, promoting inclusivity in scientific knowledge. This approach also supports sustainable research practices by leveraging findings across fields to enhance efficiency and effectiveness.
- **Social and Environmental Considerations:** Emphasizing the One Health concept underscores the interconnectedness of human, animal, and environmental health, promoting a more sustainable and holistic approach to medical research. The initiative's inclusivity ensures that findings are applicable and accessible across diverse populations, supporting global health equity.
- **Economic Implications:** Betternestic's approach to diagnostics not only aims to reduce costs in healthcare but also fosters economic growth by opening new markets in the biotechnology sector. This growth is pursued with a commitment to sustainability and inclusivity, ensuring that innovations remain accessible and beneficial to a broad spectrum of society, thus driving equitable economic advancement within the deep tech sector.

KEY LEARNINGS



1. — Interdisciplinary Collaboration is Crucial

Tackling complex health issues like cancer requires a blend of expertise from various fields, underscoring the value of multidisciplinary teams.

2. — Technological Integration Presents Opportunities and Challenges

While merging AI with lipidomics introduces novel diagnostic possibilities, it also requires navigating the complexities of data analysis and interpretation.

3. — Comparative Oncology Bridges Gaps Between Species

This approach leverages similarities between human and animal diseases, enhancing research applicability and efficiency.

4. — Inclusivity and Diversity Enrich Research Outcomes

A diverse research team brings a wider range of perspectives, leading to more comprehensive and applicable solutions.

5. — Sustainability in Innovation Is Essential

Developing diagnostic methods that are not only effective but also accessible and environmentally considerate ensures long-term impact and alignment with global health goals.

CONCLUSIONS

The ONKOMICS initiative represents a beacon of innovation in oncological diagnostics, harnessing the power of AI and lipidomics within a framework of comparative oncology. This collaborative venture, underpinned by the principles of One Health, promises to advance early cancer detection methods, emphasizing inclusivity, diversity, and sustainability. Supported by a robust consortium and embedded in Navarra's vibrant innovation ecosystem, ONKOMICS exemplifies how interdisciplinary cooperation can address complex health challenges, making a significant impact on cancer care and showcasing a model for future healthcare innovations.

AUTHOR BIOS

Dr. Egoitz Astigarraga is COO of Betternestic and utilizes his expertise in biotechnological research and project management to propel the ONKOMICS initiative. His recent certifications in One Health from the World Health Organization, focusing on zoonotic disease outbreaks and collaboration between human and animal health sectors, significantly enrich the project's interdisciplinary approach and commitment to improving health security through innovation. (egoitz@betternestic.com)

Urko Múzquiz, Eng., is CEO of Betternestic. He has a strong background in Aquatic Ecotechnology and diverse professional experience ranging from water quality management to veterinary science. He has contributed significantly to the ONKOMICS initiative. His experience, applied to advanced diagnostic systems for veterinary oncology, plays a crucial role in pioneering non-invasive cancer detection methods, embodying the project's interdisciplinary approach and commitment to innovation in health care. (urko@betternestic.com)

References

Betternestic. (n.d.). Retrieved from <https://www.betternestic.com>

CEIN. (n.d.). Retrieved from <https://www.cein.es>

Huergo-Baños, C., Velasco, V., Garate, J. & et al. (2024). Lipid fingerprint-based histology accurately classifies nevus, primary melanoma, and metastatic melanoma samples. *International Journal of Cancer*, 154(4), 712–722. <https://doi.org/10.1002/ijc.34800>

Invest in Spain. (n.d.). Innovation in Spain. Retrieved from <https://www.investinspain.org/content/icex-invest/en/innovacion.html>

Invest in Navarra. (n.d.). ICT. Retrieved from <https://investinnavarra.com/en/ict/>

Koh, D. M., Papanikolaou, N., Bick, U. & et al. (2022). Artificial intelligence and machine learning in cancer imaging. *Communications Medicine*, 2(133). <https://doi.org/10.1038/s43856-022-00199-0>

Perez-Valle, A., Abad-García, B., Fresnedo, O., Barreda-Gómez, G., Aspichueta, P., Asumendi, A., Astigarraga, E., Fernández, J.A., Boyano, M.D. & Ochoa, B. (2021). A UHPLC-Mass Spectrometry View of Human Melanocytic Cells Uncovers Potential Lipid Biomarkers of Melanoma. *International Journal of Molecular Sciences*, 22, 12061. <https://doi.org/10.3390/ijms221212061>

START YOUR FUTURE YOUR WAY

Edited by

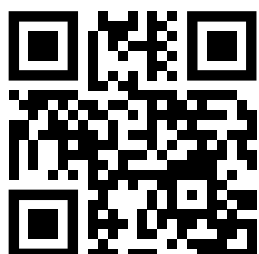
Colette Henry, Sabrina Tomasi,
Slavica Singer, Alessio Cavicchi, Margot Bucaille,
Erik Mass Lovgren & Simone Stilling

Thank you

to all SFF partners for their contributions to the
SFF Good Practice Guide

Design by studiomoormann.de

ISBN 978-3-00-079553-4



Scan to join
the SFF Platform

